OCS EIS/EA
BOEM 2023-0029
Docket Number: BOEM-2023-0030

Atlantic Shores Offshore Wind South Draft Environmental Impact Statement

May 2023

Volume 1: Chapters 1-4

BOEM
Bureau of Ocean Energy Management

COVER SHEET

Document Title

Draft (x) **Final ( )**

Type of Action: Administrative (x) Legislative ( )

Agency	Contact
U.S. Department of the Interior Bureau of Ocean Energy Management (BOEM) 45600 Woodland Road Sterling, VA 20166	Kimberly Sullivan U.S. Department of the Interior Bureau of Ocean Energy Management 45600 Woodland Road Sterling, VA 20166 (702) 338-4766

ABSTRACT

This Draft Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction and installation, operations and maintenance, and conceptual decommissioning of two wind energy facilities (Project 1 and Project 2). Collectively these projects are referred to as the Atlantic Shores Offshore Wind South Project (Atlantic Shores South), as proposed by Atlantic Shores Offshore Wind, LLC (Atlantic Shores) in its Construction and Operations Plan (COP). The proposed Atlantic Shores South Project (consisting of Project 1 and Project 2) described in the COP and this Draft EIS would be approximately 1,510 megawatts (MW) for Project 1; the number of MW is yet to be determined for Project 2. Atlantic Shores has a goal for Project 2 of 1,327 MW, which would align with the interconnection service agreements and interconnection construction service agreements Atlantic Shores intends to execute for both projects with the regional transmission organization, PJM. The Atlantic Shores South Project is proposed to be located 8.7 miles (14 kilometers) from the New Jersey shoreline at its closest point within the area covered by Renewable Energy Lease Number OCS-A 0499 (Lease Area). The Project is designed to meet the demand for renewable energy in New Jersey.

This Draft EIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 United States Code 4321 et seq.) and implementing regulations (40 Code of Federal Regulations [CFR] Parts 1500 – 1508). This Draft EIS will inform the Bureau of Ocean Energy Management in deciding whether to approve, approve with modifications, or disapprove the COP (30 CFR 585.628). Publication of the Draft EIS initiates a 45-day public comment period open to all, after which all the comments received will be assessed and considered by BOEM in preparation of a Final EIS.

Additional copies of this Draft EIS may be obtained by writing the Bureau of Ocean Energy Management, Attn: Kimberly Sullivan (address above); by telephone at (702) 338-4766; or by downloading from the BOEM website at https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-south.

Contents

List of Appendices

List of Tables

List of Figures

Abbreviations and Acronyms

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
μPa	micropascal
μg/L	microgram per liter
AAQS	ambient air quality standard
ACE	Atlantic City Electric
ACHP	Advisory Council on Historic Preservation
ADLS	Aircraft Detection Lighting System
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMM	avoidance, minimization, and mitigation
AMP	alternative monitoring plan
AMSL	above mean sea level
AOCs	Areas of Concern
AQRV	air quality related values
ASLF	ancient submerged landform feature
AOCs	areas of concern
APE	area of potential effect
Atlantic Shores	Atlantic Shores Offshore Wind, LLC
Atlantic Shores South	Atlantic Shores Offshore Wind South Project
BA	Biological Assessment
BGEPA	Bald and Golden Eagle Protection Act
BIWF	Block Island Wind Farm
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BPU	New Jersey Board of Public Utilities
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CBRA	Cable Burial Risk Assessment
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CHRVEA	Cumulative Historic Resources Visual Effects Assessment
CLOs	Community Liaison Officers
CMECS	Coastal and Marine Ecological Classification Standard
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO2 equivalent
COARE	Coupled Ocean-Atmosphere Response Experiment
COBRA	CO-Benefits Risk Assessment

Acronym	Definition
COP	Construction and Operations Plan
CTV	crew transfer vessel
CVOW	Coastal Virginia Offshore Wind Project
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DA	Department of the Army
DAS	distributed acoustic sensing
DAT	deposition analysis threshold
dB	decibels
dBA	A-weighted decibel
dBBC	double Big Bubble Curtains
DC	direct current
DH	Dredge Hole
DHAI	disproportionately high and adverse impact
DHS	Department of Homeland Security
DIN	dissolved inorganic nitrogen
DIP	dissolved inorganic phosphorus
DO	dissolved oxygen
DOI	U.S. Department of the Interior
DP	Dynamic Positioning
DPS	distinct population segment
DMA	Dynamic Management Areas
DTS	distributed temperature system
EA	Environmental Assessment
EC	earth curvature
ECC	Export Cable Corridor
EEM	estuarine emergent
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electromagnetic field
EO	Executive Order
EPM	environmental protection measure
ERP	Emergency Response Plan
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDR	Facility Design Report
FERC	Federal Energy Regulatory Commission
FIR	Fabrication and Installation Report
FLO	Fisheries Liaison Officer
FLM	Federal Land Managers
FMP	Fisheries Management Plan
FOV	field of view
FTE	full-time equivalent
G&G	geophysical and geotechnical
GBS	gravity-based structure
GDP	gross domestic product

Acronym	Definition
GHG	greenhouse gas
GIS	geographic information system
GSOE	Garden Stated Offshore Energy
GW	gigawatt
GWP	global warming potential
HAP	hazardous air pollutant
HAPCs	Habitat Areas of Particular Concern
HAT	highest astronomical tide
HDD	horizontal directional drilling
HF	high frequency
HMS	Highly Migratory Species
HPTP	historic property treatment plan
HREA	Historic Resource Effects Assessment
HRG	high-resolution geophysical
HRVEA	Historic Resources Visual Effects Assessment
HUC	hydrologic unit code
HVAC	high-voltage alternating current
HVDC	high-voltage direct current
Hz	hertz
ITA	Incidental Take Authorization
IOOS	Integrated Ocean Observing System
IWG	Interagency Working Group
IWQAR	Integrated Water Quality Assessment Report
JCP&L	Jersey Central Power & Light
KE	kinetic energy
kg/ha/yr	kilograms per hectare per year
kHz	kilohertz
kj	kilojoules
KOP	key observation point
Lease Area	Lease Area OCS-A 0499
LCA	landscape character area
LME	Large Marine Ecosystem
LOA	Letter of Authorization
Lpk	maximum broadband peak sound pressure
LNM	Local Notice to Mariners
LRR	Long Range Radar
m	meter
MAFMC	Mid-Atlantic Fishery Management Council
MAOD	Mid-Atlantic Offshore Development
MARA	Marine Archaeological Resources Assessment
MARIPARS	Massachusetts and Rhode Island Port Access Route Study
MARPOL VI	International Convention for the Prevention of Pollution from Ships, Annex VI protocol
MBES	multibeam echosounders
MDAT	Marine-life Data and Analysis Team
MEC	munitions and explosives of concern

Acronym	Definition
met	meteorological
metocean	meteorological and oceanographic
MFC	mid-frequency cetacean
mG	milligauss
mg/L	milligrams per liter
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPRSA	Marine Protection, Research, and Sanctuaries Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MW	megawatt
MWh	MW-hour
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standard
NARW	North Atlantic right whale
NAS	Naval Air Station
NAS	Noise Abatement Systems
National OCS Program	North Atlantic Planning Area of the OCS Oil and Gas Leasing Program
NCCA	National Coastal Condition Assessment
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NEXRAD	Next Generation Weather Radar
NGTC	National Guard Training Center
NHLs	National Historic Landmarks
NHPA	National Historic Preservation Act
NJDEP	New Jersey Department of Environmental Protection
NJDOT-OMR	New Jersey Department of Transportation, Office of Maritime Resources
NJGWS	New Jersey Geological and Water Survey
NJHPO	New Jersey Historic Preservation Office
NJSA	New Jersey Statutes Annotated
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_X	nitrogen oxide
NOI	Notice of Intent
NPS	National Park Service
NRHP	National Register of Historic Places
NSRA	Navigation Safety Risk Assessment
NSSP	National Shellfish Sanitation Program
NWI	National Wetlands Inventory
NWS	National Weather Service
NYSDOS	New York State Department of State

Acronym	Definition
NYSERDA	New York State Energy Research and Development Authority
O&M	operations and maintenance
O_3	ozone
OCA	ocean character area
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OE/AA	Obstruction Evaluation/Airspace Analysis
OLPD	online partial discharge
OPAREA	Operating Area
OREC	Offshore Wind Renewable Energy Certificate
OSRP	Oil Spill Response Plan
OSS	offshore substation
PAM	Passive Acoustic Monitoring
PATON	Private Aid to Navigation
PCB	polychlorinated biphenyls
PCN	Pre-Construction Notification
PDE	Project Design Envelope
PDES	Pollutant Discharge Elimination System
PE	potential energy
PEM	palustrine emergent
PFO	palustrine forested
PIP	Phased Identification Plan
PM_{10}	particulate matter smaller than 10 microns in diameter
$PM_{2.5}$	particulate matter smaller than 2.5 microns in diameter
POI	Point of Interconnection
PPA	purchase power agreement
ppm	parts per million
ppt	parts per thousand
Project	Atlantic Shores Offshore Wind South Project
Project 1 and Project 2	two electrically distinct wind energy facilities
PSD	Prevention of Significant Deterioration
PSO	Protected Special Observer
PSS	palustrine scrub-shrub
PST	Preliminary Screening Tool
PTS	permanent threshold shift
QMA	Qualified Marine Archaeologist
RHA	Rivers and Harbors Act of 1899
rms	root-mean-square
ROD	Record of Decision
RODA	Responsible Offshore Development Alliance
RODEO	Realtime Opportunity for Development of Environmental Observations
ROSA	Responsible Offshore Science Alliance
ROW	right-of-way
RTO	regional transmission organization
SAA	State Agreement Approach
SAP	site assessment plan

Acronym	Definition
SAR	Search and Rescue
SAROPS	Search and Rescue Optimal Planning System
SBP	sub-bottom profiler
SCA	seascape character area
SC-GHG	social cost of greenhouse gases
SCADA	supervisory control and data acquisition
SEL	sound exposure level
SF_6	sulfur hexafluoride
SFV	sound field verification
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SLIA	seascape and landscape impact assessment
SMA	Seasonal Management Area
SO_2	sulfur dioxide
SOV	service operations vessel
SPCC	Spill Prevention, Control, and Countermeasure
SPL	sound pressure level
SPL_{RMS}	root-mean-square sound pressure level
SSS	side-scan sonars
SUA	special use airspace
SWPPP	stormwater pollution prevention plan
SZ	shutdown zone
TARA	Terrestrial Archaeological Resources Assessment
TCP	traditional cultural property
TDWR	Terminal Doppler Weather Radar
TMP	Traffic Management Plan
TSS	total suspended solid
TTS	temporary threshold shift
UDP	Unanticipated Discovery Plan
ULSD	ultra-low sulfur diesel
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UXO	Unexploded ordnances
VGP	Vessel General Permit
VHF	very high frequency
VIA	Visual Impact Assessment
VMS	Vessel Monitoring System
VOC	volatile organic compound
VTR	vessel trip report
WEA	Wind Energy Area
WNS	white-nose syndrome
WTA	Wind Turbine Area
WTG	wind turbine generator

This page was intentionally left blank.

Executive Summary

Executive Summary

ES.1 Introduction

This Draft Environmental Impact Statement (EIS) assesses the potential impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation, operations and maintenance (O&M), and conceptual decommissioning of two wind energy facilities (Project 1 and Project 2). Collectively these projects are referred to as the Atlantic Shores Offshore Wind South Project (Atlantic Shores South) as proposed by Atlantic Shores Offshore Wind Project 1, LLC (Atlantic Shores Project 1 Company) and Atlantic Shores Offshore Wind Project 2, LLC (Atlantic Shores Project 2 Company) in its Construction and Operations Plan (COP) (Atlantic Shores 2023). As Atlantic Shores (Atlantic Shores Offshore Wind, LLC) is the owner and an affiliate of both the Atlantic Shores Project 1 Company and the Atlantic Shores Project 2 Company, for ease of reference, the term "Atlantic Shores" is used throughout the Draft EIS to refer interchangeably to the Project Companies.[1] The COP and its appendices are incorporated in this Draft EIS by reference and available on BOEM's website: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-south. The Bureau of Ocean Energy Management (BOEM) has prepared the Draft EIS under the National Environmental Policy Act (NEPA) (42 U.S. Code [USC] 4321–4370f). This Draft EIS will inform BOEM's decision on whether to approve, approve with modifications, or disapprove the Project's COP.

Cooperating agencies may rely on this Draft EIS to support their decision-making. In conjunction with submitting its COP, Atlantic Shores (the Applicant) applied to the National Marine Fisheries Service (NMFS) for an incidental take authorization under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 USC 1361 et seq.), for incidental take of marine mammals during Project construction. NMFS is required to review applications and, if appropriate, issue an incidental take authorization under the MMPA. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support the authorization. The U.S. Army Corps of Engineers (USACE) similarly intends to adopt the EIS to meet its responsibilities under Sections 10 and 14 of the Rivers and Harbors Act of 1899 (RHA), Section 404 of the Clean Water Act (CWA), and Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA).

ES.2 Purpose and Need for the Proposed Action

In Executive Order (EO) 14008, *Tackling the Climate Crisis at Home and Abroad*, issued January 27, 2021, President Biden stated that it is the policy of the United States "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a Government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and

[1] Atlantic Shores Offshore Wind, LLC is a joint venture between EDF-RE Offshore Development, LLC (a wholly owned subsidiary of EDF Renewables, Inc.) and Shell New Energies US LLC, each having 50 percent ownership.

spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure."

Through a competitive leasing process under 30 Code of Federal Regulations (CFR) 585.211, Atlantic Shores was awarded commercial Renewable Energy Lease OCS-A 0499 covering an area offshore New Jersey (Lease Area). Under the terms of the lease, Atlantic Shores has the exclusive right to submit a COP for activities within the Lease Area. Atlantic Shores has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of two offshore wind energy facilities in the Lease Area in accordance with BOEM's COP regulations under 30 CFR 585.626, et seq. The proposed Project (consisting of Project 1 and Project 2) would generate approximately 1,510 megawatts (MW) for Project 1 and an output that is yet to be determined for Project 2. Atlantic Shores has a goal of 1,327 MW for Project 2, which would align with the interconnection service agreements and interconnection construction service agreements Atlantic Shores intends to execute for both projects with the regional transmission organization (RTO), PJM. (Figure ES-1).

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA)[2] to authorize renewable energy activities on the Outer Continental Shelf (OCS); EO 14008; the shared goals of the federal agencies to deploy 30 gigawatts (GW) of offshore wind energy capacity in the United States by 2030, while protecting biodiversity and promoting ocean co-use[3]; and in consideration of the goals of the Applicant, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove Atlantic Shores' COP. BOEM will make this determination after weighing the factors in Subsection 8(p)(4) of the OCSLA that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which require BOEM to make a decision on the lessee's plans to construct and operate two commercial-scale offshore wind energy facilities within the Lease Area (the Proposed Action) (30 CFR 585.628).

In addition, NMFS received a request for authorization under the MMPA to take marine mammals incidental to activities related to the Project. NMFS' issuance of an MMPA incidental take authorization is a major federal action and, in relation to BOEM's action, is considered a connected action (40 CFR 1501.9(e)(1)). The purpose of the NMFS action—which is a direct outcome of Atlantic Shores' request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate Atlantic Shores' request pursuant to specific requirements of the MMPA (16 USC 1371(a)(5)(A and D)) and its implementing regulations administered by NMFS and to decide whether to issue the authorization. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's EIS to support that decision and to fulfill its NEPA requirements.

---

[2] 43 USC 1331 et seq.

[3] *Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs | The White House*: https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

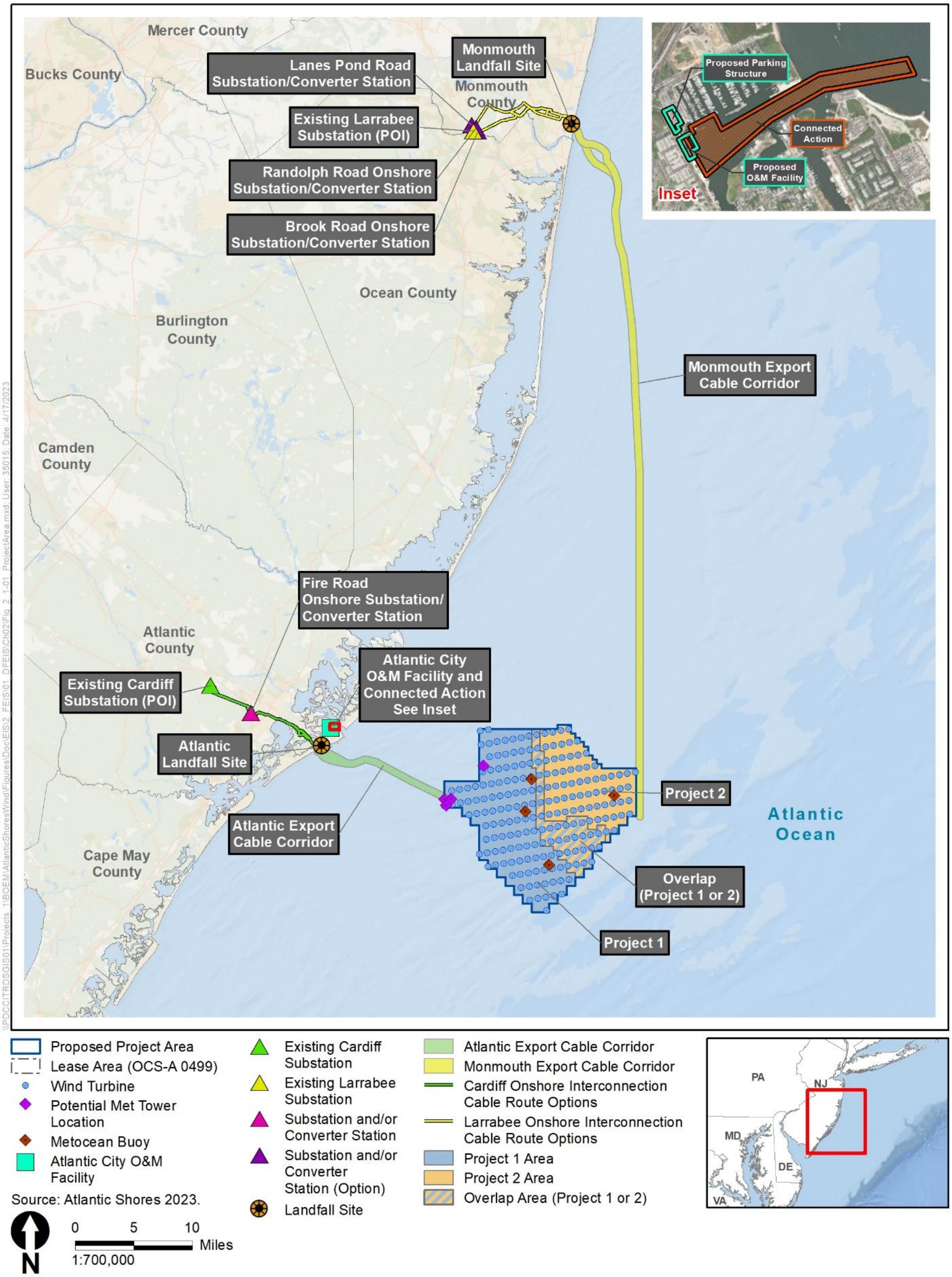


Figure E0-1. Atlantic Shores South Project

The USACE Philadelphia District received requests for authorization of a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR 325.8, pursuant to Section 10 of the RHA (33 USC 403) and Section 404 of the CWA (33 USC 1344). In addition, USACE received a request for "Section 408 permission," which is required pursuant to Section 14 of the RHA (33 USC 408) for any proposed alterations that have the potential to alter, occupy, or use any federally authorized civil works projects. USACE's Regulatory Branch and its Section 408 Program perform distinct but concurrent reviews for the permits and the Section 408 permission, respectively. In addition, if applicable, USACE would issue a permit for the ocean disposal of dredged materials under Section 103 of the MPRSA. USACE considers issuance of permits under these four delegated authorities a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)).

The need for the Project as provided by the Applicant in Atlantic Shores' COP and reviewed by USACE for NEPA purposes is to provide two commercially viable offshore wind energy projects within Lease Area OCS-A 0499 to meet New Jersey's need for clean energy. The Project's basic purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Project purpose for Section 404(b)(1) guidelines (40 CFR Part 230) evaluation, as determined by USACE, is the construction and operation of two commercial-scale offshore wind energy projects, including transmission lines, for renewable energy generation in Lease Area OCS-A 0499 and transmission to the New Jersey energy grids.

The purpose of the USACE Section 408 action as determined by Engineer Circular 1165-2-220, *Policy and Procedural Guidance for Processing Requests to Alter U.S. Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408,* issued September 10, 2018, is to evaluate the Applicant's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE civil works project. USACE Section 408 permission is needed to ensure that congressionally authorized projects continue to provide their intended benefits to the public.

USACE intends to adopt BOEM's EIS to support its decision on any permits and permissions requested under Sections 10 and 14 of the RHA and Section 404 of the CWA, and Section 103 of the MPRSA. USACE would adopt the EIS per 40 CFR 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies USACE's comments and recommendations. Based on its participation as a cooperating agency and its consideration of the Final EIS, USACE would issue a Record of Decision (ROD) to formally document its decision on the Proposed Action. The ROD would be a combined decision document for both the USACE Regulatory Branch and the Section 408 Program.

ES.3 Public Involvement

On September 30, 2021, BOEM issued a Notice of Intent (NOI) to prepare an EIS consistent with NEPA regulations (42 USC 4321 et seq.), initiating a 30-day public scoping period from September 30 to November 1, 2021 (86 *Federal Register* 54231). The NOI solicited public input on the significant resources and issues, impact-producing factors, reasonable alternatives, and potential mitigation measures to analyze in the EIS. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the National Historic Preservation Act (54 USC 300101 et seq.), as permitted by 36 CFR 800.2(d)(3), and sought public comment and input through the NOI regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the Atlantic Shores South COP. BOEM held three virtual public scoping meetings on October 19, 21, and 25, 2021, to present information on the Project and NEPA process, answer questions from meeting attendees, and solicit public comments. Scoping comments were received through Regulations.gov on docket number BOEM-2021-0057, via email and postal mail to a BOEM representative, and through oral testimony at each of the three public scoping meetings. BOEM received a total of 246 comment submissions from federal, tribal, and state agencies; local governments; non-governmental organizations; and the general public during the scoping period. The topics most referenced in the scoping comments included the NEPA/public involvement process, marine mammals, planned activities scenario/cumulative impacts, commercial fisheries and for-hire recreational fishing, mitigation and monitoring, climate change, employment and job creation, and scenic and visual resources. BOEM considered all scoping comments while preparing this Draft EIS. Publication of this Draft EIS initiates a 45-day public comment period. BOEM will consider the comments received on the Draft EIS during preparation of the Final EIS.

ES.4 Alternatives

BOEM considered a reasonable range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. The Draft EIS evaluates the No Action Alternative and six action alternatives (three of which have sub-alternatives). The action alternatives are not mutually exclusive; BOEM may select a combination of alternatives that meet the purpose and need of the proposed Project. The alternatives are as follows:

- Alternative A – No Action
- Alternative B – Proposed Action
- Alternative C – Habitat Impact Minimization / Fisheries Habitat Impact Minimization[4]
    - Alternative C1 – Lobster Hole Avoidance
    - Alternative C2 – Sand Ridge Complex Avoidance
    - Alternative C3 – Demarcated Sand Ridge Complex Avoidance
    - Alternative C4 – Micrositing
- Alternative D – No Surface Occupancy at Select Locations to Reduce Visual Impacts4

[4] The number of wind turbine generators (WTGs) that could be removed may be reduced if this alternative is selected and combined with another alternative that requires removal of additional WTG positions, and if that combination of alternatives would fail to meet the purpose and need, including any awarded offtake agreement(s).

- Alternative D1 – No Surface Occupancy of Up to 12 Miles (19.3 Kilometers) from Shore; Removal of Up to 21 Turbines
- Alternative D2 – No Surface Occupancy of Up to 12.75 Miles (20.5 Kilometers) from Shore; Removal of Up to 31 Turbines
- Alternative D3 – No Surface Occupancy of Up to 10.8 Miles (17.4 Kilometers) from Shore; Removal of Up to 6 Turbines

- Alternative E – Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 14
- Alternative F – Foundation Structures
    - Alternative F1 – Piled Foundations
    - Alternative F2 – Suction Bucket Foundations
    - Alternative F3 – Gravity-Based Foundations

Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Chapter 2, Section 2.2, *Alternatives Considered but Not Analyzed in Detail*.

ES.4.1 Alternative A – No Action

Under the No Action Alternative, BOEM would not approve the COP. The Project's construction and installation, O&M, and eventual decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization to the applicant under the MMPA. The current resource conditions, trends, and effects from ongoing activities under the No Action Alternative serve as the existing baseline against which all direct and indirect impacts from action alternatives are evaluated.

Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities are expected to occur, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable planned activities described in Appendix D, *Planned Activities Scenario*, without the Proposed Action serves as the future baseline for the evaluation of cumulative impacts.

ES.4.2 Alternative B – Proposed Action

Under the Proposed Action, the construction and installation, O&M, and eventual decommissioning of the Atlantic Shores South Project, which consists of two wind energy facilities (Project 1 and Project 2) on the OCS offshore of New Jersey, would be built within the range of the design parameters outlined in the Atlantic Shores South COP (Atlantic Shores 2023), subject to applicable mitigation measures. The Atlantic Shores South Project would include up to 200 wind turbine generators (WTGs) (between 105 and 136 for Project 1, and between 64 and 95 for Project 2), up to 10 offshore substations (OSSs) (up to 5 in each Project), up to 1 permanent meteorological (met) tower (Project 1), up to 4 temporary meteorological and oceanographic (metocean) buoys (up to 3 metocean buoys in Project 1, 1 metocean buoy in Project 2), interarray and interlink cables, 2 onshore substations, 1 O&M facility, and up to 8 transmission cables making landfall at two New Jersey locations. The proposed landfall locations are the Monmouth landfall in Sea Girt, New Jersey, with an onshore route to the existing Larrabee Substation Point of Interconnection (POI) and the Atlantic landfall in Atlantic City, New Jersey, with an onshore route to the existing Cardiff Substation POI. Project 1 would have a capacity of 1,510 MW. Project 2's capacity is not yet determined, but Atlantic Shores has a goal of 1,327 MW, which would align with Atlantic Shores required payments under the interconnection service agreement it intends to execute for both projects with the RTO, PJM. The Proposed Action is summarized in Table ES-1 and Appendix C, *Project Design Envelope and Maximum-Case Scenario*. Refer to Volume I of the Atlantic Shores COP (Atlantic Shores 2023) for additional details on Project design.

Table ES-1. Summary of Project Design Envelope parameters

Project Parameter Details
General (Layout and Project Size)

• Up to 200 total WTGs
  ○ A minimum of 105 WTGs to a maximum of 136 WTGs for Project 1
  ○ A minimum of 64 WTGs to a maximum of 95 WTGs for Project 2
• Up to 10 OSSs
• Up to 1 permanent meteorological tower
• Up to 4 temporary metocean buoys
• Grid layout with east-northeast/west-southwest rows and approximately north/south columns

Foundations
• The foundations for the WTGs in Project 1 would be monopile; the foundations for the WTGs in Project 2 would be monopile or piled jacket; only one foundation type would be used for all WTGs in Project 2 • The foundations for small OSSs would be monopile, piled jacket, or suction bucket; the foundations for medium or large OSSs would be piled jacket, suction bucket jacket, or GBS • The foundation for the permanent met tower would be monopile, piled jackets, suction bucket jacket, mono suction buckets, or GBS • The scour protection around all foundations would vary based on foundation type
Wind Turbine Generators
• Rotor diameter up to 918.6 feet (280 meters) • Hub height up to 574.2 feet (175 meters) AMSL • Tip height up to 1,046.6 feet (319 meters) AMSL
Offshore Substations
• Up to 10 OSSs (10 small, 5 medium, or 4 large) • Total structure height of topside above MLLW up to 174.8 feet (53.3 meters) for a small OSS, up to 191.2 feet (58.3 meters) for a medium OSS, and up to 207.6 feet (63.3 meters) for a large OSS • Maximum length of 131.2 feet (40 meters) for a small OSS, up to 213.3 feet (65 meters) for a medium OSS, up to 295.3 feet (90 meters) for a large OSS

Project Parameter Details
• Small OSSs would be located at least 12 miles (19.3 kilometers) from shore, whereas medium and large OSSs would be located at least 13.5 miles (21.7 kilometers) from shore
Interarray Cables

• Target burial depth of 5 to 6.6 feet (1.5 to 2 meters)
• Cables would be between 66 to 150 kV HVAC
• Maximum total cable length would be 547 miles (880 kilometers)
  ○ Up to 274 miles (440 kilometers) of HVAC interarray cables for Project 1
  ○ Up to 274 miles (440 kilometers) of HVAC interarray cables for Project 2
• Cable installation may involve jet trenching, plowing/ jet plowing, or mechanical trenching

Interlink Cables

• Target burial depth of 5 to 6.6 feet (1.5 to 2 meters)
• Cables would be between 66 to 275 kV HVAC
• Maximum total cable length would be 37 miles (60 kilometers)
  ○ Up to 18.6 miles (30 kilometers) of HVAC interlink cables for Project 1
  ○ Up to 18.6 miles (30 kilometers) of HVAC interlink cables for Project 2
• Cable installation may involve jet trenching, plowing/ jet plowing, or mechanical trenching

Offshore Export Cables

• Target burial depth of 5 to 6.6 feet (1.5 to 2 meters)
• 230 to 275 kV HVAC cables and/or 320 to 525 kV HVDC cables
• Two ECCs: Atlantic ECC and Monmouth ECC
  ○ Atlantic ECC: maximum total cable length would be 99.4 miles (160 kilometers)
  ○ Monmouth ECC: maximum total cable length would be 341.8 miles (550 kilometers)
• Maximum of 4 HVAC cables per corridor
• Maximum of 1 HVDC cables per corridor
Cable installation may involve jet trenching, plowing/ jet plowing, or mechanical trenching

Landfall Sites
• HDD installation of cables at two landfall sites • Atlantic Landfall Site would be located in Atlantic City, New Jersey • Monmouth Landfall Site would be located within the Borough of Sea Girt in Monmouth County, New Jersey
Permanent Meteorological Tower and Metocean Buoys

• One permanent met tower would be installed within Project 1 in one of four potential locations
  ○ Maximum height would not exceed 16.5 feet (5 meters) above the hub height of the largest WTG installed, estimated to be 590.6 feet (180 meters) AMSL
  ○ The tower would be composed of square lattice consisting of tubular steel
  ○ The tower would be equipped with a deck that would be approximately 50 feet by 50 feet (15 meters by 15 meters)
• Up to 4 temporary metocean buoys would be installed, 3 in Project 1 and 1 in Project 2

Onshore Facilities
• Atlantic Landfall Site would be connected to the approximately 12.4- to 22.6-mile (20.0- to 36.4-kilometer) Cardiff Onshore Interconnection Cable Route that would continue to the potential site for the Cardiff Substation and/or Converter Station and terminate at the Cardiff Substation POI • Monmouth Landfall Site would be connected to the approximate 9.8- to 23.0-mile (15.8- to 37.0-kilometer) Larrabee Onshore Interconnection Cable Route, which would continue to one of three potential sites for the Larrabee Substation and/or Converter Station and terminate at the Larrabee Substation POI • 230 to 275 kV HVAC cables and/or 320 to 525 kV HVDC cables

Project Parameter Details
O&M Facility
• New facility proposed in Atlantic City, New Jersey

AMSL = above mean sea level; ECC = export cable corridor; GBS = gravity-based structure; HDD = horizontal directional drilling; HVAC = high-voltage alternating current; HVDC= High-voltage direct current; kV = kilovolt; MLLW = mean lower low water.

ES.4.3 Alternative C – Habitat Impact Minimization/Fisheries Habitat Impact Minimization

Under Alternative C, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, the layout and maximum number of WTGs and OSSs would be adjusted to avoid and minimize potential impacts on important habitats. NMFS identified two areas of concern (AOCs) within the Lease Area that have pronounced bottom features and produce habitat value. AOC 1 is part of a designated recreational fishing area called "Lobster Hole." AOC 2 is part of a sand ridge (ridge and trough) complex.

- **Alternative C1: Lobster Hole Avoidance**

  Alternative C1 would avoid and minimize the potential impacts on the Lobster Hole (AOC 1), a designated recreational fishing area, by removing up to 16 WTGs, 1 OSS, and associated interarray cables.

- **Alternative C2: Sand Ridge Complex Avoidance**

  Alternative C2 would avoid and minimize potential impacts on the sand ridge features in the southernmost portion of the Lease Area (AOC 2) by removing up to 13 WTGs and associated interarray cables within the NMFS-identified sand ridge complex.

- **Alternative C3: Demarcated Sand Ridge Complex Avoidance**

  Alternative C3 would remove up to 6 WTGs and associated interarray cables within 1,000 feet (305 meters) of the sand ridge complex area identified by NMFS, but further demarcated using NOAA's Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores.

- **Alternative C4: Micrositing**

  Alternative C4 was proposed by Atlantic Shores and would involve the micrositing of 29 WTGs, 1 OSS, and associated interarray cables outside of the 1,000-foot (305-meter) buffer of the ridge and swale features within both AOC 1 and AOC 2.

ES.4.4 Alternative D – No Surface Occupancy at Select Locations to Reduce Visual Impacts

Under Alternative D, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, there would be no surface occupancy at select WTG positions to reduce the visual impacts of the proposed Project, as detailed in the following sub-alternatives.

- **Alternative D1: No Surface Occupancy of Up to 12 Miles (19.3 Kilometers) from Shore: Removal of Up to 21 Turbines**

  Alternative D1 would result in the exclusion of up to 21 WTG positions in Project 1 within 12 miles (19.3 kilometers) from shore. The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) above mean sea level (AMSL) and maximum blade tip height of 932 feet (284 meters) AMSL.

- **Alternative D2: No Surface Occupancy of Up to 12.75 Miles (20.5 Kilometers) from Shore: Removal of Up to 31 Turbines**

  Alternative D2 would result in the exclusion of up to 31 WTG positions in Project 1 that are sited closest to shore. The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL.

- **Alternative D3: No Surface Occupancy of Up to 10.8 Miles (17.4 Kilometers) from Shore: Removal of Up to 6 Turbines**

  Alternative D3 would result in the exclusion of up to 6 WTG positions in Project 1 that are sited closest to shore. The remaining WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL.

ES.4.5 Alternative E – Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1

Under Alternative E, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to create a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback range between WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) and WTGs in the Ocean Wind 1 Lease Area (OCS-A 0498) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation.

There would be no surface occupancy along the southern boundary of the Atlantic Shores South Lease Area through the exclusion or micrositing of up to 4 to 5 WTG positions, or relocation of up to 4 to 5 WTG positions, or some combination of exclusion and relocation of WTG positions, to allow for a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) buffer between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area.

ES.4.6 Alternative F – Foundation Structures

Under Alternative F, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. This includes a range of foundation types (of monopile and piled jacket, mono-bucket and suction bucket jacket, and gravity-based) to assess the extent of potential impacts of each foundation type for up to 211 foundations (inclusive of WTGs, OSSs, and 1 permanent met tower [Project 1]). This Draft EIS analyzes the following:

- **Alternative F1**: **Piled Foundations**

  Under Alternative F1, the use of monopile and piled jacket foundations only is analyzed for the maximum extent of impacts.

- **Alternative F2: Suction Bucket Foundations**

  Under Alternative F2, the use of the mono-bucket, suction bucket jacket, and suction bucket tetrahedron base foundations only is analyzed for the maximum extent of impacts.

- **Alternative F3: Gravity-Based Foundations**

  Under Alternative F3, the use of gravity-pad tetrahedron and gravity-based structure (GBS) foundations only is analyzed for the maximum extent of impacts.

ES.5 Environmental Impacts

This Draft EIS uses a four-level classification scheme to characterize the potential beneficial impacts and adverse impacts of alternatives as **negligible**, **minor**, **moderate**, or **major**. Resource-specific adverse and beneficial impact level definitions are presented in each resource section of Chapter 3, *Affected Environment and Environmental Consequences*.

BOEM analyzes the impacts of past and ongoing activities in the absence of the Project as the No Action Alternative. The No Action Alternative serves as the existing baseline against which all action alternatives are evaluated. BOEM also separately analyzes cumulative impacts of the No Action Alternative, which considers all other ongoing and reasonably foreseeable future activities described in Appendix D, *Planned Activities Scenario*. In this analysis, the cumulative impacts of the No Action Alternative serve as the baseline against which the cumulative impacts of all action alternatives are evaluated. Table ES-2 summarizes the impacts of each alternative and the cumulative impacts of each alternative. Under the No Action Alternative, the environmental and socioeconomic impacts and benefits of the action alternatives would not occur.

NEPA implementing regulations (40 CFR 1502.16) require that an EIS evaluate the potential unavoidable adverse impacts associated with a proposed action. Adverse impacts that can be reduced by mitigation measures but not eliminated are considered unavoidable. The same regulations also require that an EIS review the potential impacts of irreversible or irretrievable commitments of resources resulting from implementation of a proposed action. Irreversible commitments occur when the primary or secondary impacts from the use of a resource either destroy the resource or preclude it from other uses. Irretrievable commitments occur when a resource is consumed to the extent that it cannot recover or be replaced.

Chapter 4, *Other Required Impact Analyses,* describes potential unavoidable adverse impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction and installation phase, and would be temporary. Chapter 4 also describes irreversible and irretrievable commitment of resources by resource area. The most notable such commitments could include effects on habitat or individual members of protected species.

Appendix E, *Analysis of Incomplete and Unavailable Information* describes the incomplete or unavailable information that has been identified. BOEM considered whether the information was relevant to the assessment of impacts and essential to its analysis of alternatives based upon the resource analyzed.

Table ES-2. Summary and comparison of impacts among alternatives with no mitigation measures[5]

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
3.4.1 Air Quality						
Alternative Impacts	Moderate	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Cumulative Impacts	Moderate; minor to moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.4.2 Water Quality						
Alternative Impacts	Minor to moderate	Minor	Minor	Minor	Minor	Minor
Cumulative Impacts	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
3.5.1 Bats						
Alternative Impacts	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Cumulative Impacts	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
3.5.2 Benthic Resources						
Alternative Impacts	Negligible to moderate	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	F1: Negligible to moderate; moderate beneficial F2 and F3: negligible to minor; minor beneficial

[5] All sub-alternatives were deemed to have similar impacts unless otherwise stated within the applicable column.

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
Cumulative Impacts	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; moderate beneficial	Negligible to moderate; minor to moderate beneficial
3.5.3 Birds						
Alternative Impacts	Minor	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial
Cumulative Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.5.4 Coastal Habitats and Fauna						
Alternative Impacts	Negligible to moderate	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
Cumulative Impacts	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
3.5.5 Finfish, Invertebrates, and Essential Fish Habitat						
Alternative Impacts	Negligible to moderate	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Cumulative Impacts	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
3.5.6 Marine Mammals						
Alternative Impacts	Odontocetes and pinnipeds: negligible to moderate	Odontocetes and pinnipeds: negligible to minor; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial
	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate
	NARW: negligible to major[2]	NARW: negligible to moderate	NARW: negligible to moderate	NARW: negligible to moderate	NARW: negligible to moderate	NARW: negligible to moderate
Cumulative Impacts	Odontocetes and pinnipeds: negligible to moderate; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial	Odontocetes and pinnipeds: negligible to minor; minor beneficial
	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate	Mysticetes other than NARW: negligible to moderate
	NARW: negligible to major[2]	NARW: negligible to major[2]	NARW: negligible to major[2]	NARW: negligible to major[2]	NARW: negligible to major[2]	NARW: negligible to major[2]

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
3.5.7 Sea Turtles						
Alternative Impacts	Negligible to minor	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
Cumulative Impacts	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
3.5.8 Wetlands						
Alternative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Cumulative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3.6.1 Commercial Fisheries and For-Hire Recreational Fishing						
Alternative Impacts	Commercial fisheries: Moderate to major	Commercial fisheries: Moderate to major; minor beneficial	Commercial fisheries: Moderate to major; minor beneficial	Commercial fisheries: Moderate to major; minor beneficial	Commercial fisheries: Moderate to major; minor beneficial	Commercial fisheries: Moderate to major; minor beneficial
	For-hire recreational fishing: Moderate to major	For-hire recreational fishing: Minor to moderate; minor beneficial	For-hire recreational fishing: Minor to moderate; minor beneficial	For-hire recreational fishing: Minor to moderate; minor beneficial	For-hire recreational fishing: Minor to moderate; minor beneficial	For-hire recreational fishing: Minor to moderate; minor beneficial
Cumulative Impacts	Commercial fisheries: Moderate to major; minor beneficial	Commercial fisheries: Major; minor beneficial	Commercial fisheries: Major; minor beneficial	Commercial fisheries: Major; minor beneficial	Commercial fisheries: Major; minor beneficial	Commercial fisheries: Major; minor beneficial

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
	For-hire recreational fishing: Minor to moderate; minor beneficial	For-hire recreational fishing: Major; minor beneficial	For-hire recreational fishing: Major; minor beneficial	For-hire recreational fishing: Major; minor beneficial	For-hire recreational fishing: Major; minor beneficial	For-hire recreational fishing: Major; minor beneficial
3.6.2 Cultural Resources						
Alternative Impacts	Moderate	Major	Major	D1 and D2: Moderate D3: Major	Major	Major
Cumulative Impacts	Major	Major	Major	Major	Major	Major
3.6.3 Demographics, Employment, and Economics						
Alternative Impacts	Negligible to minor; minor beneficial	Negligible; minor beneficial	Negligible; minor beneficial	Negligible; minor beneficial	Negligible; minor beneficial	Negligible; minor beneficial
Cumulative Impacts	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial
3.6.4 Environmental Justice						
Alternative Impacts	Minor	Minor to moderate; negligible to minor beneficial	Minor to moderate; negligible to minor beneficial	Minor to moderate; negligible to minor beneficial	Minor to moderate; negligible to minor beneficial	Minor to moderate; negligible to minor beneficial
Cumulative Impacts	Moderate; minor beneficial	Moderate; minor to moderate beneficial	Moderate; minor to moderate beneficial	Moderate; minor to moderate beneficial	Moderate; minor to moderate beneficial	Moderate; minor to moderate beneficial
3.6.5 Land Use and Coastal Infrastructure						
Alternative Impacts	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
Cumulative Impacts	Minor; minor beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial
3.6.6 Navigation and Vessel Traffic						
Alternative Impacts	Moderate	Moderate	Moderate	Moderate	Negligible to minor	Moderate
Cumulative Impacts	Moderate	Moderate to major	Moderate to major	Moderate to major	Minor to moderate	Moderate to major
3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys)						
Alternative Impacts	Marine mineral extraction: Minor	Marine mineral extraction: Minor	Marine mineral extraction: Minor	Marine mineral extraction: Minor	Marine mineral extraction: Minor	Marine mineral extraction: Minor
	Military and national security uses: Negligible	Military and national security uses: Minor to major	Military and national security uses: Negligible to major	Military and national security uses: Negligible to major	Military and national security uses: Minor to moderate	Military and national security uses: Negligible to major
	Aviation and air traffic: Negligible	Aviation and air traffic: Minor	Aviation and air traffic: Negligible to minor	Aviation and air traffic: Negligible to minor	Aviation and air traffic: Minor	Aviation and air traffic: Negligible to minor
	Cables and pipelines: Negligible	Cables and pipelines: Negligible	Cables and pipelines: Negligible to minor	Cables and pipelines: Negligible to minor	Cables and pipelines: Negligible	Cables and pipelines: Negligible to minor
	Radar systems: Negligible	Radar systems: Moderate	Radar systems: Minor	Radar systems: Minor	Radar systems: Moderate	Radar systems: Minor
	Scientific research and surveys: Moderate	Scientific research and surveys: Major	Scientific research and surveys: Major	Scientific research and surveys: Major	Scientific research and surveys: Major	Scientific research and surveys: Major
Cumulative Impacts	Marine mineral extraction: Negligible to minor	Marine mineral extraction: Minor	Marine mineral extraction: Negligible to minor	Marine mineral extraction: Negligible to minor	Marine mineral extraction: Negligible to minor	Marine mineral extraction: Negligible to minor

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
	Military and national security uses: Minor to major	Military and national security uses: Negligible to major	Military and national security uses: Negligible to major	Military and national security uses: Negligible to major	Military and national security uses: Negligible to moderate	Military and national security uses: Negligible to major
	Aviation and air traffic: Negligible to minor	Aviation and air traffic: Negligible to minor	Aviation and air traffic: Negligible to minor	Aviation and air traffic: Negligible to minor	Aviation and air traffic: Negligible to minor	Aviation and air traffic: Negligible to minor
	Cables and pipelines: Negligible to minor	Cables and pipelines: Negligible to minor	Cables and pipelines: Negligible to minor	Cables and pipelines: Negligible to minor	Cables and pipelines: Negligible to minor	Cables and pipelines: Negligible to minor
	Radar systems: Minor	Radar systems: Moderate	Radar systems: Moderate	Radar systems: Moderate	Radar systems: Moderate	Radar systems: Moderate
	Scientific research and surveys: Major	Scientific research and surveys: Major	Scientific research and surveys: Major	Scientific research and surveys: Major	Scientific research and surveys: Major	Scientific research and surveys: Major
3.6.8 Recreation and Tourism						
Alternative Impacts	Minor	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Cumulative Impacts	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
3.6.9 Scenic and Visual Resources						
Alternative Impacts	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major
Cumulative Impacts	Major	Major	Major	Major	Major	Major

Impact rating colors are as follows: orange = major; yellow = moderate; green = minor; light green = negligible or beneficial to any degree.
All impact levels are assumed to be adverse unless otherwise specified as beneficial. Where impacts are presented as multiple levels, the color representing the most adverse level of impact has been applied.
[2] Impacts were assessed as major for the No Action Alternative and Proposed Action scenarios for North Atlantic right whale (NARW) because impacts on individual NARWs could have severe population-level effects and compromise the viability of the species due to their low population numbers and continued state of decline.

This page was intentionally left blank.

Chapter 1

Introduction

This Draft Environmental Impact Statement (EIS) assesses the potential impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation, operations and maintenance (O&M), and conceptual decommissioning of two wind energy facilities (Project 1 and Project 2). Collectively these projects are referred to as the Atlantic Shores Offshore Wind South Project (Atlantic Shores South), as proposed by Atlantic Shores Offshore Wind Project 1, LLC (Atlantic Shores Project 1 Company) and Atlantic Shores Offshore Wind Project 2, LLC (Atlantic Shores Project 2 Company) in their Construction and Operations Plan (COP) (Atlantic Shores 2023). As Atlantic Shores (Atlantic Shores Offshore Wind, LLC) is the owner and an affiliate of both the Atlantic Shores Project 1 Company and the Atlantic Shores Project 2 Company, for ease of reference, the term "Atlantic Shores" is used throughout the Draft EIS to refer interchangeably to the Project Companies.[1] The COP and its appendices are incorporated in this Draft EIS by reference and available on BOEM's website: https://www.boem.gov/renewable-energy/state-activities/atlantic-shores-south. The proposed Atlantic Shores South Project (consisting of Project 1 and Project 2) described in the COP and this Draft EIS would be approximately 1,510 megawatts (MW) for Project 1; the number of MW is yet to be determined for Project 2. Atlantic Shores has a goal for Project 2 of 1,327 MW, which would align with the interconnection service agreements and interconnection construction service agreements Atlantic Shores intends to execute for both projects with the regional transmission organization (RTO), PJM. PJM is an RTO that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia.

The Atlantic Shores South Project is proposed to be located 8.7 miles (14 kilometers)[2] from the New Jersey shoreline at its closest point within the area covered by Renewable Energy Lease Number OCS-A 0499 (Lease Area). The Project is designed to meet the demand for renewable energy in New Jersey. This Draft EIS will inform the Bureau of Ocean Energy Management (BOEM) in deciding whether to approve, approve with modifications, or disapprove the COP (30 Code of Federal Regulations [CFR] 585.628). Publication of the Draft EIS initiates a 45-day public comment period open to all, after which all the comments received will be assessed and considered by BOEM in preparation of a Final EIS.

This Draft EIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321 et seq.) and implementing regulations (40 CFR Parts 1500 – 1508). The Council on Environmental Quality's (CEQ) current regulations contain a presumptive time limit of 2 years for completing EISs, and a presumptive page limit of 150 pages or fewer, or up to 300 pages for proposals of unusual scope or complexity. BOEM followed those limits in preparing this Draft EIS in accordance with the current regulations. Additionally, this Draft EIS was prepared consistent with the U.S. Department of the Interior's (DOI's) NEPA regulations (43 CFR Part 46); longstanding federal judicial and regulatory interpretations; and Administration priorities and policies, including Secretary's Order No. 3399 entitled *Department-Wide Approach to the Climate Crisis and Restoring Transparency and Integrity to the Decision-Making Process*, dated April 16, 2021, requiring bureaus and offices to not apply any of the provisions of the 2020 changes to CEQ regulations (85 *Federal Register* 43304-43376)

---

[1] Atlantic Shores Offshore Wind, LLC is a joint venture between EDF-RE Offshore Development, LLC (a wholly owned subsidiary of EDF Renewables, Inc.) and Shell New Energies US LLC, each having 50 percent ownership.
[2] Equates to 7.6 nautical miles. 1 nautical mile = 1.1508 statute miles.

"in a manner that would change the application or level of NEPA that would have been applied to a proposed action before the 2020 Rule went into effect."[3]

1.1 Background

In 2009, DOI announced final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which was authorized by the Energy Policy Act of 2005.[4] These implementing regulations, codified in 30 CFR Part 585, provide a framework for BOEM to issue renewable energy leases, easements, and rights-of-way (ROWs) for OCS activities (see Section 1.3, *Regulatory Overview*). BOEM's renewable energy program occurs in four distinct phases: (1) planning and analysis, (2) lease issuance, (3) site assessment, and (4) construction and operations. The history of BOEM's planning and leasing activities offshore New Jersey is summarized in Table 1-1.

Table 1-1. History of BOEM planning and leasing offshore New Jersey

Year	Milestone
2011	On April 20, 2011, BOEM published a Call for Information and Nominations for Commercial Leasing for Wind Power on the OCS Offshore New Jersey in the *Federal Register*. The public comment period for the Call closed on June 6, 2011. In response, BOEM received 11 commercial indications of interest. After analyzing AIS data and holding discussions with stakeholders, BOEM removed OCS Blocks Wilmington NJ18–02 Block 6740 and Block 6790 (A, B, C, D, E, F, G, H, I, J, K, M, N) and Block 6840 (A) to alleviate navigational safety concerns resulting from vessel transits out of New York Harbor.
2012	On February 3, 2012, BOEM published in the *Federal Register* a Notice of Availability of a Final EA and FONSI for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia.
2014	On July 21, 2014, BOEM published a Proposed Sale Notice requesting public comments on the proposal to auction two leases offshore New Jersey for commercial wind energy development.
2015	On September 25, 2015, BOEM published a Final Sale Notice, which stated a commercial lease sale would be held November 9, 2015, for the WEA offshore New Jersey. The New Jersey WEA was auctioned as two leases. RES America Developments, Inc. was the winner of Lease Area OCS-A 0498 and US Wind, Inc. was the winner of Lease Area OCS-A 0499.
2016	On March 17, 2016, BOEM received a request to extend the preliminary term for commercial lease OCS-A 0499, from March 1, 2017, to March 1, 2018. BOEM approved the request on June 10, 2016.
2018	On January 29, 2018, BOEM received a second request to extend the preliminary term[5] for commercial Lease Area OCS-A 0499, from March 1, 2018, to March 1, 2019. BOEM approved the request on February 14, 2018.
2018	On November 16, 2018, BOEM received an application from U.S. Wind Inc. to assign 100 percent of Lease Area OCS-A 0499 to EDF Renewables Development, Inc. BOEM approved the assignment on December 4, 2018.
2019	On April 29, 2019, BOEM received an application from EDF Renewables Development, Inc. to assign 100 percent of commercial lease OCS-A 0499 to Atlantic Shores Offshore Wind, LLC. BOEM approved the assignment on August 13, 2019.

[3] Secretarial Order 3399 is available on DOI's website: https://www.doi.gov/sites/doi.gov/files/elips/documents/so-3399-508_0.pdf.
[4] Public Law No. 109-58, 119 Stat. 594 (2005).
[5] Per 30 CFR 585.235(a)(1), each commercial lease will have a preliminary term of 12 months, within which the lessee must submit a Site Assessment Plan (SAP) or a combined SAP and COP. The preliminary term begins on the effective date of the lease.

Year	Milestone
2021	On March 25, 2021, Atlantic Shores submitted its COP for the construction and installation, operations and maintenance, and conceptual decommissioning of the Project within the Lease Area. Updates to the COP, supporting appendices, and GIS data were submitted on August 25, 2021; September 24, 2021; October 20, 2021; December 17, 20, and 22, 2021; January 17, 18, and 31, 2022; March 9, and 28, 2022; April 29, 2022; August 4, 19, and 26, 2022; September 1, 2022; October 13 and 17, 2022; November 14 and 23, 2022; December 12, 21, and 30, 2022; January 10, 18, and 20, 2023; February 2, 6, 10, 13, and 25, 2023; March 7, 10, 14, 16, and 31, 2023; and April 6, 13, and 14, 2023.
2021	On April 8, 2021, BOEM approved the SAP for Lease OCS-A 0499 (Atlantic Shores Offshore Wind, LLC). The SAP approval allows for the installation of two FLiDARs.
2021	On September 28, 2021, BOEM received an application from Atlantic Shores Offshore Wind, LLC to assign 100 percent interest in the southern portion of Lease Area OCS-A 0499 (which contains the Atlantic Shores South Project 1 and 2 areas) to Atlantic Shores Offshore Wind Project 1, LLC and Atlantic Shores Offshore Wind Project 2, LLC with each entity having a 50 percent interest.
2021	On September 30, 2021, BOEM published a Notice of Intent to Prepare an EIS for the Atlantic Shores Offshore Wind South Project offshore New Jersey.
2022	On April 19, 2022, the northern portion of Lease Area OCS-A 0499 was retained by Atlantic Shores Offshore Wind, LLC and given a new lease number (OCS-A 0549) by BOEM, while the southern portion retains the original lease number assigned by BOEM: OCS-A 0499.

AIS = Automatics Identification System; EA = Environmental Assessment; FLiDAR = floating light and detection ranging buoy; FONSI = Finding of No Significant Impact; GIS = geographic information system; SAP = Site Assessment Plan; WEA = Wind Energy Area.

1.2 Purpose of and Need for the Proposed Action

In Executive Order (EO) 14008, *Tackling the Climate Crisis at Home and Abroad*, issued January 27, 2021, President Joseph R. Biden stated that it is the policy of the United States "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a Government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure."

As discussed in Table 1-1, Atlantic Shores acquired 100 percent interest in Renewable Energy Lease Number OCS-A 0499 covering an area offshore New Jersey (the Lease Area) by assignment effective December 4, 2018.[6] Under the terms of the lease, Atlantic Shores has the exclusive right to submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of two offshore wind energy facilities in the Lease Area (the Atlantic Shores South Project) in accordance with BOEM's COP regulations under 30 CFR 585.626, et seq.

Atlantic Shore's goal is to develop two offshore wind energy generation facilities (referred to as Project 1 and Project 2) in the Lease Area to provide clean, renewable energy to the New Jersey grid. The

[6] Atlantic Shores retains interest in the area covered by Renewable Energy Lease Number OCS-A 0499 (now referred to as Atlantic Shores South) and also retains interest in the area covered by Renewable Energy Lease Number OCS-A 0549 (now referred to as Atlantic Shores North).

Atlantic Shores South Project would include up to 200 total wind turbine generators (WTGs) (between 105 and 136 WTGs for Project 1, and between 64 and 95 WTGs for Project 2), up to 10 offshore substations (OSSs) (up to 5 in each Project), up to 1 permanent meteorological (met) tower, up to 4 temporary meteorological and oceanographic (metocean) buoys (up to 1 met tower and 3 metocean buoys in Project 1 and 1 metocean buoy in Project 2), interarray and interlink cables, up to 2 onshore substations, two points of interconnection (POIs), 1 O&M facility, and up to 8 transmission cables making landfall at 2 New Jersey locations.

The exact locations and numbers of OSSs, metocean buoy locations, and met tower location have not yet been finalized. The known locations of the elements of Project 1 and Project 2, as well as the potential locations of the met tower, can be found in Figure 1-1. Projects 1 and 2 would be in an approximately 102,124-acre (41,328-hectare) Wind Turbine Area (WTA) located in the Lease Area. Project 1 would be located in the western 54,175 acres (21,924 hectares) of the WTA and Project 2 would be located in the eastern 31,847 acres (12,888 hectares) of the WTA, with a 16,102-acre (6,516-hectare) Overlap Area that could be used by either Project 1 or Project 2. The Overlap Area is included in the event engineering or technical challenges arise at certain locations in the WTA, to provide flexibility for final selection of a WTG supplier for the Atlantic Shores South Project (which would determine the final number of WTG positions needed for Project 1 and Project 2), and for environmental or other considerations. Though not shown in Figure 1-1, the OSSs would be located along the same east-northeast to west-northwest rows as the WTGs. Small OSSs would be located no closer than 12 miles (19.3 kilometers) from shore, whereas medium and large OSSs would be located at least 13.5 miles (21.7 kilometers) from shore.

The Atlantic Shores South Project would contribute to New Jersey's goal of 11 gigawatts (GW) of offshore wind energy generation by 2040 as outlined in New Jersey Governor's EO No. 307, issued on September 22, 2022. Project 1 would fulfill the New Jersey Board of Public Utilities (BPU) September 10, 2020 solicitation, and subsequent June 30, 2021 award to Atlantic Shores for 1,510 MW of offshore wind capacity (BPU Docket No. QO21050824, In the Matter of the Board of Public Utilities Offshore Wind Solicitation 2 for 1,200 to 2,400 MW – Atlantic Shores Offshore Wind Project 1, LLC). Atlantic Shores is actively seeking additional Offshore Wind Renewable Energy Certificate (OREC) awards or purchase power agreements (PPA) for Project 2. Although Project 2's capacity has not yet been determined, Atlantic Shores has a goal of 1,327 MW. The Atlantic Shores South Project is intended to contribute substantially to the region's electrical reliability and help New Jersey achieve its renewable energy goals.

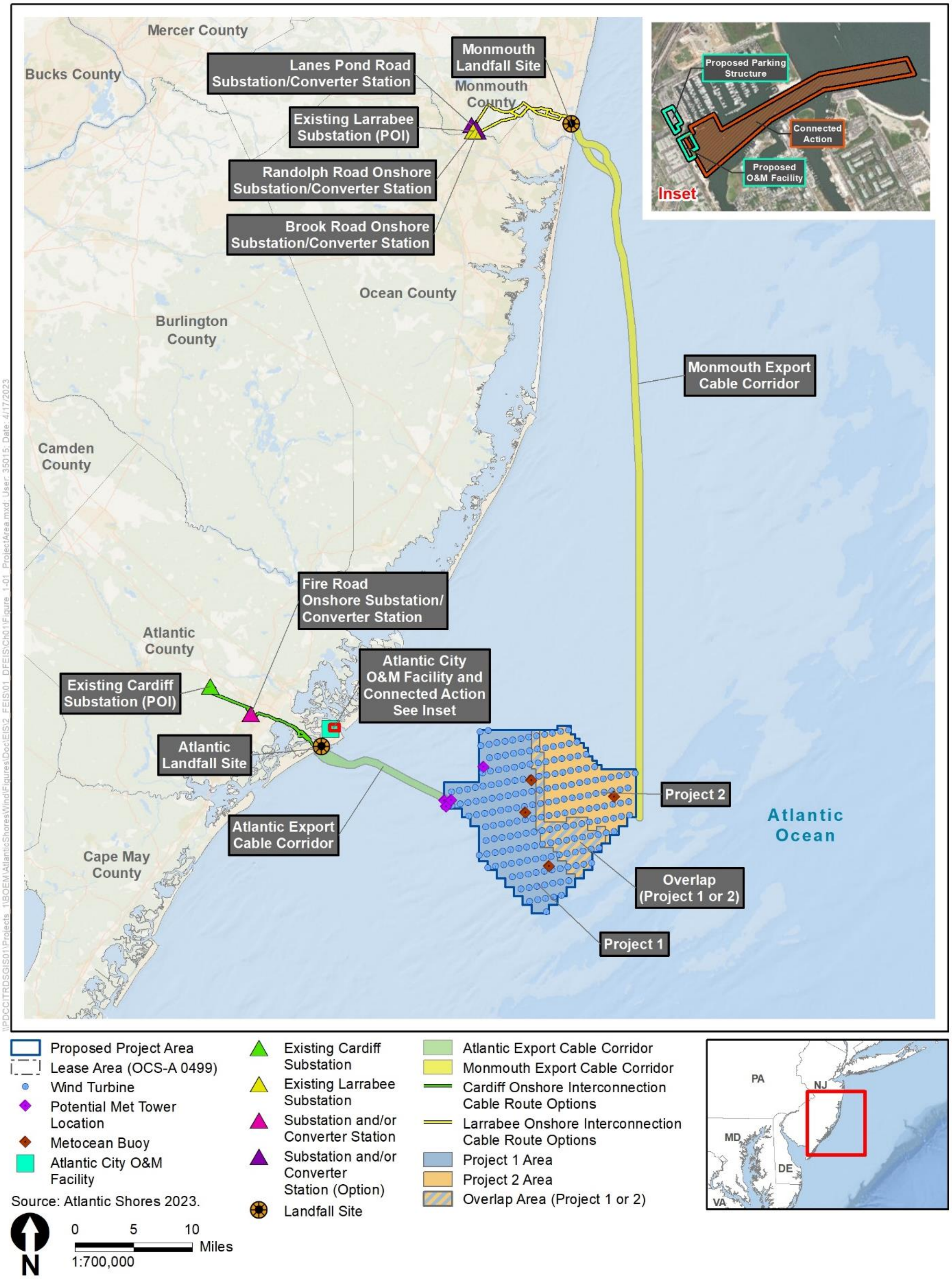


Figure 1-1. Atlantic Shores South Project area

The BPU Order identifies 1,510 MW[7] of offshore wind as the required capacity of Project 1. The BPU Order also requires as a Term and Condition of the award that Project 1 be funded through OREC as defined by the New Jersey Offshore Wind Economics Development Act 2010. For each MW-hour (MWh) delivered to the transmission grid, Project 1 will be credited, and subsequently compensated, for one OREC. Atlantic Shores' annual OREC allowance is 6,181,000 MWh per year per the 2021 award by BPU. According to the BPU Order, any unmet OREC allowances in a given year may be carried forward to the next year, and the total allowance cannot be reduced or increased without mutual consent of BPU and Atlantic Shores. Atlantic Shores' stated goal is to routinely meet the OREC allowance in order to obtain the maximum possible annual payment from BPU for the Atlantic Shores South Project's operations.

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA)[8] to authorize renewable energy activities on the OCS; EO 14008; the shared goals of the federal agencies to deploy 30 GW of offshore wind energy capacity in the United States by 2030, while protecting biodiversity and promoting co-ocean use;[9] and in consideration of the goals of the Applicant, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove Atlantic Shores' COP. BOEM will make this determination after weighing the factors in subsection 8(p)(4) of OCSLA that are applicable to plan decisions, and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which requires BOEM to make a decision on Atlantic Shores' plan to construct and operate two commercial-scale offshore wind energy facilities in the Lease Area.

In addition, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) received a request for authorization to take marine mammals incidental to activities related to the Atlantic Shores South Project, which NMFS may authorize under the Marine Mammal Protection Act (MMPA). NMFS' issuance of an MMPA incidental take authorization is a major federal action, and in relation to BOEM's action, is considered a connected action (40 CFR 1501.9(e)(1)). The purpose of the NMFS action—which is a direct outcome of Atlantic Shores' request for authorization to take marine mammals incidental to specified activities associated with the Atlantic Shores South Project (e.g., pile driving)—is to evaluate Atlantic Shores' request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, and to decide whether to issue the authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS' responsibilities under the MMPA (16 USC 1371(a)(5)(A and D)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's Final EIS to support that decision and to fulfill its NEPA requirements.

The U.S. Army Corps of Engineers (USACE) Philadelphia District received requests for authorization of a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR 325.8, pursuant to Section 10 of the Rivers and Harbors Act of 1899 (RHA) (33 USC 403) and Section 404 of the

---

[7] The New Jersey Board of Public Utilities awarded an OREC to Atlantic Shores for 1,509.6 MW, which solely for convenience is rounded up to 1,510 MW throughout the COP.
[8] 43 USC 1331 *et seq*.
[9] Fact Sheet: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs | The White House. Available: https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

Clean Water Act (CWA) (33 USC 1344). In addition, USACE received a request for "Section 408 permission," which is required pursuant to Section 14 of the RHA (33 USC 408) for any proposed alterations that have the potential to alter, occupy, or use any federally authorized civil works projects. USACE's Regulatory Branch and its Section 408 Program perform distinct but concurrent reviews for the permits and the Section 408 permission, respectively. In addition, if applicable, USACE would issue a permit for the ocean disposal of dredged materials under Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA). USACE considers issuance of permits under these four delegated authorities a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)).

The need for the Project as provided by the Applicant in Atlantic Shores' COP and reviewed by USACE for NEPA purposes is to provide two commercially viable offshore wind energy facilities within Lease Area OCS-A 0499 to meet New Jersey's need for clean energy. The Project's basic purpose, as determined by USACE for Section 404(b)(1) guidelines (40 CFR Part 230) evaluation, is offshore wind energy generation. The overall Project's purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of two commercial-scale offshore wind energy projects, including transmission lines, for renewable energy generation in Lease Area OCS-A 0499 and transmission to the New Jersey energy grids.

The purpose of the USACE Section 408 action, as determined by Engineer Circular 1165-2-220, *Policy and Procedural Guidance for Processing Requests to Alter U.S. Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408,* issued September 10, 2018, is to evaluate the Applicant's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE civil works project. USACE Section 408 permission is needed to ensure that congressionally authorized civil works projects continue to provide their intended benefits to the public.

USACE intends to adopt BOEM's EIS to support its decision on any permits and permissions requested under Sections 10 and 14 of the RHA, Section 404 of the CWA, and Section 103 of the MPRSA. USACE would adopt the EIS per 40 CFR 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies USACE's comments and recommendations. Based on its participation as a cooperating agency and its consideration of the Final EIS, USACE would issue a Record of Decision (ROD) to formally document its decision on the Proposed Action. The ROD would be a combined decision document for both the USACE Regulatory Branch and the Section 408 Program.

1.3 Regulatory Overview

The Energy Policy Act of 2005 amended OCSLA by adding a new subsection 8(p) that authorizes the Secretary of the Interior to issue leases, easements, and ROWs in the OCS for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas," which include wind energy projects. The Secretary delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing the authority for renewable energy leasing under OCSLA were promulgated on April 22, 2009.[10] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove Atlantic Shores' COP.[11]

Section 2 of BOEM's Renewable Energy Lease OCS-A 0499 provides the lessee with an exclusive right to submit a COP to BOEM for approval. Section 3 provides that BOEM will decide whether to approve a COP in accordance with applicable regulations in 30 CFR Part 585, noting that BOEM retains the right to disapprove a COP based on its determination that the proposed activities would have unacceptable environmental consequences, would conflict with one or more of the requirements set forth in subsection 8(p)(4) of OCSLA (43 USC 1337(p)(4)), or for other reasons provided by BOEM under 30 CFR 585.628(f). Section 3 of the lease also provides that BOEM reserves the right to approve a COP with modifications, as well as the right to authorize other uses within the leased area that will not unreasonably interfere with activities described in Addendum A, *Description of Leased Area and Lease Activities*.

BOEM's evaluation and decision on the COP are also governed by other applicable federal statutes and implementing regulations, such as NEPA and the Endangered Species Act (ESA) (16 USC 1531–1544). The analyses in this Draft EIS will inform BOEM's decision under 30 CFR 585.628 for the COP that was initially submitted to BOEM on March 25, 2021, and later updated with new information on August 25, 2021; September 24, 2021; October 29, 2021; December 17, 20, and 22, 2021; January 17, 18, and 31, 2022; March 9 and 28, 2022; April 29, 2022; August 4, 19, and 26, 2022; September 1, 2022; October 13 and 17, 2022; November 14 and 23, 2022; December 12, 21, and 30, 2022; and January 10, 18, and 20, 2023.

BOEM is required to coordinate with federal agencies and state and local governments and ensure that renewable energy development occurs in a safe and environmentally responsible manner. In addition, BOEM's authority to approve activities under OCSLA extends only to approval of activities on the OCS. Appendix A, *Required Environmental Permits and Consultations,* outlines the federal, state, regional, and local permits and authorizations that are required for the Atlantic Shores South Project and the status of each permit and authorization. Appendix A also provides a description of BOEM's consultation efforts during development of the Draft EIS.

1.4 Relevant Existing NEPA and Consulting Documents

The following NEPA documents were utilized to inform the preparation of this Draft EIS and are incorporated in their entirety by reference.

- Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf, OCS EIS/EA MMS 2007-046 (MMS 2007).

[10] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 (April 29, 2009).
[11] See 30 CFR 585.628.

This programmatic EIS examined the potential environmental consequences of implementing the Alternative Energy and Alternate Use Program on the OCS and established initial measures to mitigate environmental consequences. As the program evolves and more is learned, the mitigation measures may be modified or new measures developed.

- Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment, OCS EIS/EA BOEM 2012-003 (BOEM 2012).

  BOEM prepared this Environmental Assessment (EA) to determine whether issuance of leases and approval of Site Assessment Plans (SAPs) within the Wind Energy Areas (WEAs) offshore New Jersey, Delaware, Maryland, and Virginia would lead to reasonably foreseeable significant impacts on the environment, and, thus, whether an EIS should be prepared before a lease is issued.

Additional environmental studies conducted to support decisions concerning offshore wind energy development are available on BOEM's website: https://www.boem.gov/renewable-energy-research-completed-studies.

1.5 Methodology for Assessing the Project Design Envelope

Atlantic Shores proposes to develop the Atlantic Shores South Project using the Project Design Envelope (PDE) concept. This concept allows Atlantic Shores to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as WTGs, foundations, submarine cables, and OSSs.

This Draft EIS assesses the impacts of the PDE that is described in the Atlantic Shores South COP and presented in Appendix C, *Project Design Envelope and Maximum-Case Scenario*, by using the "maximum-case scenario" process. The maximum-case scenario is composed of each design parameter or combination of parameters that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Draft EIS evaluates potential impacts of the Proposed Action and each action alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource.[12] This Draft EIS considers the interrelationship between aspects of the PDE rather than simply viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. Appendix C explains the PDE approach in more detail and presents a detailed table outlining the design parameters with the highest potential for impacts by resource area. Through consultation with its own engineers and outside industry experts, BOEM verified that the maximum-case scenario analyzed in the Draft EIS could reasonably occur.

[12] BOEM's draft guidance on the use of design envelopes in a COP is available at: https://www.boem.gov/sites/default/files/renewable-energy-program/Draft-Design-Envelope-Guidance.pdf.

1.6 Methodology for Assessing Impacts

This Draft EIS assesses past, present (ongoing), and reasonably foreseeable future (planned) actions that could occur during the life of the Atlantic Shores South Project. Ongoing and planned actions occurring within the geographic analysis area include (1) other offshore wind energy development activities; (2) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (3) tidal energy projects; (4) marine minerals use and ocean-dredged material disposal; (5) military use; (6) marine transportation (commercial, recreational, and research-related); (7) fisheries use, management, and monitoring surveys; (8) global climate change; (9) oil and gas activities; and (10) onshore development activities. Appendix D, *Ongoing and Planned Activities Scenario*, describes the actions that BOEM has identified as potentially contributing to the existing baseline, and the actions potentially contributing to cumulative impacts when combined with impacts from the alternatives over the specified spatial and temporal scales.

1.6.1 Past and Ongoing Activities and Trends (Existing Baseline)

Each resource-specific *Environmental Consequences* section in Chapter 3, *Affected Environment and Environmental Consequences,* of this Draft EIS includes a description of the baseline conditions of the affected environment. The existing baseline considers past and present activities in the geographic analysis area, including those related to offshore wind projects with an approved COP (e.g., Vineyard Wind 1 and South Fork) and approved past and ongoing site assessment surveys, as well as other non-wind activities (e.g., Navy military training, existing vessel traffic, climate change). The existing condition of resources as influenced by past and ongoing activities and trends comprises the existing baseline condition for impact analysis. Other factors currently affecting the resource, including climate change, are also analyzed for that resource and are included in the impact-level conclusion.

1.6.2 Cumulative Impacts of Ongoing and Planned Activities

It is reasonable to predict that future activities may occur over time and that, cumulatively, those activities would affect the existing baseline conditions discussed in Section 1.6.1, *Past and Ongoing Activities and Trends (Existing Baseline).* Cumulative impacts are analyzed and concluded separately in each resource-specific *Environmental Consequences* section in Chapter 3 of this Draft EIS. The existing baseline condition as influenced by future planned activities evaluated in Appendix D and the Proposed Action represent the sum of the cumulative impacts expected if the Project is approved. The impacts of future planned offshore wind projects are predicted using information from, and assumptions based on, COPs submitted to BOEM that are currently undergoing independent review.

Chapter 2

Alternatives

This chapter (1) describes the alternatives carried forward for detailed analysis in this Draft EIS, including the No Action, Proposed Action, and other action alternatives; (2) describes the non-routine activities and low-probability events that could occur during construction, O&M, and conceptual decommissioning of the proposed Atlantic Shores South Project; and (3) presents a summary and comparison of impacts between alternatives and resources affected.

2.1 Alternatives Analyzed in Detail

BOEM considered a reasonable range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. Alternatives were reviewed using BOEM's screening criteria, presented in Section 2.2, *Alternatives Considered but Not Analyzed in Detail*. Alternatives that did not meet the screening criteria (i.e., were found to be infeasible or did not meet the purpose and need) were dismissed from detailed analysis in this Draft EIS. The alternatives carried forward for detailed analysis in this Draft EIS are summarized in Table 2-1 and described in detail in Sections 2.1.3 through 2.1.7. Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.2.

Although BOEM's authority under the OCSLA extends only to authorization of activities on the OCS, alternatives related to addressing nearshore and onshore elements as well as offshore elements of the Proposed Action are analyzed in the Draft EIS. BOEM's regulations (30 CFR 585.620) require that the COP describe all planned facilities that the lessee would construct and use for the Project, including onshore and support facilities and all anticipated easements. As a result, those federal, state, and local agencies with jurisdiction over nearshore and onshore impacts could adopt, at their discretion, those portions of BOEM's EIS that support their own permitting decisions.

The alternatives listed in Table 2-1 are not mutually exclusive. BOEM may "mix and match" multiple listed Draft EIS alternatives or sub-alternatives, to result in a preferred alternative that will be identified in the Final EIS, provided that: (1) the design parameters are compatible, (2) the preferred alternative still meets the purpose and need, and (3) the preferred alternative does not exceed the PDE. The number of WTGs that could be removed may be reduced if an alternative is selected and combined with another alternative that requires removal of additional WTG positions and, if that combination of alternatives would fail to meet the purpose and need, including any awarded offtake agreement(s). The offtake agreements (PPAs or ORECs) are awarded by the state and subject to the state's determination and processes as to whether a separate environmental review is warranted.

NMFS and USACE are serving as cooperating agencies and intend to adopt the Final EIS if they deem it sufficient, after an independent review and analysis, to meet their NEPA compliance requirements. Under the Proposed Action and other action alternatives, NMFS' action alternative is to issue the requested Letter of Authorization (LOA) to the Applicant to authorize incidental take for the activities specified in its application and that are being analyzed by BOEM in the reasonable range of alternatives described here. USACE is required to analyze alternatives to the proposed Atlantic Shores South Project to satisfy NEPA and the CWA 404(b)(1) Guidelines. The analysis in this Draft EIS considers a reasonable range of alternatives, including cable route options within the PDE and alternatives considered but dismissed.

BOEM decided to use the NEPA substitution process for National Historic Preservation Act (NHPA) Section 106 purposes, in accordance with 36 CFR 800.8(c), during its review of the Project. Section 106 of the NHPA regulations, "Protection of Historic Properties" (36 CFR Part 800), provides for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. Draft avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties are presented in Appendix G, *Mitigation and Monitoring*. Ongoing consultation with consulting parties may result in additional measures or changes to these measures.

The Proposed Action is developed based on a PDE as described in the COP, and explained in Section 1.5, *Methodology for Assessing the Project Design Envelope*, and Appendix C.

Table 2-1. Alternatives considered for analysis

Alternative	Description
Alternative A – No Action	Under Alternative A, BOEM would not approve the COP, the Project's construction and installation, O&M, and eventual decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization to the applicant under the MMPA. The current resource conditions, trends, and effects from ongoing activities under the No Action Alternative serve as the existing baseline against which all action alternatives are evaluated. Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities are expected to occur, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix D, *Ongoing and Planned Activities Scenario,* without the Proposed Action serves as the baseline for the evaluation of cumulative impacts.
Alternative B – Proposed Action	Under Alternative B (Figure 2.1-1), the construction and installation, O&M, and eventual decommissioning of the Atlantic Shores South Project, which consists of two wind energy facilities (Project 1 and Project 2) on the OCS offshore of New Jersey, would be built within the range of the design parameters outlined in the Atlantic Shores South COP (Atlantic Shores 2023), subject to applicable mitigation measures. The Atlantic Shores South Project would include up to 200 total WTGs (between 105 and 136 WTGs for Project 1, and between 64 and 95 WTGs for Project 2), up to 10 OSSs (up to 5 in each Project), up to 1 permanent met tower, and up to 4 temporary meteorological and oceanographic (metocean) buoys (up to 1 met tower and 3 metocean buoys in Project 1, and 1 metocean buoy in Project 2), interarray and interlink cables, 2 onshore substations, 1 O&M facility, and up to 8 transmission cables making landfall at 2 New Jersey locations. The proposed landfall locations are the Monmouth landfall in Sea Girt, New Jersey with an onshore route to the existing

Alternative	Description
	Larrabee Substation POI and the Atlantic landfall in Atlantic City, New Jersey, with an onshore route to the existing Cardiff Substation POI. Project 1 would have a capacity of 1,510 MW. Project 2's capacity is not yet determined, but Atlantic Shores has a goal of 1,327 MW, which would align with the interconnection service agreement Atlantic Shores intends to execute for both projects with the RTO, PJM.[1]
Alternative C – Habitat Impact Minimization/Fisheries Habitat Impact Minimization[2]	Under Alternative C, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, the layout and maximum number of WTGs and OSSs would be adjusted to avoid and minimize potential impacts on important habitats. NMFS identified two areas of concern (AOCs) within the Lease Area that have pronounced bottom features and produce habitat value. AOC 1 is part of a designated recreational fishing area called "Lobster Hole." AOC 2 is part of a sand ridge (ridge and trough) complex. • **Alternative C1: Lobster Hole Avoidance** (Figure 2.1-8) Up to 16 WTGs, 1 OSS, and associated interarray cables within the Lobster Hole designated area as identified by NMFS would be removed. • **Alternative C2: Sand Ridge Complex Avoidance** (Figure 2.1-9) Up to 13 WTGs and associated interarray cables within the NMFS-identified sand ridge complex would be removed. • **Alternative C3: Demarcated Sand Ridge Complex Avoidance** (Figure 2.1-10) Up to 6 WTGs and associated interarray cables within 1,000 feet (305 meters) of the sand ridge complex area identified by NMFS, but further demarcated through the use of the NOAA's Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores, would be removed. • **Alternative C4: Micrositing** This alternative consists of micrositing 29 WTGs, 1 OSS, and associated interarray cables outside of 1,000-foot (305-meter) buffers of ridges and swales within AOC 1 and AOC 2.
Alternative D – No Surface Occupancy at Select Locations to Reduce Visual Impacts[2]	Under Alternative D, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, the no surface occupancy would occur at select WTG positions to reduce the visual impacts of the proposed Project. • **Alternative D1: No Surface Occupancy of Up to 12 Miles (19.3 Kilometers) from Shore: Removal of Up to 21 Turbines** (Figure 2.1-11) This alternative would exclude placement of WTGs up to 12 miles (19.3 kilometers) from shore, resulting in the removal of up to 21 WTGs from Project 1 and associated interarray cables. The remaining turbines in Project 1

[1] Atlantic Shores plans to enter into interconnection service agreements and interconnection construction service agreements with PJM to fund improvements to the onshore Cardiff and Larrabee substations, along with required grid updates. These agreements are distinct from PPAs (applicable in Connecticut, Massachusetts, and Rhode Island) and ORECs (applicable in Maryland, New Jersey, and New York). An OREC represents the environmental attributes of one MWh of electric generation from an offshore wind project. BPU awards ORECs through a competitive bidding process and they represent a long-term contract with the State of New Jersey.

[2] The number of WTGs that could be removed may be reduced if this alternative is selected and combined with another alternative that requires removal of additional WTG positions, and if that combination of alternatives would fail to meet the purpose and need, including any awarded offtake agreement(s).

Alternative	Description
	would be restricted to a maximum hub height of 522 feet (159 meters) above mean sea level (AMSL) and maximum blade tip height of 932 feet (284 meters) AMSL. • **Alternative D2: No Surface Occupancy of Up to 12.75 Miles (20.5 Kilometers) from Shore: Removal of Up to 31 Turbines** (Figure 2.1-12) The up to 31 WTGs sited closest to shore would be removed, as well as the associated interarray cables. The remaining WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL. • **Alternative D3: No Surface Occupancy of Up to 10.8 Miles (17.4 Kilometers) from Shore: Removal of Up to 6 Turbines** (Figure 2.1-13) The up to 6 WTGs sited closest to shore would be removed, as well as the associated interarray cables. The remaining WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL.
Alternative E – Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1[2]	Under Alternative E (Figure 2.1-14), the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to create a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback range between WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) and WTGs in the Ocean Wind 1 Lease Area (OCS-A 0498) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation. There would be no surface occupancy along the southern boundary of the Atlantic Shores South Lease Area through the exclusion or micrositing of up to 4 to 5 WTG positions to allow for a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) separation between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area.
Alternative F – Foundation Structures	Under Alternative F, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. This includes a range of foundation types (of monopile and piled jacket, suction bucket, and gravity-based). To assess the extent of potential impacts of each foundation type for up to 211 foundations (inclusive of WTGs, OSSs, and 1 permanent met tower [Project 1]), this Draft EIS analyzes the following: • **Alternative F1: Piled Foundations** The use of monopile and piled jacket foundations only is analyzed for the maximum extent of impacts. • **Alternative F2: Suction Bucket Foundations** The use of the mono-bucket, suction bucket jacket, and suction bucket tetrahedron base foundations only is analyzed for the maximum extent of impacts. • **Alternative F3: Gravity-Based Foundations** The use of gravity-pad tetrahedron and gravity-based structure foundations only is analyzed for the maximum extent of impacts.

2.1.1 Alternative A – No Action

Under the No Action Alternative, BOEM would not approve the COP. The Atlantic Shores South Project's construction and installation, O&M, and eventual decommissioning would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization to the applicant under the MMPA. The current resource conditions, trends, and effects from ongoing activities under the No Action Alternative serve as the existing baseline against which all direct and indirect impacts from action alternatives are evaluated.

Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities are expected to occur, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable planned activities described in Appendix D, *Ongoing and Planned Activities Scenario*, without the Proposed Action, serves as the future baseline for the evaluation of cumulative impacts.

2.1.2 Alternative B – Proposed Action

Under the Proposed Action, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore of New Jersey would occur within the range of design parameters outlined in Volume I of the COP (Atlantic Shores 2023), which are summarized in Appendix C, *Project Design Envelope and Maximum-Case Scenario.* Project 1 would have a capacity of 1,510 MW. Project 2's capacity has not yet been determined. Atlantic Shores has a goal of 1,327 MW for Project 2, which would align with Atlantic Shores' required payments under the interconnection service agreement it intends to execute for both projects with the RTO, PJM.[3]
A description of construction and installation, O&M, and decommissioning activities to be undertaken for the Proposed Action is included in Sections 2.1.2.1 through 2.1.2.3. Refer to Volume I of the COP (Atlantic Shores 2023) for additional details on the Project's design.

[3] Atlantic Shores plans to enter into interconnection service agreements and interconnection construction service agreements with PJM to fund improvements to the onshore Cardiff and Larrabee substations, along with required grid updates. These agreements are distinct from PPAs (applicable in Connecticut, Massachusetts, and Rhode Island) and ORECs (applicable in Maryland, New Jersey, and New York). An OREC represents the environmental attributes of one MWh of electric generation from an offshore wind project. BPU awards ORECs through a competitive bidding process and they represent a long-term contract with the State of New Jersey.

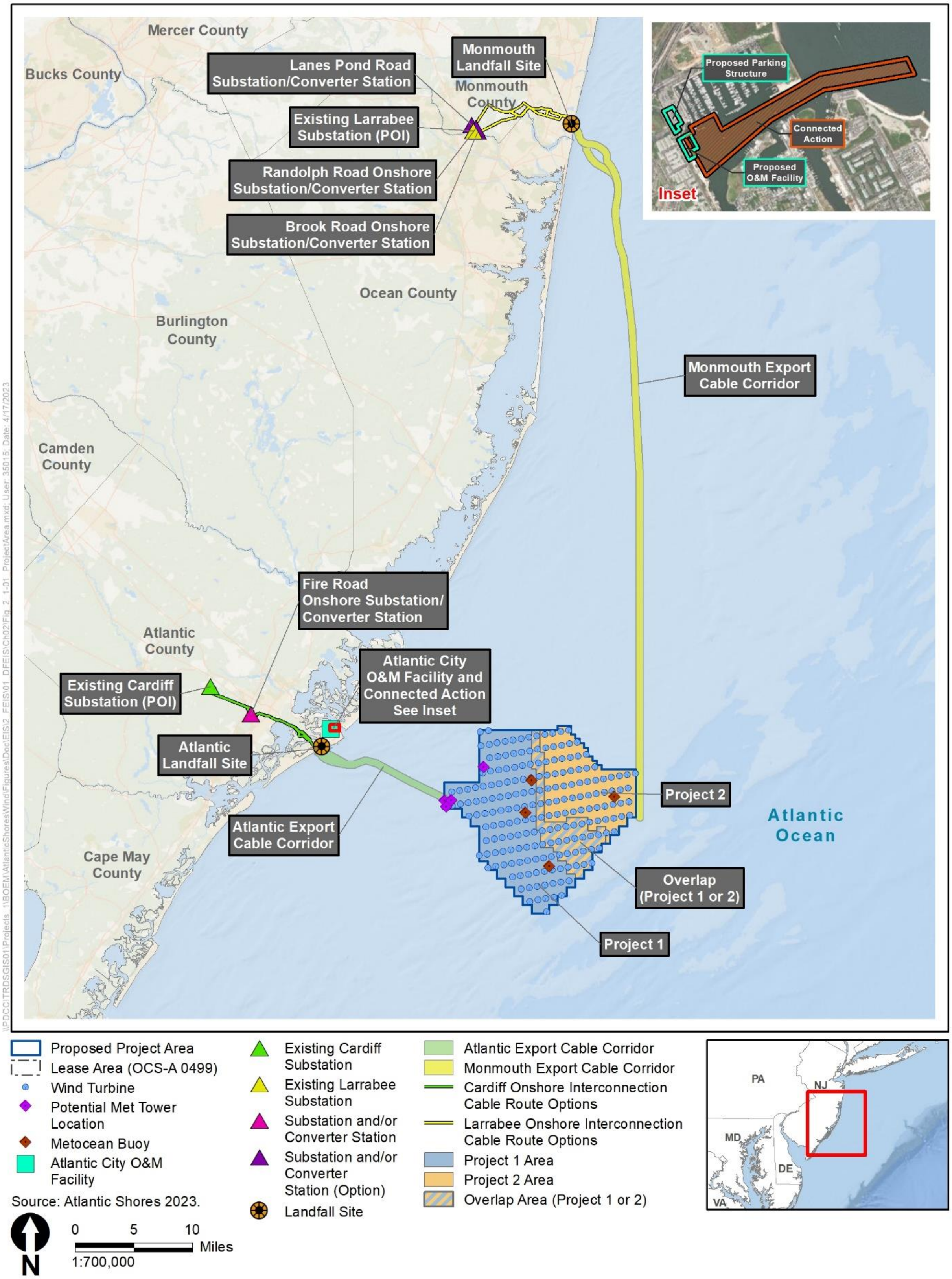


Figure 2.1-1. Atlantic Shores South Offshore Wind Project

Atlantic Shores has committed to environmental protection measures (EPMs) as part of its Proposed Action to avoid, minimize, and otherwise mitigate impacts on physical, biological, socioeconomic, and cultural resources (summarized at the end of each section of COP Volume II; Atlantic Shores 2023). These measures are described in Appendix G and are incorporated as part of the Proposed Action and applicable action alternatives in this Draft EIS. Consultations and authorizations under the MMPA, Section 7 of the ESA, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and Coastal Zone Management Act (CZMA), as well as the submission of applications for and issuance of other necessary permits and authorizations under applicable statutes and regulations, may result in additional measures or changes to these measures.

Atlantic Shores has also committed to comprehensive monitoring of fisheries and benthic habitat conditions throughout the phases of the Project's life-cycle. These monitoring activities will document baseline environmental conditions relevant to fisheries and benthic resources in the WTA, and monitoring of those conditions will continue throughout construction and installation, O&M, and decommissioning of the Proposed Action. These surveys will allow Atlantic Shores to measure Project-related disturbances and monitor the recovery of habitats and biological communities. Atlantic Shores' Fisheries Monitoring Plan will utilize survey gear including clam dredges, demersal fish trawls, and fish traps/pots. Benthic monitoring surveys will utilize gear types including benthic grab samplers, multibeam echosounders, and underwater video cameras.

2.1.2.1 Construction and Installation

The Proposed Action would include the construction and installation of both onshore and offshore facilities. Construction and installation is expected to begin in 2024 and be completed in 2027. Atlantic Shores anticipates initiating land-based construction before beginning the construction of offshore components. The construction of Project 1 and Project 2 would follow a similar schedule up until the activity of WTG Installation and Commissioning. An anticipated Proposed Action schedule is summarized in Table 2-2.

Table 2-2. Anticipated Proposed Action construction schedule

Activity	Expected Timeframe	
	Project 1	Project 2
Onshore Interconnection Cable Installation	2024–2025	
Onshore Substation Construction or Converter Station Construction	2024–2026	
Cofferdam Installation and Removal	2025–2026	
Export Cable Installation	2025	
OSS Installation and Commissioning	2025–2027	
WTG Foundation Installation	2026–2027	
Interarray Cable Installation	2026–2027	
WTG Installation and Commissioning	2026	2027

Source: COP Volume I, Chapter 4, Table 4.1.1; Atlantic Shores 2023.

Construction of the Proposed Action is anticipated to begin with the installation of onshore interconnection cables and construction of onshore substations and/or converter stations. Temporary cofferdams are expected to be installed prior to export cable installation. Construction of the offshore facilities is expected to begin with installation of the export cables and the WTG and OSS foundations (including scour foundation). Once the OSS foundations are installed, the topsides can be installed and commissioned, and the interlink cables (if used) can be installed. At each WTG position, after the foundation is installed, the associated interarray cables and WTGs can be installed (if WTGs are not installed onto gravity-based structures [GBS] foundations at port). Given the number of WTG and OSS positions, there is expected to be considerable overlap in the various equipment installation periods. Installation of the Atlantic Shores South Project's onshore and offshore facilities may occur over a period of up to 4 years (to accommodate weather or seasonal work restrictions); offshore construction is expected to last approximately 3 years, with the exception of high resolution geophysical and geotechnical (G&G) surveys, which are expected to last 5 years. The surveys would be conducted prior to offshore construction commencing and would continue throughout Project construction. In addition, geophysical surveys would be conducted post-construction to ensure proper installation of the Project components.

Onshore Activities and Facilities

Proposed Onshore Project elements include the landfall sites for the submarine export cables, onshore export cable routes, onshore substations (if high-voltage alternating current [HVAC] export cables are used) and/or converter stations (if high-voltage direct current [HVDC] export cables are used), and the interconnection cables linking the onshore substations and/or converter stations to the POIs to the existing grid. Appendix C describes the PDE for onshore activities and facilities, and the COP Volume I provides additional details on construction and installation methods (Atlantic Shores 2023). These onshore elements of the Proposed Action are included in BOEM's analysis in this Draft EIS to support the analysis of a complete Project; however, BOEM's authority under the OCSLA extends only to the activities on the OCS.

The Atlantic Landfall Site for the submarine Atlantic Export Cable Corridor (ECC), would be located in Atlantic City, New Jersey on a site currently consisting of a paved public parking lot. As shown on Figure 2.1-2, the proposed landfall site is located at the eastern terminus of South California Avenue adjacent to the Atlantic City Boardwalk. The site is bounded by Pacific, South Belmont, and South California Avenues and is owned by Atlantic Shores. The landfall site would include underground transition vaults associated with the Atlantic export cables (one vault per cable export). An offset would be instituted around an existing outfall pipe at the proposed location.

The landfall would be connected to the approximately 12.4- to 22.6-mile (20.0- to 36.4-kilometer) Cardiff Onshore Interconnection Cable Route that would continue northwest under urban residential, commercial, and industrial areas to the potential site for the Cardiff Substation and/or Converter Station and terminate at the Cardiff Substation POI, owned by Atlantic City Electric (ACE). The potential substation and/or converter station site, shown on Figure 2.1-2, is a vacant lot located in Egg Harbor Township, approximately 20 acres (8 hectares) in size and bordered by Fire Road (County Road 651) to the north and Hingston Avenue to the south.

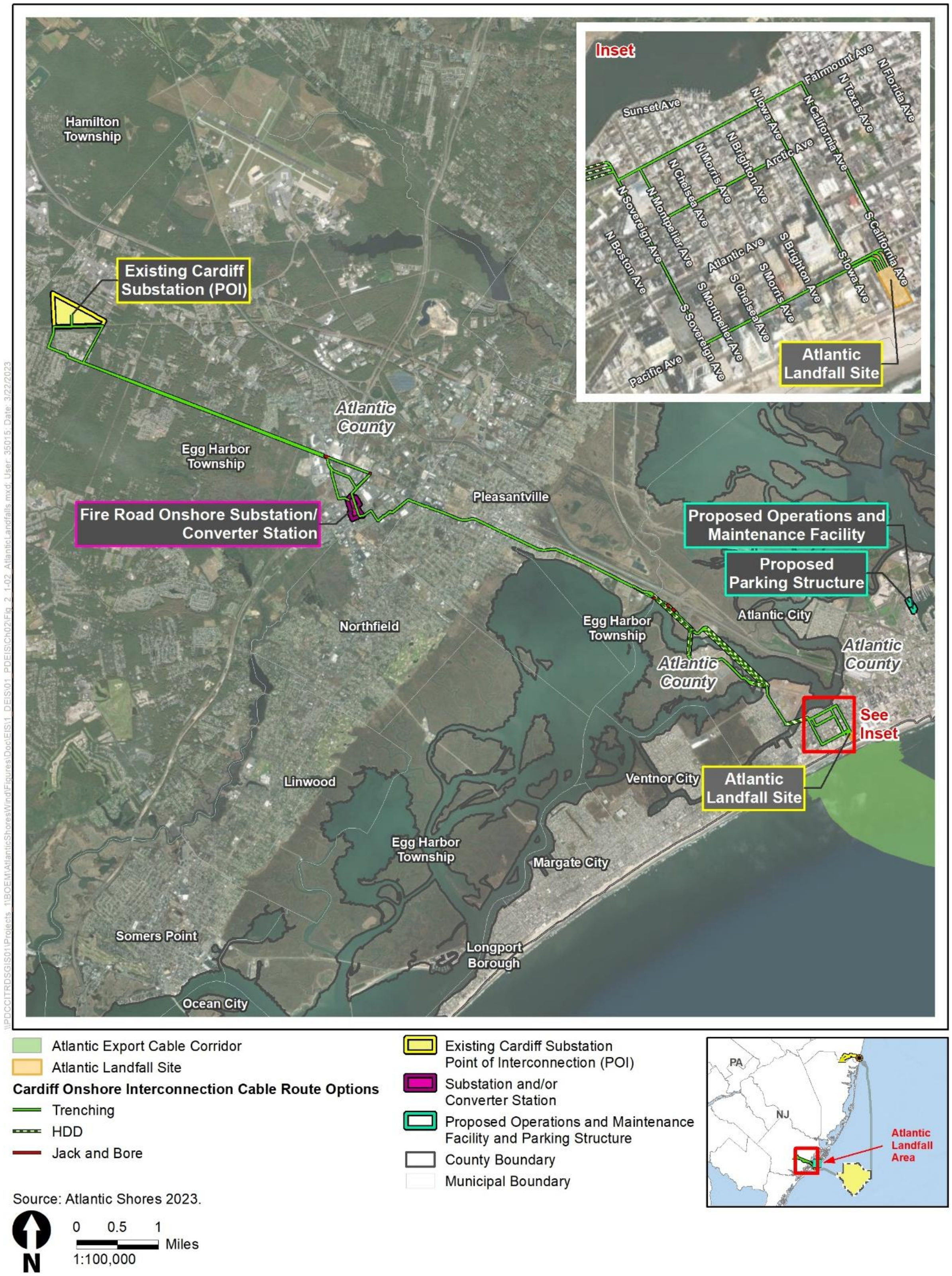


Figure 2.1-2. Onshore Project elements: Atlantic Landfall Site to Cardiff Substation POI

The onshore substation and/or converter station would contain transformers and other electrical gear, and the transmission voltage would be increased or decreased in preparation for grid interconnection at the existing Cardiff Substation POI. Modifications to the POI would be required to accommodate the interconnection of the Atlantic Shores South Project. The scope of the modifications at the POI may range from expanding the existing substation by adding additional breaker bay(s) to upgrading the existing high-voltage section of the substation to a breaker and a half configuration. ACE would be responsible for the design and construction of the required upgrades on the existing electrical grid, including the upgrades at the Cardiff Substation.

If construction of the cable landings is to occur during a scheduled state and/or federal beach nourishment project, Atlantic Shores would coordinate with the New Jersey Department of Environmental Protection (NJDEP), Office of Coastal Engineering and USACE.

The Monmouth Landfall Site for the submarine Monmouth ECC would be located in Sea Girt, New Jersey, at the U.S. Army National Guard Training Center (NGTC), as seen on Figure 2.1-3. The underground transition vaults (one per export cable) would be located in the southeast corner of the NGTC property in a previously disturbed area. This area currently serves as a staging and access location for a federal beach nourishment project, and, as such, Atlantic Shores would coordinate all planned activities at this location with USACE and NJDEP, Office of Coastal Engineering. The landfall would be connected to the approximately 9.8- to 23.0-mile (15.8- to 37.0-kilometer) Larrabee Onshore Interconnection Cable Route, which would continue west to one of three potential sites for the Larrabee Substation and/or Converter Station and terminate at the Larrabee Substation POI owned by Jersey Central Power & Light (JCP&L). The three potential substation and/or converter station sites, shown on Figure 2.1-3, are the approximately 16.3-acre (6.6-hectare) Lanes Pond Road Site, located at the southeast intersection of Lanes Pond Road and Miller Road; the approximately 24.6-acre (10-hectare) Randolph Road Site, located east of Lakewood Farmingdale Road and north of Randolph Road; and the approximately 99.4-acre (40.2-hectare) Brook Road Site, located west of Brook Road and south of Randolph Road.[4] All three sites are located in Howell Township, New Jersey.

The PDE includes the proposed onshore substation and/or converter stations and cable routes as options, and therefore, will be analyzed collectively as part of the Proposed Action. However, the Brook Road Site is expected to be prepared and developed as part of the State of New Jersey's State Agreement Approach (SAA) to support multiple offshore wind generation projects that the state will procure in the future. New Jersey's third offshore solicitation requires bidders to utilize the state's transmission provider and their infrastructure (to be developed by Mid-Atlantic Offshore Development [MAOD][5]) in their bids. If Atlantic Shores receives the award on behalf of the Atlantic Shores South Project, Atlantic Shores will route to MAOD's prepared site (the Brook Road Site).

---

[4] New Jersey's Third Solicitation for Offshore Wind Renewable Energy Certificates (OREC), released March 6, 2023, https://www.nj.gov/bpu/pdf/boardorders/2023/20230306/8D%20ORDER%20OSW%20Third%20Solicitation.pdf.
[5] MAOD is a joint venture of EDF Renewables-North America and Shell New Energies U.S.

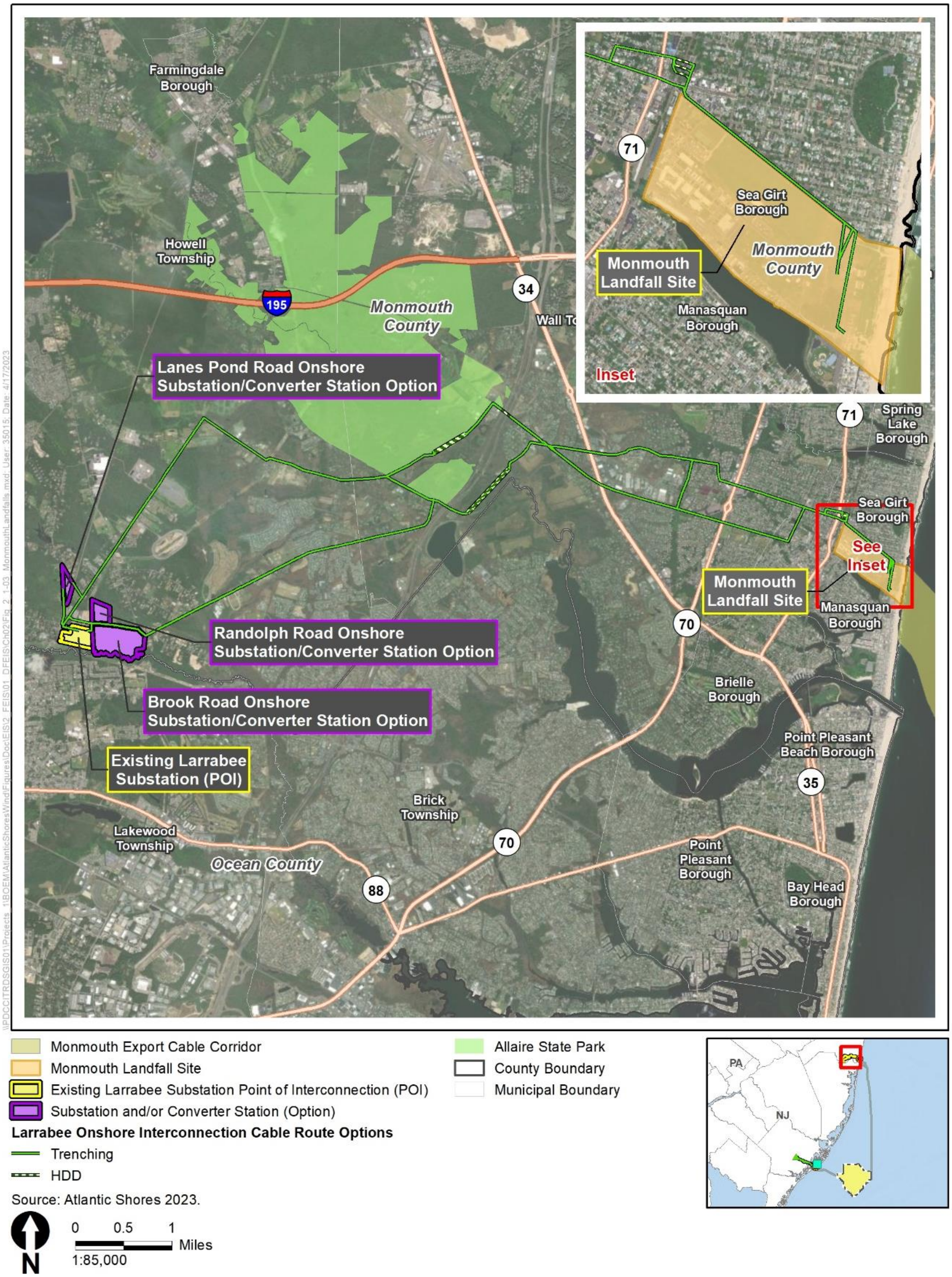


Figure 2.1-3. Onshore Project elements: Monmouth Landfall Site to Larrabee Substation POI

All siting, environmental review, permitting, and other preparation activities at the Brook Road Site are to be completed by MAOD (or the designated lead State or Federal agency, as appropriate) and are thereby not included in the environmental analysis of this Draft EIS, except as part of the cumulative impacts analysis. If Atlantic Shores does not receive the award to utilize the Brook Road Site, Atlantic Shores will utilize either the Lanes Pond Road Site or the Randolph Road Site. Additional details regarding the state's development of the Brook Road Site can be found in Appendix D, Table D-8.

The onshore substation and/or converter station would contain transformers and other electrical gear, and the transmission voltage would be increased or decreased in preparation for grid interconnection at the existing Larrabee Substation POI. Modifications to the POI would be required to accommodate the interconnection of the Atlantic Shores South Project. The scope of the modifications is expected to include upgrading the existing substation by adding an additional breaker bay(s). JCP&L would be responsible for the design and construction of the required upgrades on the existing electrical grid, including the upgrades to the Larrabee Substation.

The onshore interconnection cables would be contained within buried concrete duct banks. The installation of the duct banks and encased cables within the cable routes would be completed via open trenching except in areas where resources are present and need to be avoided. Both the Cardiff and Larrabee Onshore Interconnection Cable Routes include several wetland and waterway crossings. Techniques such as horizontal directional drilling (HDD), pipe jacking, or jack-and-bore methodologies would be utilized to avoid direct surface disturbance. Atlantic Shores is coordinating with USACE to ensure the proposed HDD depth and distance would meet USACE requirements.

To support construction of the Cardiff Onshore Interconnection Cable Route and Larrabee Onshore Interconnection Cable Route, a Traffic Management Plan (TMP) would be developed to avoid and minimize traffic impacts and would adhere to seasonal construction restrictions near the shoreline. Subject to ongoing coordination with local authorities, no onshore construction would occur during the summer (generally Memorial Day to Labor Day) for the Cardiff Onshore Interconnection Cable Route and a portion of the Larrabee Onshore Interconnection Cable Route.

Offshore Activities and Facilities

Proposed Offshore Project components include up to 200 WTGs and their foundations, up to 10 OSSs and their foundations, up to 1 permanent met tower and its foundation, scour protection for foundations, interarray cables and offshore export cables, and up to 4 temporary metocean buoys (these elements collectively compose the Offshore Project area). The proposed Offshore Project elements would be located on the OCS as defined in the OCSLA, except that a portion of the offshore export cables would be located within state waters (Figure 2.1-4). Appendix C describes the PDE for offshore activities and facilities, and COP Volume I, Section 4.0 provides additional details on construction and installation methods (Atlantic Shores 2023).

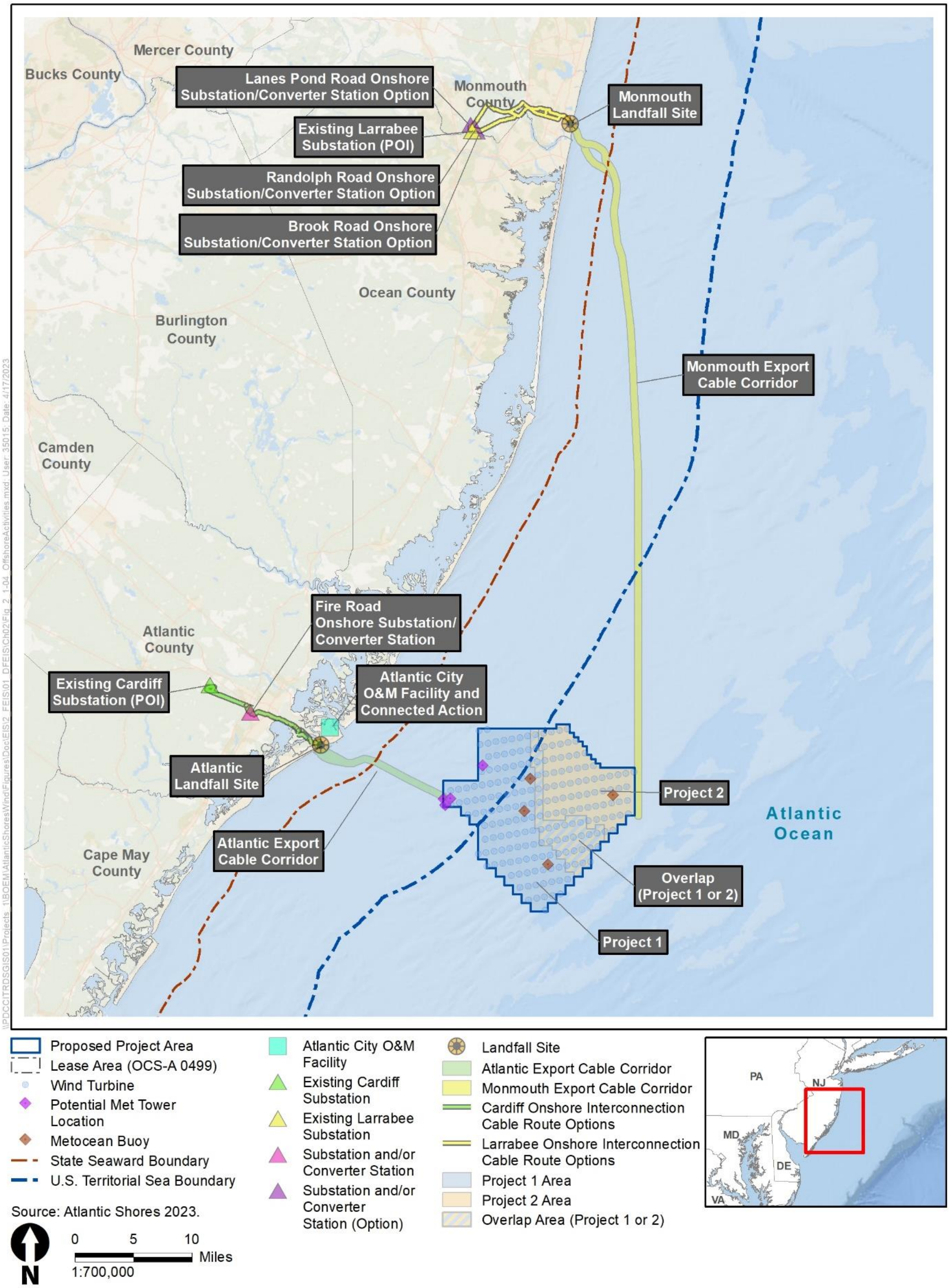
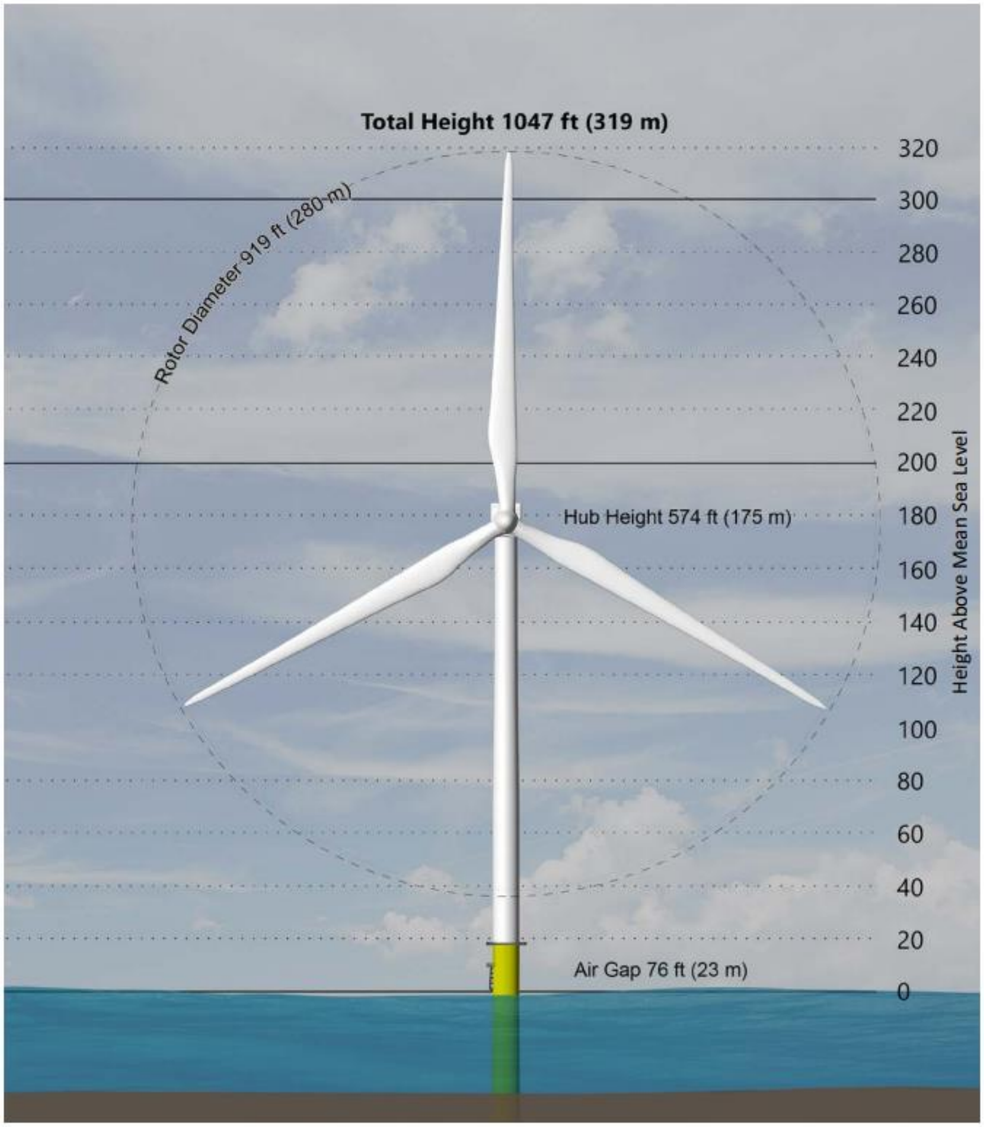


Figure 2.1-4. Offshore activities and facilities and state and U.S. territorial sea boundaries

Atlantic Shores proposes the installation of a maximum of 200 WTGs (inclusive of the 31 WTGs in the Overlap Area); this would include a minimum of 105 WTGs to a maximum of 136 WTGs for Project 1 and a minimum of 64 WTGs to a maximum of 95 WTGs for Project 2, within the approximately 102,124-acre (41,328-hectare) WTA. The WTGs would extend to a maximum height of up to approximately 1,046.6 feet (319.0 meters) AMSL with 0.6-nautical-mile (1,100-meter) spacing. The WTG dimensions on Figure 2.1-5 are indicative of the maximum dimensions of WTGs anticipated to be commercially available within the Atlantic Shores South Project's expected development schedule. Atlantic Shores would mount the WTGs on monopile foundations for Project 1 and monopile or piled jacket foundations for Project 2. All WTGs within each project would be on the same type of foundation (i.e., all monopile or all piled jacket foundations for WTGs in Project 2).



Source: Atlantic Shores 2023

Figure 2.1-5. Maximum wind turbine generator dimensions AMSL

Once the WTG dimensions have been established, Atlantic Shores will coordinate with the National Weather Service (NWS) to conduct a required analysis by the Radar Operations Center on potential data contamination for the NEXRAD Weather Surveillance Radar, 1988 Doppler (WSR-88D) and Federal Aviation Administration (FAA) Terminal Doppler Weather Radar (TDWR). Offshore installation of WTGs would likely involve a jack-up WTG installation vessel assisted by feeder barges or jack-up feeder vessels.

The Atlantic Shores South Project would include up to 10 OSSs that would serve as common collection points for power from the WTGs as well as the origin for the export cables that deliver power to shore. Atlantic Shores is considering three sizes of OSS. Depending on the final OSS design, there would be up to ten small OSSs, up to five medium OSSs, or up to four large OSSs in Project 1 and Project 2 combined. The breakdown of OSSs per project can be found in Table 2-3. OSSs would be located along the same east-northeast to west-southwest rows as the WTGs; small OSSs would be located at least 12 miles (19.3 kilometers) from shore, whereas medium and large OSSs would be located at least 13.5 miles (21.7 kilometers) from shore. More information on installation can be found in COP Volume I, Section 4.4 (Atlantic Shores 2023).

Table 2-3. Types of OSS needed per project

Projects	Small OSS	Medium OSS	Large OSS
Project 1	Up to 5	Up to 2	Up to 2
Project 2	Up to 5	Up to 3	Up to 2

Source: COP Volume I, Section 4.1.1, Project Design Envelope Overview; Atlantic Shores 2023.

Atlantic Shores is planning to leave the option open to include one of three categories of OSS foundations: piled, suction bucket, or gravity-based foundations. The type of foundation would depend on the size of the OSS itself. The foundations for small OSSs would be piled (monopile or piled jacket) or suction bucket (suction bucket jacket). The foundations for medium or large OSSs would be piled (piled jacket), suction bucket (suction bucket jacket), or GBS. Power generated by the WTGs would be transmitted to the OSSs via 66 kilovolts (kV) to 150 kV interarray cables, which would connect to circuit breakers and transformers located within the OSS topsides. These transformers would increase the voltage level to the export cable voltage (230 kV to 275 kV HVAC cables or 320 kV to 525 kV HVDC cables). From the OSSs, the export cables would transmit electricity to shore.

During construction and operation, the OSSs would be lighted and marked in accordance with FAA, U.S. Coast Guard (USCG), and BOEM guidelines to aid safe navigation within the WTA. Atlantic Shores does not currently anticipate installing helicopter pads on the OSSs, though this feature may be added depending on the O&M strategy employed. If a helicopter pad is installed, it would be designed to support a USCG helicopter, including appropriate lighting and marking as required.

Up to eight export cables would be installed to deliver electricity from the OSSs to the landfall sites. The export cables from each Project have the potential to utilize either ECC or be co-located in the same ECC. Both Project 1 and Project 2 would also include electrically distinct interarray cables to connect strings of WTGs to an OSS and may include interlink cables to connect OSSs to each other. Project 1 and Project 2 would each include HVAC or HVDC export cables. If HVAC cables are used, the voltage would be between 230 kV and 275 kV; if HVDC cables are used, the voltage would be between 320 kV and

525 kV. Furthermore, if HVDC cables are used, offshore converter stations using closed-loop cooling technologies would be installed.

Atlantic Shores proposes to construct separate submarine export cables, with approximately 328–820 feet (100–250 meters) between each cable, for Project 1 and Project 2 within the submarine ECCs identified in the COP and shown on Figure 2.1-1. The approximately 12-mile (19-kilometer) Atlantic ECC would travel from the western tip of the WTA westward to the Atlantic Landfall Site. The approximately 61-mile (98-kilometer) Monmouth ECC would travel north from the eastern corner of the WTA along the eastern edge of the Lease Area to the Monmouth Landfall Site.

The interarray and interlink cables could be installed using one or more of the following methods: simultaneous lay and burial, post-lay burial, or pre-lay trenching. Atlantic Shores is carefully evaluating available cable installation tools to select techniques that are appropriate for the site and that would maximize the likelihood of achieving the target cable burial depth of 5 to 6.6 feet (1.5 to 2.0 meters).

Most of the export, interarray, and interlink cables would be installed using jet trenching (either simultaneous lay and burial or post-lay burial) or jet plowing, with limited areas of mechanical trenching. It is estimated that 80 to 90 percent of the offshore cables would be installed with a single pass of the cable installation tool. However, in limited areas expected to be more challenging for cable burial (along up to 10 to 20 percent of the export, interarray, and interlink cable routes), an additional one to three passes of the cable installation tool may be required to further lower the cable to its target burial depth.

The cables are proposed to be routed around federal aids to navigation (ATONs) where practical. However, where existing obstructions (such as artificial reefs and sand borrow areas) did not allow for avoidance, Atlantic Shores surveyed around the aids to navigation and will coordinate with USCG on potential repositioning of an aid to navigation.

The width of each ECC would correspond to the width of the surveyed corridors, in which the potential cable easements would be located, and would range from approximately 3,300 to 4,200 feet (1,000 to 1,280 meters) for all of the Monmouth ECC and most of the Atlantic ECC, though the Atlantic ECC widens to approximately 5,900 feet (1,800 meters) near the Atlantic Landfall Site. The proposed width of each ECC accommodates the planned export cable options as well as the associated cable installation vessel activities and would allow for avoidance of resources such as shipwrecks, artificial reefs, and sensitive habitats. Variations in width at the landfall sites are needed to accommodate the construction vessel activities necessary to support the landfall of each export cable via HDD. Up to eight temporary cofferdams, four at each landfall site, may be constructed. The cofferdams would be approximately 98.4 feet by 26.2 feet (30 meters by 8 meters). Following the installation of the HDD conduit and export cable, the seabed would be restored, and the cofferdam removed. Atlantic Shores would conduct vibration monitoring at the Atlantic Landfall Site during HDD activities to ensure minimal impacts to the existing outfall pipe at the proposed location.

Atlantic Shores would survey all cable crossings, and if a cable being crossed is active, Atlantic Shores would develop a crossing agreement with its owner. At each crossing, before installation, Atlantic Shores would clear the area around the crossing of any marine debris. Depending on the status of the existing cable and its location, such as burial depth and substrate characteristics, cable protection may be placed between the existing cable and Atlantic Shores' overlying cable. However, if sufficient vertical distance exists, such protection may be avoided. The presence of an existing cable may prevent Atlantic Shores' cable from being buried to its target burial depth. In this case, cable protection may be required on top of the proposed cable at the crossing location. Following installation of the proposed cables, Atlantic Shores would survey the cable crossing again. Additionally, Atlantic Shores is coordinating with Ocean Wind, LLC (Ocean Wind), the developer of the proposed neighboring Ocean Wind 1 Offshore Wind Farm Project (Ocean Wind 1) to develop a mutually acceptable crossing agreement to govern proposed cable crossings.

A single permanent met tower up to 590.6 feet (180 meters) AMSL may be installed within the WTA during construction of Project 1. Up to four locations for the met tower, all located within Project 1, are under consideration. All four potential locations (shown on Figures 2.1-4 and 2.1-6) fall within the navigation corridors but are located on or near the western perimeter of the WTA so as to minimize potential interference with the corridors. The met tower would not replace a WTG location. The foundation options for the met tower include piled (monopile or piled jacket), suction bucket (suction bucket jacket or mono-bucket), and GBS. The met tower would be composed of square lattice consisting of tubular steel and would be equipped with an approximately 50-foot by 50-foot (15-meter by 15-meter) deck.

Up to four metocean buoys (three for Project 1 and one for Project 2) may be installed within the WTA during construction. These buoys, shown in Figure 2.1-4, would be temporary and used to monitor weather and sea state conditions during construction. The buoys would be anchored to the seafloor using a steel chain connected to a steel chain weight and possibly an additional bottom weight associated with a water level sensor. Once construction is completed, the buoys would be decommissioned in accordance with 30 CFR Part 285, Subpart I.

Indicative locations of the up to ten small OSSs, up to five medium OSSs, and up to four large OSSs, as well as the four potential met tower locations and four metocean buoy locations are shown on Figure 2.1-6.

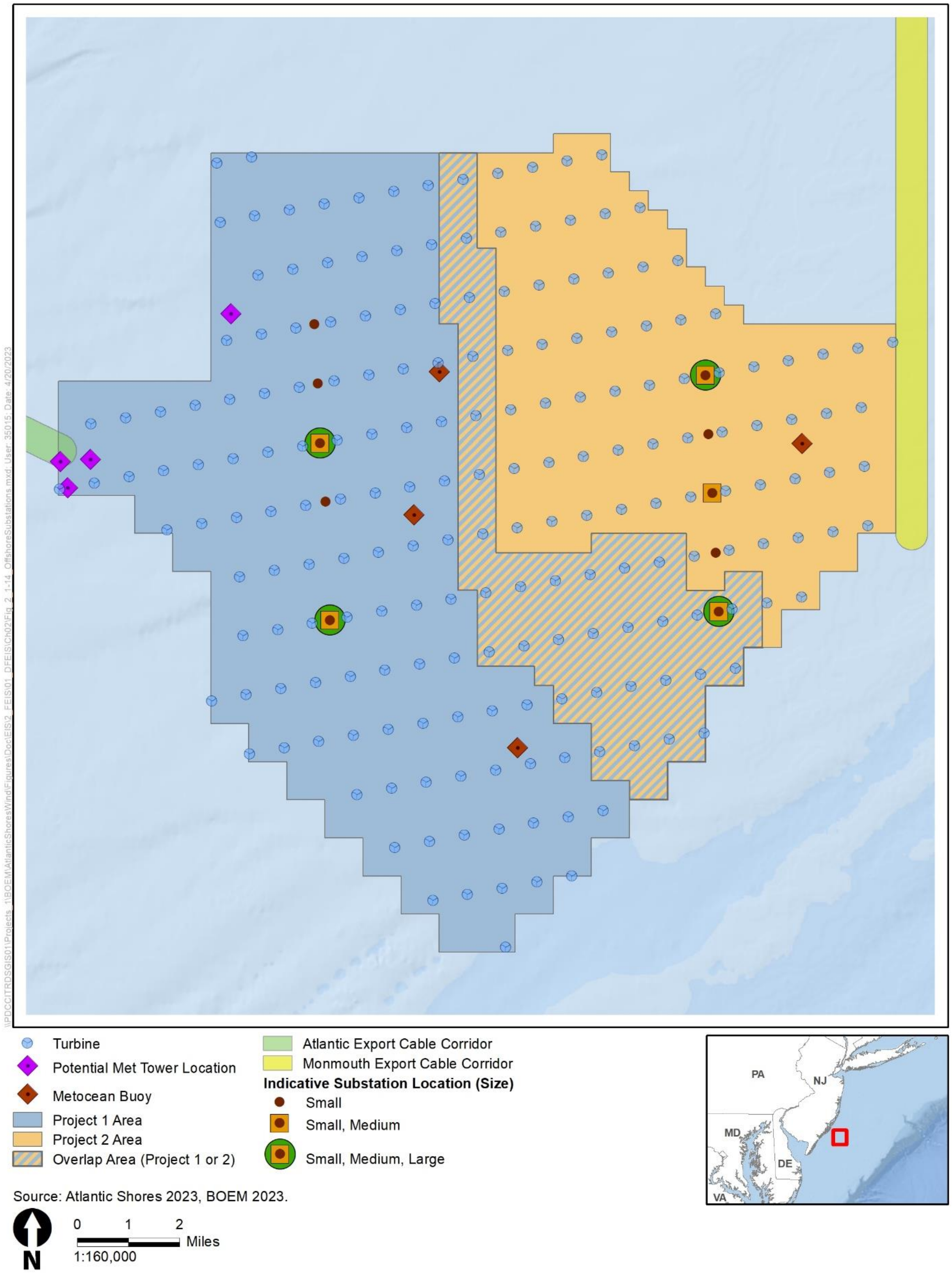


Figure 2.1-6. Offshore Project structures

2.1.2.2 Operations and Maintenance

Once installed and commissioned, both Project 1 and Project 2 are designed to operate for up to 30 years.[6] O&M activities would ensure that Project 1 and Project 2 function safely and efficiently. To minimize equipment downtime and maximize energy generation, the Project would conduct O&M activities through scheduled, predictive, and remotely controlled activities. Remotely controlled activities include remotely turning on and off Project equipment to accommodate maintenance activities, requests from grid operators or the USCG, or other activities, and continuous remote monitoring of the status, production, and health of offshore structures, cables, and equipment.

The Project's facilities would operate autonomously without onsite attendance by technicians. Project 1 and Project 2 would be equipped with a supervisory control and data acquisition (SCADA) system, which would provide an interface between each Project's facilities and all environmental and condition monitoring sensors and would provide detailed performance and system information. The operator would monitor the status, production, and health of the Project 24 hours a day. As part of the Proposed Action, an O&M facility would be constructed in Atlantic City, New Jersey, on a site previously used for vessel docking or other port activities (Figure 2.1-7). Construction of the O&M facility would involve construction of a new building and associated parking structure, repairs to the existing docks, and installation of new dock facilities. The new O&M facility may include installation of a communication antenna with a height up to 120 feet (36.6 meters). Repair or installation of a new bulkhead and maintenance dredging in coordination with Atlantic City's dredging of the adjacent basins would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead repair/installation and dredging activities are considered to be a connected action under NEPA (Section 2.1.2.4). As shown in Figure 2.1-7, the dock repair and installation area overlaps with the area associated with the connected action activities.

Scheduled maintenance would be performed on a fixed, predetermined schedule (e.g., annually) and may consist of remote monitoring, inspections, testing, replacement of consumables, and preventative maintenance. As part of the scheduled maintenance, self-inspections would be conducted in accordance with 30 CFR 285.824 and 285.825. Scheduled maintenance of offshore facilities would be performed during non-winter months when accessibility would be highest. The frequency of inspections, tests, and maintenance would be based on industry standards and best practices.

---

[6] For analysis purposes, BOEM assumes in this Draft EIS that the proposed project would have an operating period of 30 years. Atlantic Shore's lease with BOEM (Lease OCS-A 0499) has an operational term of 25 years that commences on the date of COP approval. (See https://www.boem.gov/sites/default/files/documents/oil-gas-energy/OCS-A%200499%20Lease.pdf; see also 30 CFR 585.235(a)(3).) Atlantic Shores would need to request and be granted a renewal of the operations term of its lease under BOEM's regulations at 30 CFR 585.425 et seq. in order to operate the proposed Atlantic Shores South Project for 30 years. While Atlantic Shores has not made such a request, this Draft EIS uses the longer period in order to avoid the possibility of underestimating any potential effect.

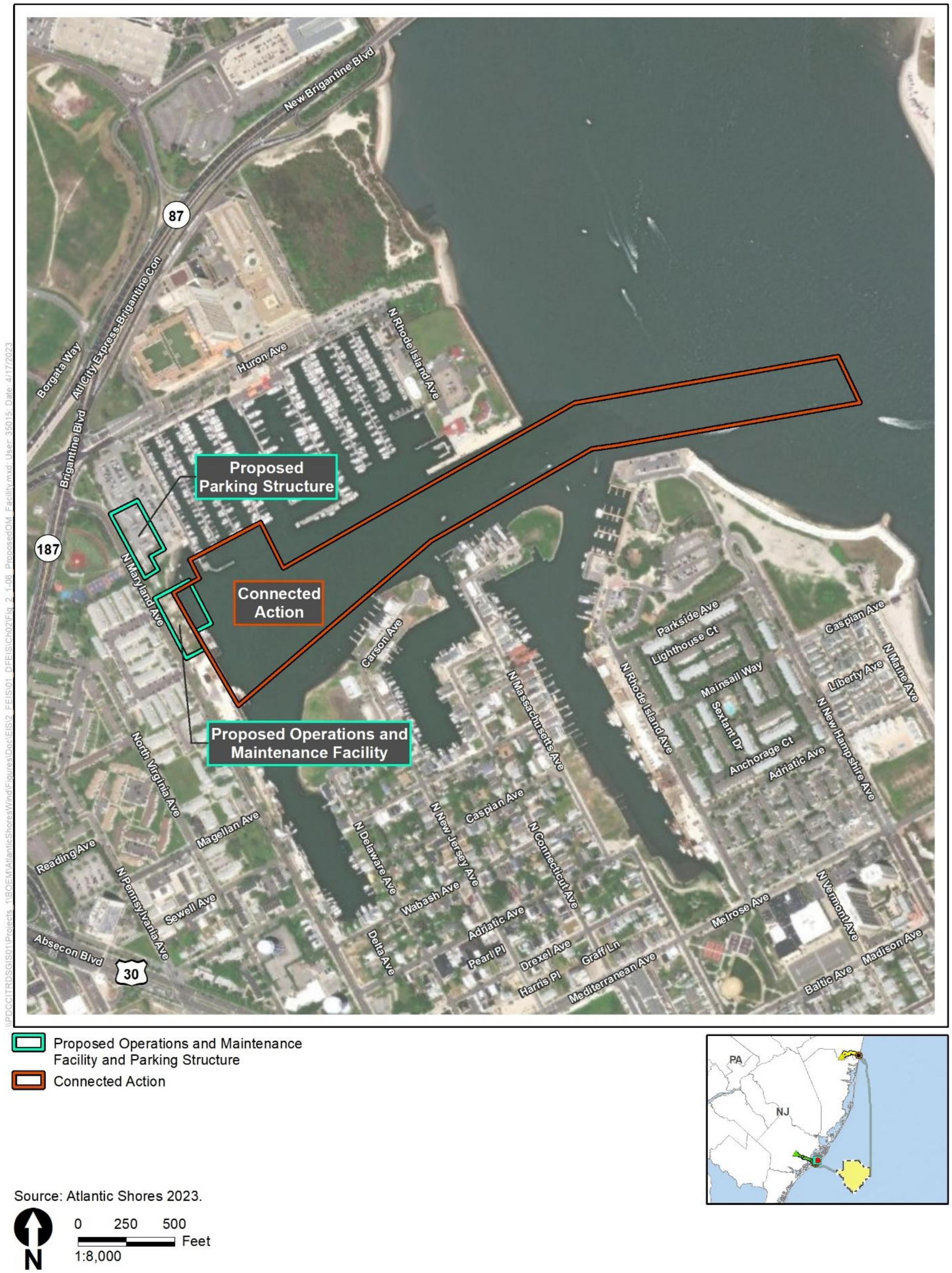


Figure 2.1-7. Proposed operations and maintenance facility

Unscheduled maintenance would be performed in response to a sensor alarm or fault indicating a component malfunction or in response to an event that causes accidental damage. Unscheduled maintenance may involve inspections, troubleshooting, and corrective maintenance, and would occur at any time of the year. Atlantic Shores would conduct a post-event inspection after an event that causes damage to a structure (e.g., a ship allision) or after a storm during which measured environmental conditions exceeded specified conditions (e.g., a hurricane or significant storm event).

Onshore Activities and Facilities

The onshore substations and/or converter stations, onshore export cables, and grid POIs would be inspected regularly and may require preventative maintenance and, as needed, corrective maintenance. Electrical systems at the onshore substations and/or converter stations—such as transformers, switchgear, harmonic filters, reactive power equipment, revenue meters, protection and control systems, and auxiliary services—would be regularly monitored. Scheduled maintenance of the onshore interconnection cables would also be performed; any necessary maintenance would be accessed through manholes and completed within the installed transmission infrastructure.

Offshore Activities and Facilities

Scheduled maintenance of WTGs would include regularly scheduled inspections and routine maintenance of mechanical and electrical components. The types and frequency of inspections and maintenance activities would be based on detailed original equipment manufacturer specifications. Annual maintenance campaigns would be dedicated to general upkeep (e.g., bolt tensioning, crack and coating inspection, safety equipment inspection, cleaning, high-voltage component service, and blade inspection) and replacement of consumable components (e.g., lubrication, oil changes). Best management practices will be employed to reduce the risk of spills, discharges, and accidental releases of lubricants, oils, and fuels during these activities.

OSSs would undergo annual maintenance to both medium-voltage and high-voltage systems, auxiliary systems, and safety systems as well as topside structural inspections. Portions of the topsides may require the reapplication of corrosion-resistant coating. Routine maintenance and refueling would also be performed on diesel generators located on the OSSs.

WTG, OSS, and met tower foundations would be inspected both above and underwater at regular intervals to check their condition, including checking for corrosion, cracking, and marine growth. Scheduled maintenance of foundations would also include safety inspections and testing; coating touch up; preventative maintenance of cranes, electrical equipment, and auxiliary equipment; and removal of marine growth.

The offshore cables would be continuously monitored using a distributed temperature system (DTS), a distributed acoustic sensing (DAS) system, or online partial discharge (OLPD) monitoring. In addition, cable surveys would be performed at regular intervals to identify any issues associated with potential scour and depth of burial. Annual surveys would be performed for the first few years of operation. Atlantic Shores would determine inspection intervals based on trends established from inspection and measurement data collected during these annual surveys and updated throughout the life of the Project as new inspections are completed. Additional surveys would be performed, as appropriate, in response to abnormal conditions or significant events, such as major storms, marine incidents in the area, or major maintenance activities. In addition, monitoring systems would be installed on all major components, which would alert Atlantic Shores to potential issues and may trigger additional surveys. Cable terminations and hang-offs would be inspected and maintained during scheduled maintenance of foundations, OSSs, and WTGs. Any unusual observations made during routine maintenance and inspection activities may also trigger additional surveys.

2.1.2.3 Conceptual Decommissioning

Under 30 CFR Part 285 and commercial Renewable Energy Lease OCS-A 0499, Atlantic Shores would be required to remove or decommission all facilities, projects, cables, and pipelines, and clear the seafloor of all obstructions created by the proposed Atlantic Shores South Project (see COP Volume I, Section 6.2). All foundations would need to be removed 15 feet (4.6 meters) below the mudline (30 CFR 285.910(a)). Absent permission from BSEE, Atlantic Shores would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed. Atlantic Shores has submitted a conceptual decommissioning plan as part of the COP, and the final decommissioning application would outline Atlantic Shores' process for managing waste and recycling proposed Project components (COP Volume I, Section 6.0; Atlantic Shores 2023). Although the proposed Atlantic Shores South Project is anticipated to have an operational life of 30 years, it is possible that some installations and components may remain fit for continued service after this time. Atlantic Shores would need to request and be granted a renewal of the operations term of its lease under BOEM's regulations at 30 CFR 585.425 et seq. if it wanted to operate the proposed Atlantic Shores South Project for more than the 25-year operations term stated in its lease.

BSEE would require Atlantic Shores to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease; 90 days after completion of the commercial activities on the commercial lease; or 90 days after cancellation, relinquishment, or other termination of the lease (see 30 CFR 285.905). Upon completion of the technical and environmental reviews, BSEE may approve, approve with conditions, or disapprove the lessee's decommissioning application. This process would include an opportunity for public comment and consultation with municipal, state, and federal management agencies. Atlantic Shores would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the proposed Atlantic Shores South Project. Approval of such activities would require compliance under NEPA and other federal statutes and implementing regulations.

If the COP is approved or approved with modifications, Atlantic Shores would have to submit financial assurance (e.g., a bond) prior to installation that would be held by the U.S. government to cover the cost of decommissioning the entire facility in the event that Atlantic Shores would not be able to decommission the facility, as outlined under 30 CFR Part 585 Subpart E.

Onshore Activities and Facilities

Depending on future environmental assessments and consultations with state and municipal agencies, onshore facilities (e.g., onshore substations and buried duct banks) would either be retired in place or reused for other purposes. For example, because removing buried concrete duct banks would require excavations similar to those involved with installation, leaving these conduits in place for other infrastructure could be less disruptive and beneficial. Even if duct banks are left in place for future use, the onshore cables would likely be removed from the conduits and recycled accordingly.

Offshore Activities and Facilities

Decommissioning of the WTGs and OSSs would be a "reverse installation" process, with turbine components or the OSS topside structure removed prior to foundation removal (scour). The procedures used for decommissioning the WTG and OSS foundations would depend on the type of foundation. Piled foundations would be cut below the mudline and would be completely removed above that cut. Suction bucket foundations would be injected with water essentially reversing the installation process, enabling the complete removal of the foundation. The gravity foundations would have the ballasts within the foundations removed and the foundations would be floated away. If it is not possible to re-float the gravity foundation, it would be disassembled onsite, and all components removed.

Similar to WTGs and OSS topsides, the met tower would be disassembled and removed from its foundation using cranes, shipped to shore, and recycled or scrapped.

Export cables, interarray cables, and interlink cables (if present) would either be retired in place or removed from the seabed. The decision regarding whether to remove these cables and any overlying cable protection would be made based on future environmental assessments and consultations with federal, state, and municipal resource agencies.

2.1.2.4 Connected Action

This Draft EIS analyzes the planned bulkhead repair and/or replacement and maintenance dredging activities as a connected action under NEPA per 40 CFR 1501.9(e)(1). The bulkhead site and dredging activities would be conducted within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area. Available records indicate that the area was historically dredge-maintained during the 1950s and 1980s (USACE 2022).

The existing bulkhead is an approximately 250-foot (76-meter) structure consisting of multiple sections that are made from steel sheet piles, timbers, and concrete. The bulkhead is missing sections, leading it to become unstable and increasing the potential for erosion. Repair and/or replacement of the existing bulkhead is required in order to stabilize the shoreline and prevent additional erosion and would be necessary regardless of whether the Proposed Action is implemented. Independently of the Proposed Action, Atlantic Shores is pursuing a USACE Nationwide Permit 3/Nationwide Permit 13 to install an approximately 356-foot (109-meter) bulkhead composed of steel or composite vinyl sheet piles. The new bulkhead will be sited externally of the existing bulkhead, as the existing bulkhead will remain in place, unless removal of specific sections is required to safely install the new bulkhead. It is anticipated that the new bulkhead will be supported by anchor piles.

The City of Atlantic City obtained a USACE approval (CENAP-OPR-2021-00573-95) and a NJDEP Dredge Permit (No. 0102.20.0001.1 LUP 210001) to perform 10-year maintenance dredging of 13 city waterways, inclusive of the area associated with the proposed O&M facility: Clam Creek and Farley's Marina Fuel. Atlantic City's maintenance dredging program targets substantial shoaling that has built up over the last century and would include dredging 122,710 cubic yards (93,818 cubic meters) of shoaled sediments from a 17.75-acre (7.18-hectare) section of Clam Creek and dredging 20,113 cubic yards (15,378 cubic meters) of shoaled sediments from the 2.86-acre (1.16-hectare) footprint of Farley's Marina Fuel.

The City's maintenance dredging program would reestablish a water depth of 15 feet (4.6 meters) below the plane of Mean Low Water (MLW) plus 1.0 foot (0.3 meter) of allowable overdredge and 4:1 slide slopes within the site. Dredging would be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. The hydraulic cutterhead dredge would be the primary dredge method, with the mechanical dredge utilized to access small marina, canal, or lagoon areas. The hydraulic dredge pipeline will be marked in accordance with USCG regulations and would be sunken, except where submerged aquatic vegetation is encountered, in which case the pipeline would be floated. All resultant dredged material at the site would be removed and disposed of at Dredged Hole (DH) #86, a subaqueous borrow pit restoration site, in Beach Thorofare in Atlantic City, New Jersey, and in accordance with Department of the Army Permit Number NAP-2020-00059-95. DH #86 is owned and maintained by New Jersey Department of Transportation, Office of Maritime Resources (NJDOT-OMR). Placement of dredged material into DH #86 is contingent upon execution of a use agreement between Atlantic City and NJDOT-OMR. Each maintenance dredging event included within the permit anticipates a duration of approximately 12 weeks, including mobilization and demobilization, dredging, and material placement activities.

The maintenance dredging activities would serve to maintain safe navigational depths for transiting vessels by re-establishing in-water depths consistent with depths historically maintained in collaboration with dredging activities of adjacent harbors and waterways. These activities would be implemented independently from the Proposed Action.

2.1.3 Alternative C – Habitat Impact Minimization/Fisheries Habitat Impact Minimization

Alternative C was developed through the scoping process for the Draft EIS in response to comments received from the Mid-Atlantic Fishery Management Council (MAFMC), New England Fishery Management Council (NEFMC), NMFS, and the Environmental Protection Agency (USEPA). Alternative C includes four sub-alternatives, which would avoid entirely, or in part, two AOCs identified by NMFS within the Lease Area that have pronounced bottom features and produce valuable habitat. AOC 1 is part of a designated recreational fishing area called "Lobster Hole," and AOC 2 is part of a sand ridge (ridge and swale) complex. The layout and number of WTGs and OSSs would be adjusted to avoid and minimize potential impacts on these identified habitats.

Generally, sand ridge and trough features are physical features that are found throughout the OCS in the mid-Atlantic and provide habitat for various species. Ridge and swale habitat provide complex physical structures that affect the composition and dynamics of ecological communities, with increased structural complexity often leading to greater species diversity, abundance, overall function, and productivity. In the mid-Atlantic sand ridges and troughs are areas of biological significance for migration and spawning of mid-Atlantic fish species, many of which are recreationally targeted in those specific areas. A more detailed analysis by resource can be found in Section 3.5, *Biological Resources*. Although the overall artificial reef effect would be decreased by reducing the total number of WTGs in the Lease Area, the biological benefits of preserving natural fish habitat may be beneficial. Each of the sub-alternatives may be individually selected or combined with any or all other alternatives, subject to the combination meeting the purpose and need.

2.1.3.1 Alternative C1 – Lobster Hole Avoidance

Alternative C1 would avoid and minimize the potential impacts on the Lobster Hole (AOC 1), a designated recreational fishing area, by removing up to 16 WTGs, 1 OSS, and associated interarray cables, as shown on Figure 2.1-8.

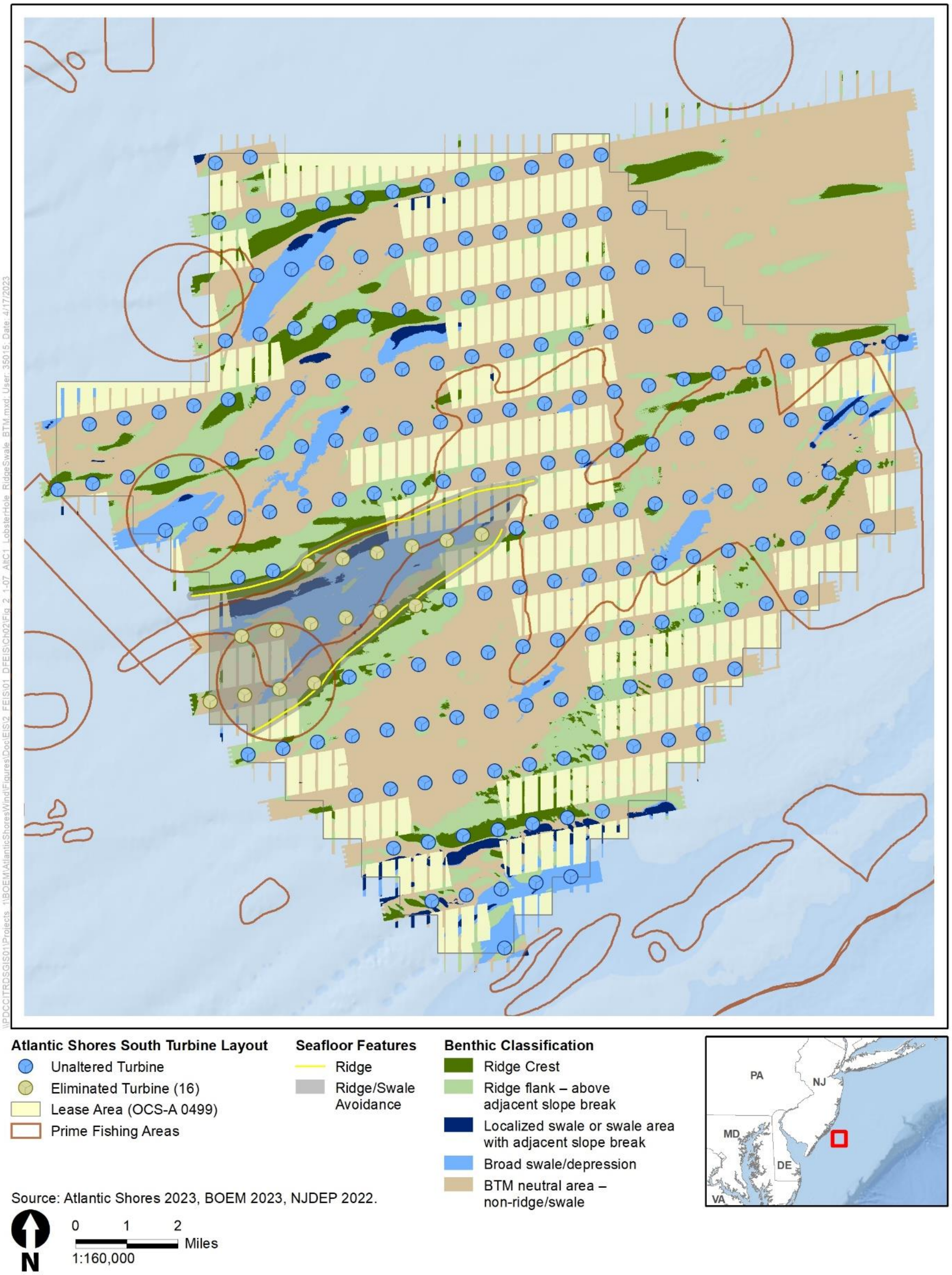


Figure 2.1-8. Alternative C1 – Lobster Hole Avoidance

2.1.3.2 Alternative C2 – Sand Ridge Complex Avoidance

Alternative C2 would avoid and minimize potential impacts on the sand ridge features in the southern-most portion of the Lease Area (AOC 2) by removing up to 13 WTGs and associated interarray cables within the NMFS-identified sand ridge complex (Figure 2.1-9).

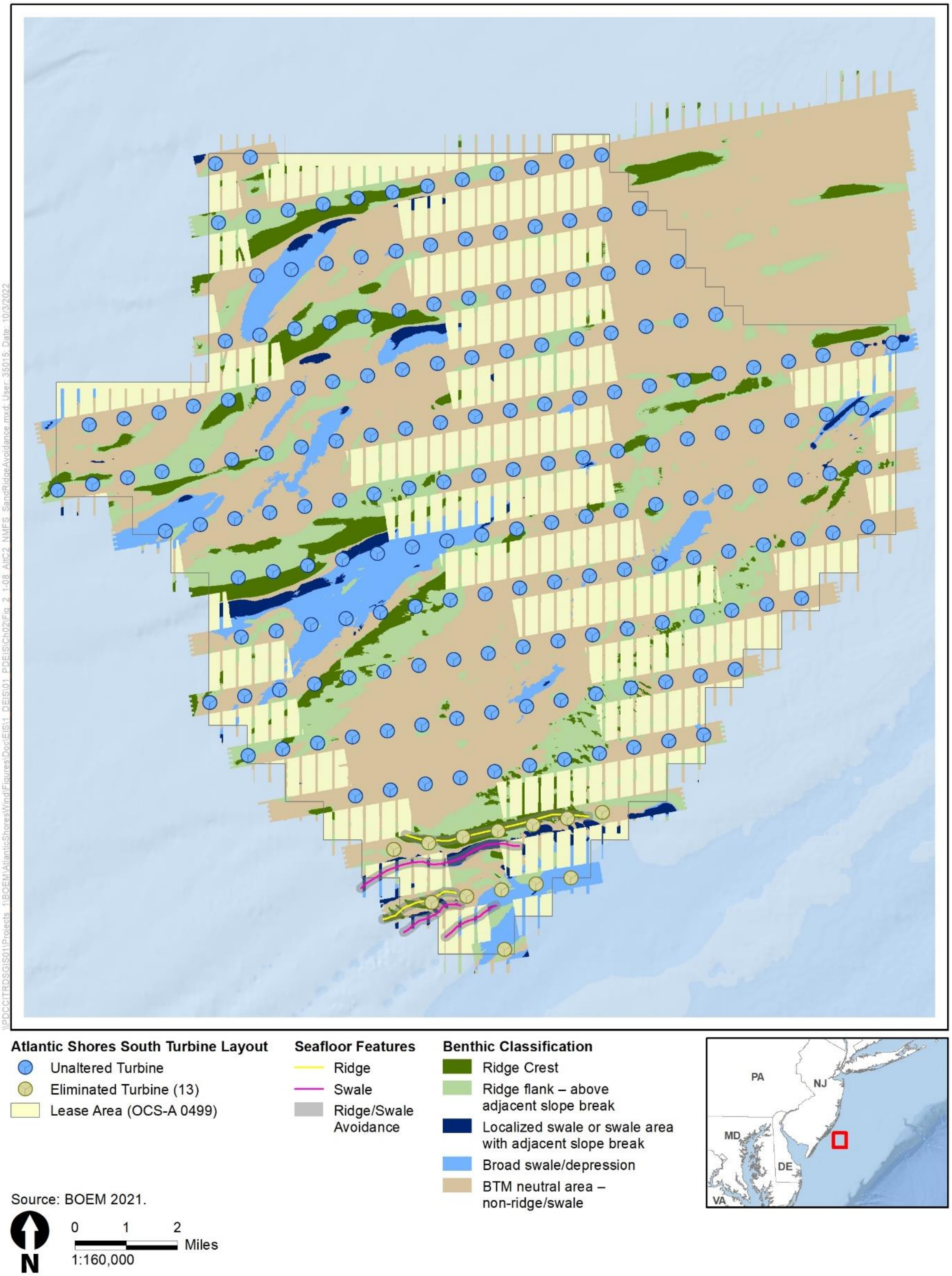


Figure 2.1-9. Alternative C2 –Sand Ridge Complex Avoidance

2.1.3.3 Alternative C3 – Demarcated Sand Ridge Complex Avoidance

Alternative C3 would remove up to 6 WTGs and associated interarray cables within 1,000 feet (305 meters) of the sand ridge complex area identified by NMFS, but further demarcated using NOAA's Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores (Figure 2.1-10).

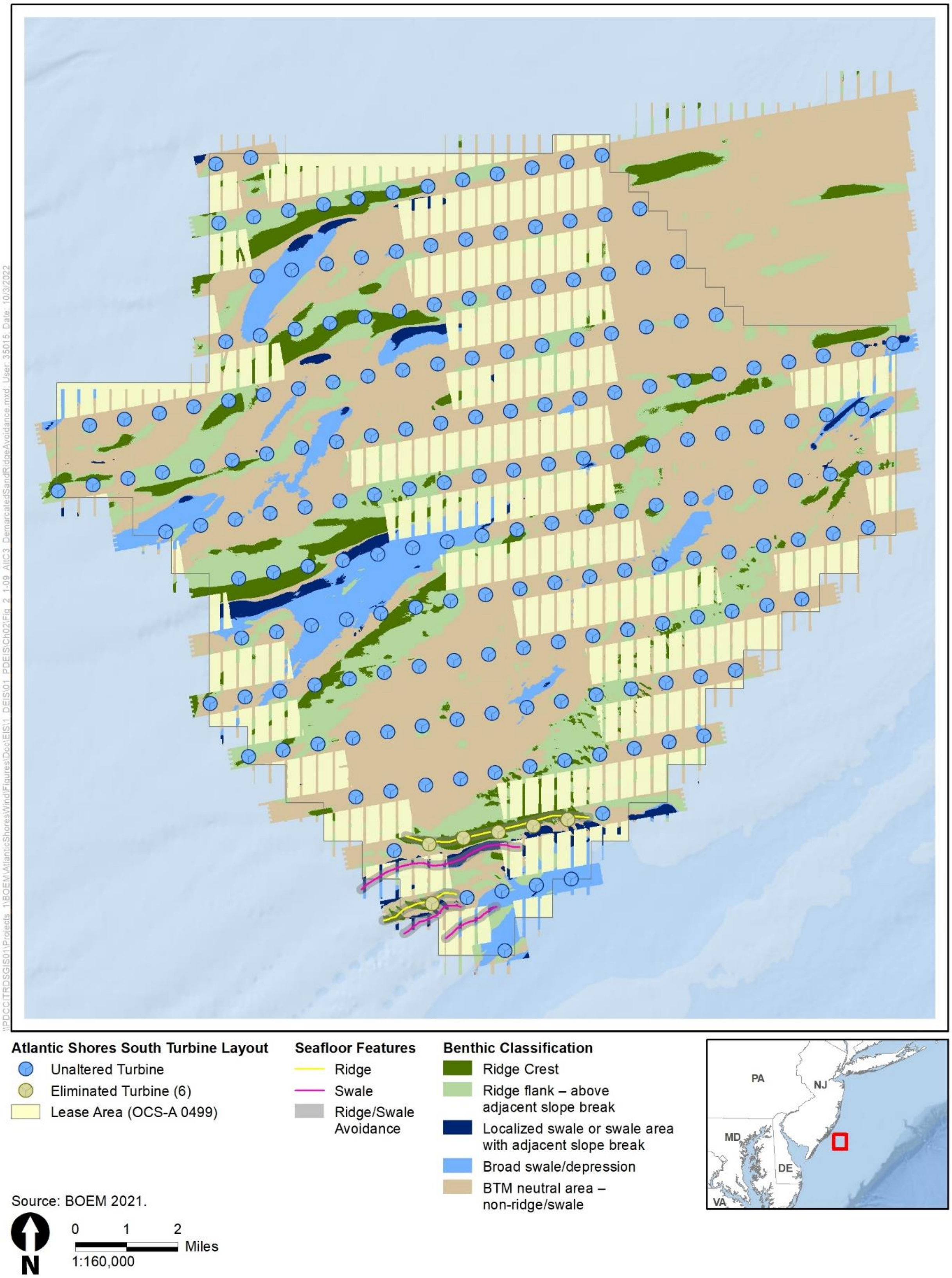


Figure 2.1-10. Alternative C3 – Demarcated Sand Ridge Complex Avoidance

2.1.3.4 Alternative C4 – Micrositing

Alternative C4 was proposed by Atlantic Shores and would involve the micrositing of 29 WTGs, 1 OSS, and associated interarray cables outside of the 1,000-foot (305-meter) buffer of the ridge and swale features within both AOC 1 and AOC 2. Micrositing would be undertaken to reduce impacts on complex habitat but would not materially change the grid layout (e.g., generally within 500 feet [152 meters] of foundation locations) that is necessary to preserve safe navigation conditions and USCG Search and Rescue (SAR) missions.

2.1.4 Alternative D – No Surface Occupancy at Select Locations to Reduce Visual Impacts

Alternative D was developed through the scoping process for the Draft EIS in response to public comments concerning the visual impacts of the Atlantic Shores South Project. Under Alternative D, no surface occupancy would occur within defined distances to shore to reduce the visual impacts of the proposed Project. The remaining range of design parameters for Project components and activities to be undertaken for construction and installation, O&M, and conceptual decommissioning would be the same as described in the Proposed Action. Alternative D includes three sub-alternatives where the number of WTGs and turbine heights would be adjusted to reduce visual impacts. Each of the sub-alternatives may be individually selected or combined with any or all other alternatives, subject to the combination meeting the purpose and need.

2.1.4.1 Alternative D1 – No Surface Occupancy of Up to 12 Miles (19.3 Kilometers) from Shore: Removal of Up to 21 Turbines

Alternative D1 would result in the exclusion of up to 21 WTG positions in Project 1 within 12 miles (19.3 kilometers) from shore (Figure 2.1-11). The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL. The overall exclusion of WTG positions would result in a reduced annual energy production and BOEM is continuing to assess the energy production impact and feasibility of this alternative. The final number of WTG positions considered for exclusion in the Final EIS may be reduced to fewer than 21 to ensure consistency with the 1,510-MW nameplate capacity and annual allowance awarded to Atlantic Shores by BPU, and any additional offtake agreements that are finalized prior to the Final EIS.

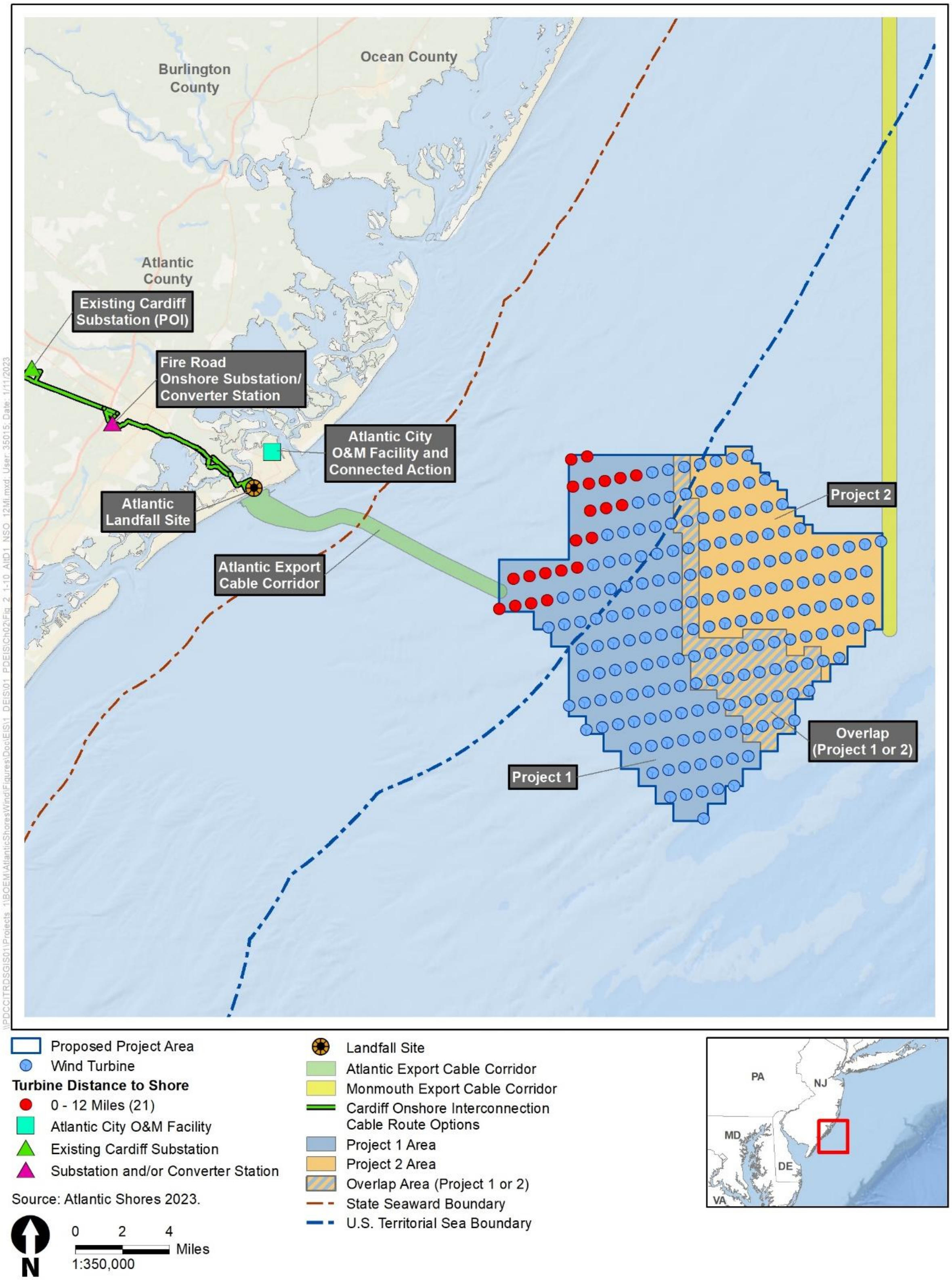


Figure 2.1-11. Alternative D1 – No Surface Occupancy of Up to 12 Miles (19.3 Kilometers) from Shore: Removal of Up to 21 Turbines

2.1.4.2 Alternative D2 – No Surface Occupancy of Up to 12.75 Miles (20.5 Kilometers) from Shore: Removal of Up to 31 Turbines

Alternative D2 would result in the exclusion of up to 31 WTG positions in Project 1 that are sited closest to shore (Figure 2.1-12). The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL. The overall exclusion of WTG positions would result in reduced annual energy production and BOEM is continuing to assess the energy production impact and feasibility of this alternative. The final number of WTG positions considered for exclusion in the Final EIS may be reduced to fewer than 31 to ensure consistency with the 1,510-MW nameplate capacity and annual allowance awarded to Atlantic Shores by BPU, and any additional offtake agreements that are finalized prior to the Final EIS.

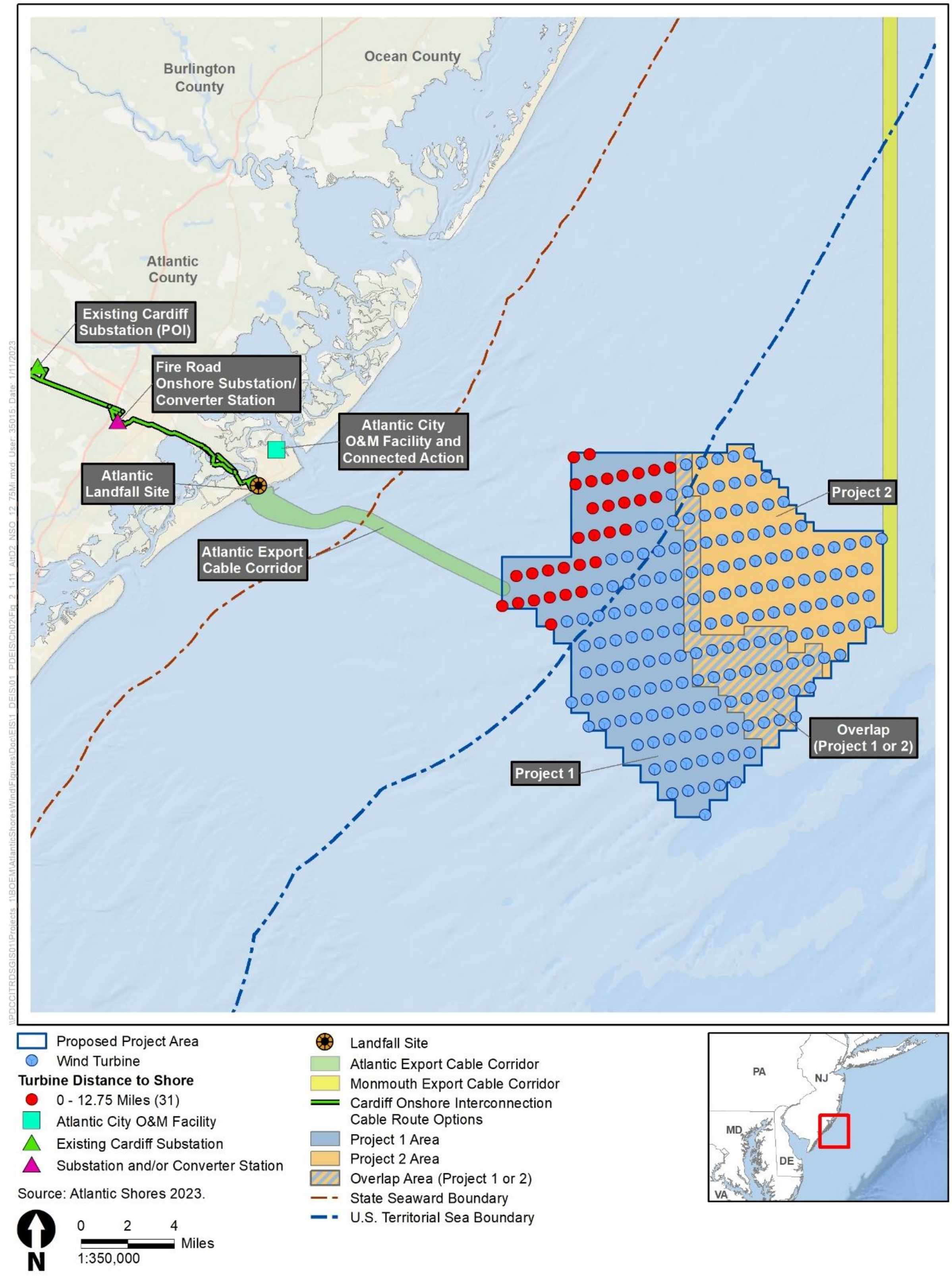


Figure 2.1-12. Alternative D2 – No Surface Occupancy of Up to 12.75 Miles (20.5 Kilometers) from Shore: Removal of Up to 31 Turbines

2.1.4.3 Alternative D3 – No Surface Occupancy of Up to 10.8 Miles (17.4 Kilometers) from Shore: Removal of Up to 6 Turbines

Alternative D3 would result in the exclusion of up to 6 WTG positions in Project 1 that are sited closest to shore (Figure 2.1-13). The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL.

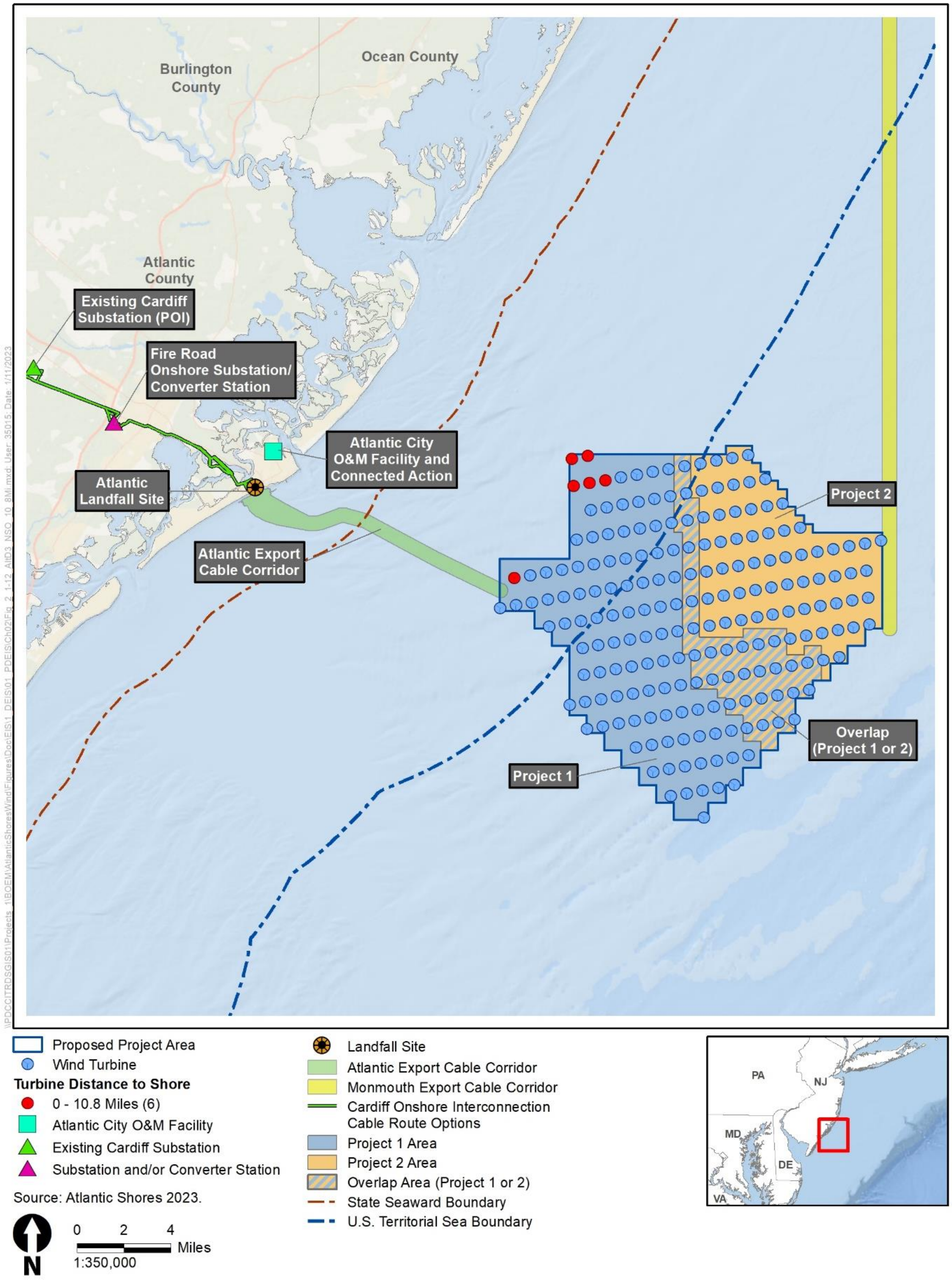


Figure 2.1-13. Alternative D3 – No Surface Occupancy of Up to 10.8 Miles (17.4 Kilometers) from Shore: Removal of Up to 6 Turbines

2.1.5 Alternative E – Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1

Alternative E was developed through the scoping process for the Draft EIS in response to comments received from the Responsible Offshore Development Alliance (RODA) concerning the different layouts between the Atlantic Shores South and Ocean Wind 1 projects and the need for a setback between the adjacent areas. Modifications would be made to the wind turbine array layout to create a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) and the WTGs in the Ocean Wind 1 Lease Area (OCS-A 0498) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation (Figure 2.1-14).

This alternative would result in no surface occupancy along the southern boundary of the Atlantic Shores South Lease Area through the exclusion or micrositing of up to 4 to 5 WTG positions. Ocean Wind 1 is currently proposing a layout[7] with a goal of creating a total buffer distance of 0.81 nautical mile (1,500 meters) between WTGs in both projects; however, Ocean Wind 1 would need to modify its wind turbine layout in order to create a total buffer distance greater than 0.81 nautical mile (1,500 meters). This Draft EIS only analyzes the portion of the setback within the Atlantic Shores South Lease Area. A setback would provide a clear visual distinction between the separate projects and provide for sufficient maneuvering space for both surface and aerial (helicopter) navigation.

The range of design parameters for Project components and activities to be undertaken for construction and installation, O&M, and conceptual decommissioning would be the same as described for the Proposed Action.

[7] Ocean Wind, LLC and Atlantic Shores Offshore Wind, LLC in coordination with USCG, developed a mutually agreeable scenario for the Ocean Wind 1 and Atlantic Shores South Projects, which was documented in a joint letter signed by both developers on July 21, 2022. This scenario is covered in the setback range identified in Alternative E.

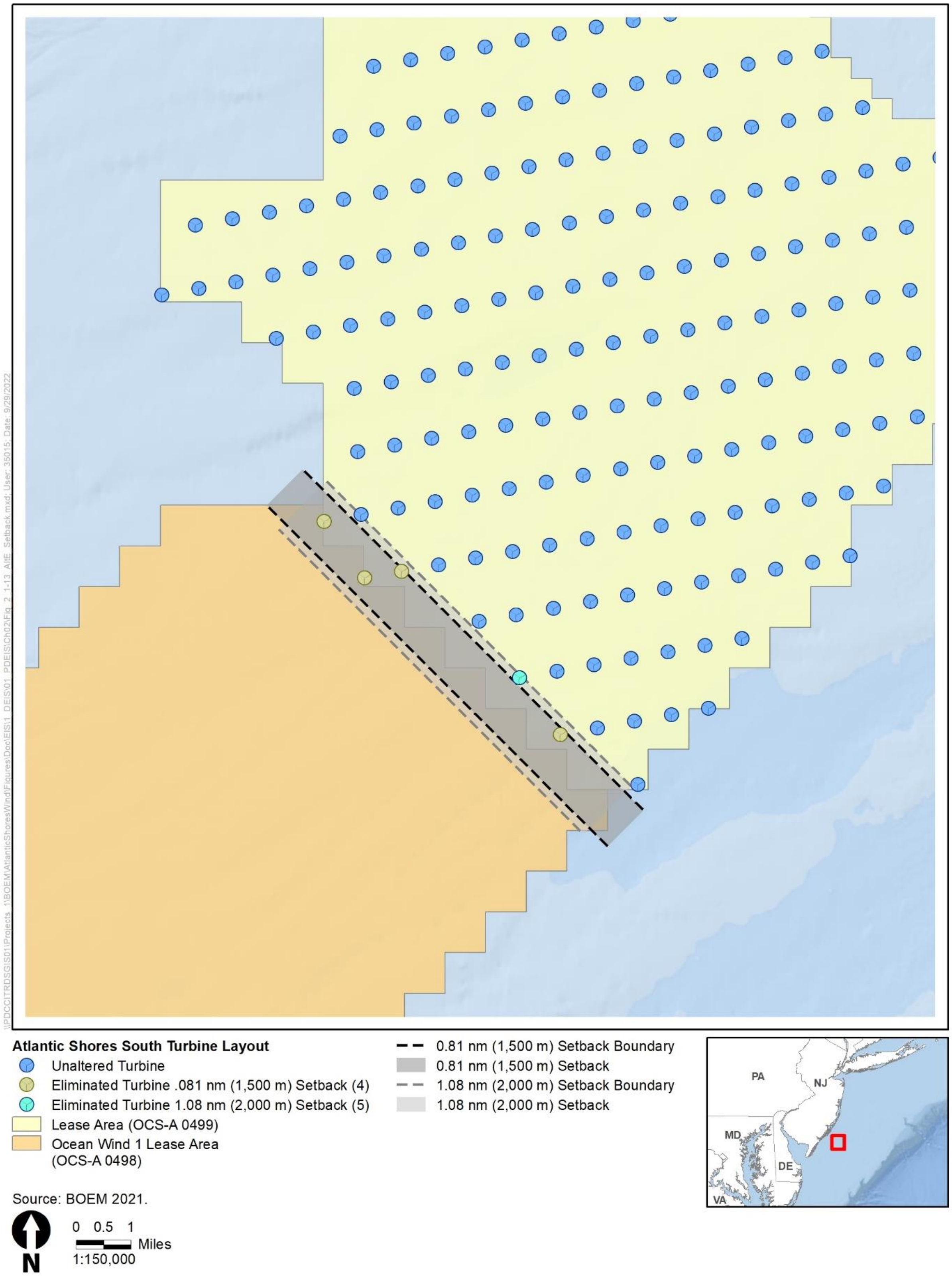


Figure 2.1-14. Alternative E – Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1

2.1.6 Alternative F – Foundation Structures

Alternative F was developed through the scoping process for the Draft EIS in response to comments, as well as options posed in the COP. Alternative F addresses the possibility for one or more foundation types to be utilized for WTGs, OSSs, and the permanent met tower, and includes three sub-alternatives that detail the different foundation structures. Depending on the final OSS design, there would be up to five small OSSs, two medium OSSs, or two large OSSs for Project 1; and up to five small OSSs, three medium OSSs, or two large OSSs for Project 2. The type of OSS foundation used depends on the size of the OSS itself as shown in Table 2-4. For the small OSS, the PDE for each foundation type is identical to the PDE for the WTG foundations. The total foundation footprint, temporary seabed impacts, and combined impacts are all higher for the large OSSs; however, the total temporary seabed disturbance area is slightly higher for the small OSSs. The foundation options for the met tower include all options under consideration for WTG foundations, and the construction methodologies for the met tower are assumed to be the same as those for the WTG foundations. Different foundation types could be used for Project 1 and Project 2 and for different components within each project. The foundation type selected for the WTGs may be different from the foundation type selected for OSSs.

Table 2-4. OSS foundation types

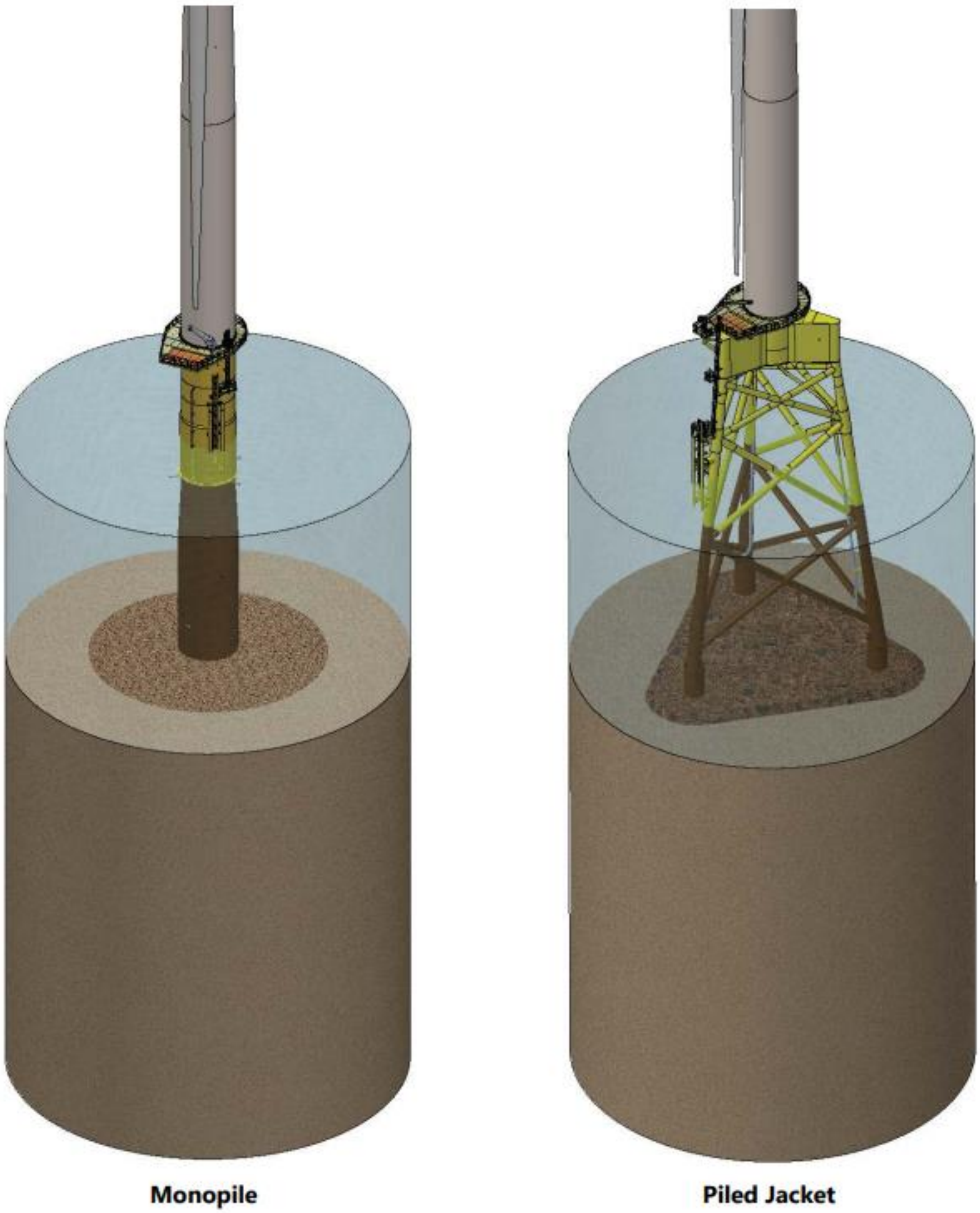
Foundation Types		Small OSS	Medium OSS	Large OSS
Piled	Monopile	•		
	Piled Jacket	•	•	•
Suction Bucket	Mono-Bucket	•		
	Suction Bucket Jacket	•	•	•
Gravity	GBS	•	•	•

Source: COP Volume I, Table 4.4-1, Atlantic Shores 2023.

This Draft EIS analyzes the maximum potential impacts on each environmental resource from each type of foundation: piled, suction bucket, and gravity-based at a project level. A representation of the impacts that could occur given the choice of foundation type per project can be found in Table 2-5. The table looks at the maximum extent of how each foundation type used within Project 1, and separately Project 2, could affect a resource. Once combined, the combined configuration of foundations for Project 1 and Project 2 would not exceed 211 (200 turbines, 10 OSSs, and 1 met tower).

2.1.6.1 Alternative F1 – Piled Foundations

Under Alternative F1, the use of the monopile and piled jacket foundation structures (Figure 2.1-15) for up to 200 WTGs, 1 permanent met tower (Project 1), and either up to 10 small OSSs (monopile or piled jacket), up to 5 medium OSSs (piled jacket), or 4 large OSSs (piled jacket) for Project 1 and Project 2 would be analyzed for the extent of impacts.

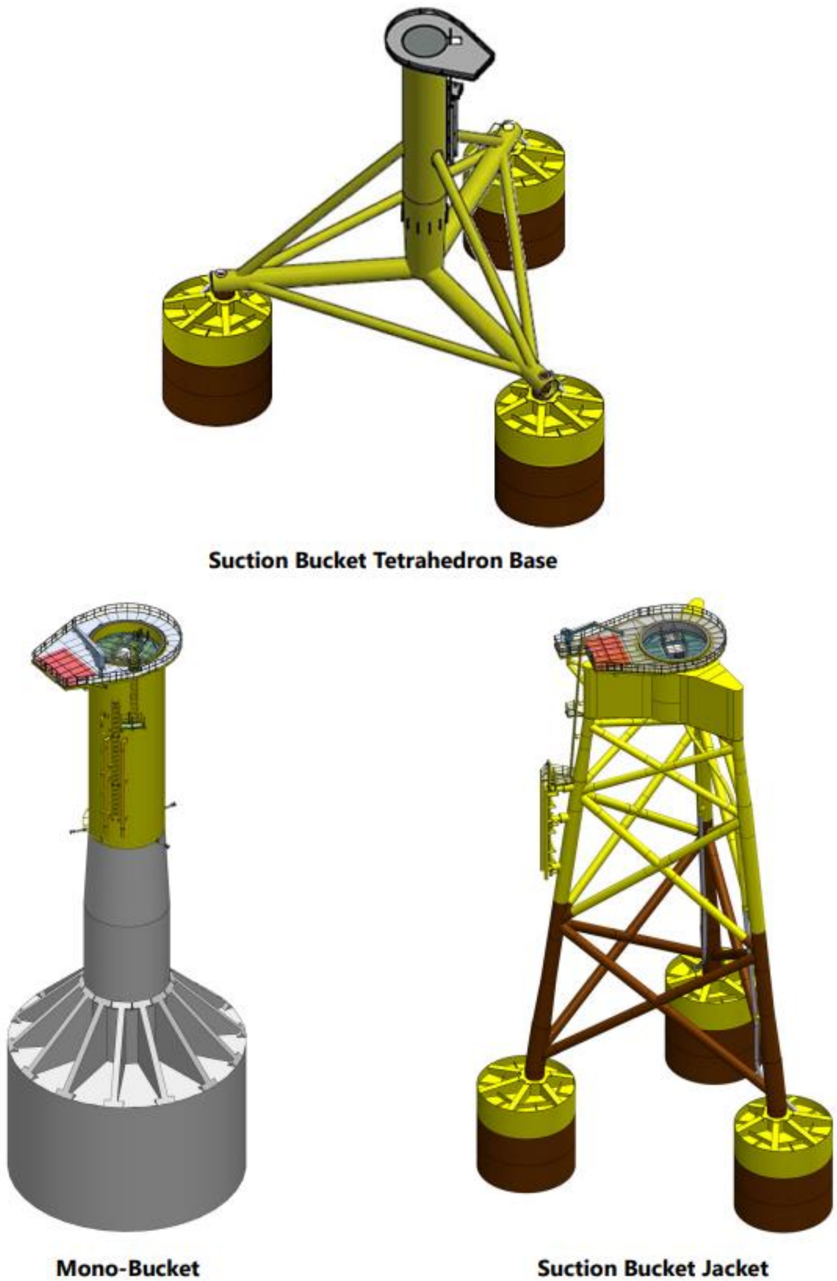


Source: Atlantic Shores 2023.

Figure 2.1-15. Piled foundations

2.1.6.2 Alternative F2 – Suction Bucket Foundations

Under Alternative F2, the use of mono-bucket, suction bucket jacket, and suction bucket tetrahedron base foundations (Figure 2.1-16) for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (mono-bucket or suction bucket jacket), up to 5 medium OSSs (suction bucket jacket), or up to 4 large OSSs (suction bucket jacket), for Project 1 and Project 2 would be analyzed for the extent of impacts.



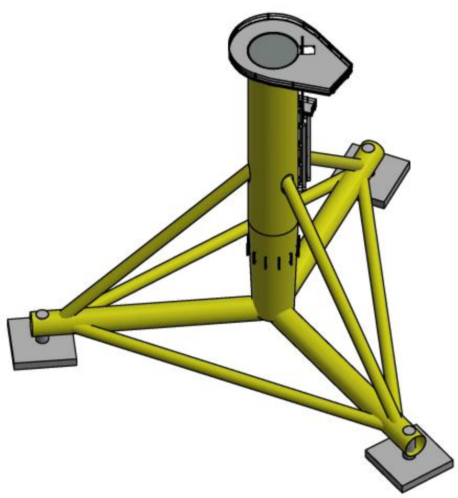
Source: Atlantic Shores 2023.

Figure 2.1-16. Suction bucket foundations

2.1.6.3 Alternative F3 – Gravity-Based Foundations

Under Alternative F3, the use of gravity-pad tetrahedron and GBS foundations (Figure 2.1-17) for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs, up to 5 medium OSSs, or up to 4 large OSSs for Project 1 and Project 2 would be analyzed for the extent of impacts.

Gravity-Base Structures (GBS)



Gravity-Pad Tetrahedron Base

Source: Atlantic Shores 2023.

Figure 2.1-17. Gravity foundations

Table 2-5. Resource effects by foundation type

Resource Affected	Foundation Types: Monopile and Piled Jacket — Project 1 (Maximum 136 Turbines, 1 Permanent Met Tower,[1] and 2 Large OSSs)	Monopile and Piled Jacket — Project 2 (Maximum 95 Turbines and 2 Large OSSs)	Mono-Buckets, Suction Bucket Jackets, and Suction Bucket Tetrahedron — Project 1 (Maximum 136 Turbines and 1 Permanent Met Tower, and 2 Large OSSs)	Mono-Buckets, Suction Bucket Jackets, and Suction Bucket Tetrahedron — Project 2 (Maximum 95 Turbines and 2 Large OSSs)	Gravity-Based Structures and Gravity-Pad Tetrahedron — Project 1 (Maximum 136 Turbines and 1 Permanent Met Tower, and 2 Large OSSs)	Gravity-Based Structures and Gravity-Pad Tetrahedron — Project 2 (Maximum 95 Turbines and 2 Large OSSs)
Habitat Loss: • Species displacement or mortality • Soft-bottom habitat loss	In general, foundations will be positioned or sized to avoid or reduce seabed preparation where possible. This will include the area of habitat conversion due to the number of foundations and scour protection. Maximum area of seabed preparation per WTG foundation[2] is 72,377 square feet. Maximum permanent footprint area per foundation (foundation + scour protection + mud mats [post-piled jackets only]) for the piled jacket, large OSS is 136,954 square feet.	Similar to Project 1 but reduced given the lower number of foundations and area of scour protection. Maximum area of seabed preparation per foundation[2] is 72,377 square feet. Maximum permanent footprint area per foundation (foundation + scour protection + mud mats [post-piled jackets only]) for the piled jacket, large OSS is 136,954 square feet.	Greatest area of habitat conversion due to scour protection. Maximum area of seabed preparation per foundation[2] is 111,988 square feet. Maximum permanent footprint area per foundation for the suction bucket jacket, large OSS is 282,961 square feet.	Greatest area of habitat conversion due to scour protection. Maximum area of seabed preparation per foundation[2] is 111,988 square feet. Maximum permanent footprint area per foundation for the suction bucket jacket, large OSS is 282,961 square feet.	Soft bottoms may be removed during seabed preparation. Maximum area of seabed preparation per foundation is 81,133 square feet. Maximum permanent footprint area per foundation for the GBS, large OSS is 241,111 square feet.	Soft bottoms may be removed during seabed preparation. Maximum area of seabed preparation per foundation is 81,133 square feet. Maximum permanent footprint area per foundation for the GBS, large OSS is 241,111 square feet.
Artificial Reefs and Attraction: • Introduction of organisms that grow on the surfaces of foundations • Increased food source and increased source of prey • Refuge/resting areas for sheltering from currents or predation • Increased predation rates due to higher predator abundance	Increased aggregation of fish near structures; more opportunities around piled jackets than monopiles. The amount of scour protection present may also increase aggregation. Each piled jacket WTG foundation will have a maximum of 4 legs/discrete contact points with the seabed. Each piled jacket large OSS will have a maximum of 8 legs (up to 3 pin piles per leg)/ discrete contact points with the seabed.	Similar to Project 1 but reduced given the lower number of foundations. Each piled jacket WTG foundation will have a maximum of 4 legs/discrete contact points with the seabed. Each piled jacket large OSS will have a maximum of 8 legs (up to 3 pin piles per leg)/discrete contact points with the seabed.	Similar to the piled jacket, the suction bucket tetrahedron base and jacket provide an increased area for aggregation. Each suction bucket jacket WTG foundation will have a maximum of 4 legs/discrete contact points with the seabed. Each suction bucket jacket large OSS will have a maximum of 8 legs/discrete contact points with the seabed.	Similar to Project 1 but reduced given the lower number of foundations. Each suction bucket jacket WTG foundation will have a maximum of 4 legs/discrete contact points with the seabed. Each suction bucket jacket large OSS will have a maximum of 8 legs/discrete contact points with the seabed.	Similar to the piled jacket, the gravity-pad tetrahedron would have an increased opportunity for aggregation. Each gravity-based WTG foundation will have a maximum of 3 legs/discrete contact points. Each large OSS will have a maximum of 2 legs/discrete contact points with the seabed.	Similar to Project 1 but reduced given the lower number of foundations. Each gravity-based WTG foundation will have a maximum of 3 legs/discrete contact points. Each large OSS will have a maximum of 2 legs/discrete contact points with the seabed.
Invasive Species Spread Effects • Introduction of invasive species	Impacts may be widespread and permanent where the species are able to establish populations. Colonization would be limited to the surface area of the foundations and scour protection.	Impacts would be similar to Project 1 but reduced given the lower number of foundations and area of scour protection.	Similar risk to the monopile and piled jacket but with increased surface area associated with the associated foundation legs and area of scour protection.	Impacts would be similar to Project 1 but reduced given the lower number of foundations and area of scour protection.	Larger risk given the increased surface area of the foundations and sour protection.	Impacts would be similar to Project 1 but reduced given the lower number of foundations and area of scour protection.
Wake and Scour: • Increased concentration or availability of prey in wakes • Altered conditions can affect recruitment of larvae of benthic species, suspended sediment concentration, availability of food, oxygen, and waste removal	Maximum total permanent footprint per foundation (foundation + scour protection + mud mats [post-piled jackets only]) is 56,844 square feet. The additional volume of scour protection for each large OSS is estimated to be about 666,999 cubic feet	Maximum total permanent footprint per foundation (foundation + scour protection + mud mats [post-piled jackets only]) is 56,844 square feet. The additional volume of scour protection for each large OSS is estimated to be about 666,999 cubic feet	Maximum total permanent footprint per foundation (foundation + scour protection + mud mats [post-piled jackets only]) is 111,988 square feet. The additional volume of scour protection for each large OSS is estimated to be about 1,485,370 cubic feet	Maximum total permanent footprint per foundation (foundation + scour protection + mud mats [post-piled jackets only]) is 111,988 square feet. The additional volume of scour protection for each large OSS is estimated to be about 1,485,370 cubic feet	Maximum total permanent footprint per foundation (foundation + scour protection + mud mats [post-piled jackets only]) is 58,239 square feet. The additional volume of scour protection for each large OSS is estimated to be about 1,186,572 cubic feet	Maximum total permanent footprint per foundation (foundation + scour protection + mud mats [post-piled jackets only]) is 58,239 square feet. The additional volume of scour protection for each large OSS is estimated to be about 1,186,572 cubic feet

Resource Affected	Foundation Types					
	Monopile and Piled Jacket		Mono-Buckets, Suction Bucket Jackets, and Suction Bucket Tetrahedron		Gravity-Based Structures and Gravity-Pad Tetrahedron	
	Project 1 (Maximum 136 Turbines, 1 Permanent Met Tower,[1] and 2 Large OSSs)	**Project 2 (Maximum 95 Turbines and 2 Large OSSs)**	**Project 1 (Maximum 136 Turbines and 1 Permanent Met Tower, and 2 Large OSSs)**	**Project 2 (Maximum 95 Turbines and 2 Large OSSs)**	**Project 1 (Maximum 136 Turbines and 1 Permanent Met Tower, and 2 Large OSSs)**	**Project 2 (Maximum 95 Turbines and 2 Large OSSs)**
Release of Suspended Sediment and Sediment Deposition: • Decreased water quality due to increased suspended sediment • Smothering of species and habitats by deposited sediment • Avoidance of area by species due to increase sediments • Changes in organic matter content in sediments associated with sediment particle size • Exposure to toxic contaminants within sediment	Not expected to require seabed preparation unless the seabed is not sufficiently level. Maximum area of seabed preparation per WTG and met tower foundation is 72,377 square feet.	Not expected to require seabed preparation unless the seabed is not sufficiently level. Maximum area of seabed preparation per WTG foundation is 72,377 square feet.	The majority of suction bucket foundations are not expected to require seabed preparation unless the seabed it is not sufficiently level. Maximum area of seabed preparation per WTG and met tower foundation is 111,988 square feet.	The majority of suction bucket foundations are not expected to require seabed preparation unless the seabed it is not sufficiently level. Maximum area of seabed preparation per WTG foundation is 111,988 square feet.	3–4 days to prepare the seabed through sediment removal. Maximum area of seabed preparation per WTG and met tower foundation is 81,133 square feet.	3–4 days to prepare the seabed through sediment removal. Maximum area of seabed preparation per WTG foundation is 81,133 square feet.
Avoidance Effects: • Displacement of species from the WTA • Disruption of migration routes	During installation, there may be temporary displacement of species in the area. There is an estimated total of 201 piling days for WTGS. See *Acoustic* for installation timeframes.	Similar to Project 1 but with a lower number of required piles.	Similar to the monopile and piled jacket, but the temporary displacement may be more related to the scour protection installation.	Similar to Project 1 but with a lower number of required foundations and scour protection.	Similar to the monopile and piled jacket, but the temporary displacement may be more related to the scour protection installation.	Similar to Project 1 but with a lower number of required foundations and scour protection.
Acoustic: • Mortality or physical injury from noise • Behavioral alterations like startling, fleeing, or hiding • Masking of biologically significant sounds	During the installation, activities that create noise and vibrations may harm or displace marine animals, birds, benthic invertebrates, and finfish. Impact pile driving will last from approximately 3–4 hours per day (piled jacket) to 7–9 hours a day (monopile) with a maximum of two (monopile) to four (piled jacket) installed in a day given the number of piles. The estimated maximum duration to drive one pile for the OSSs is 3–4 hours per day with a maximum of 4 piles driven per day. Other potential anthropogenic sound sources were not quantitatively modeled as they are expected to be much less than impulsive pile driving.	Similar to Project 1 but with a lower number of required piles.	Suction bucket foundation installation is nearly noise free, and the non-impulsive pile installation method is expected to result in low peak pressure noise unlikely to induce injury in fish or pelagic invertebrates. The foundation has the potential to be completely removed upon decommissioning.	Suction bucket foundation installation is nearly noise free, and the non-impulsive pile installation method is expected to result in low peak pressure noise unlikely to induce injury in fish or pelagic invertebrates. The foundation has the potential to be completely removed upon decommissioning.	Other sounds related to the construction, O&M, and decommissioning of the Project are expected to be much less than impulsive pile driving.	Other sounds related to the construction, O&M, and decommissioning of the Project are expected to be much less than impulsive pile driving.

[1] The foundation options for the met tower include all options under consideration for WTG foundations, and the construction methodologies are assumed to be the same as those for WTG foundations.
[2] In a limited number of foundation positions, up to 19.7 feet (6 meters) of seabed leveling could be required. Piled and suction bucket foundations are not expected to require seabed preparation unless the seabed is not sufficiently level.

2.2 Alternatives Considered but Not Analyzed in Detail

Under NEPA, a reasonable range of alternatives framed by the purpose and need must be developed for analysis for any major federal action. The alternatives should be "reasonable," which DOI has defined as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action."[8] There should also be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or environmental effects of the project.[9] Therefore, alternatives that could not be implemented if they were chosen (for legal, economic, or technical reasons), or do not resolve the need for action and fulfill the stated purpose in taking action to a large degree, are not considered reasonable.

BOEM considered alternatives to the Proposed Action that were identified through coordination with cooperating and participating agencies and through public comments received during the public scoping period for the EIS. BOEM then evaluated the alternatives identified, and dismissed from further consideration the alternatives that did not meet BOEM's screening criteria.[10] Consistent with the screening criteria, an alternative was considered but not analyzed in detail if it met any of the following criteria:

- It does not respond to BOEM's purpose and need.
- It results in activities that are prohibited under the lease (e.g., requires locating part, or all, of the wind energy facility outside of the lease area, or constructing and operating a facility for another form of energy).
- It is inconsistent with the federal and state policy goals below:
    - The United States' policy under the OCSLA to make OCS energy resources available for expeditious and orderly development, subject to environmental safeguards.
    - EO 14008, Tackling the Climate Crisis at Home and Abroad, issued on January 27, 2021.
    - The shared goal of the Departments of Interior, Energy and Commerce to deploy 30 GW of offshore wind in the United States by 2030, while protecting biodiversity and promoting ocean co-use.
    - The goals of affected states, including state laws that establish renewable energy goals and mandates, where applicable.

---

[8] 43 CFR 46.420(b)
[9] 43 CFR 46.415(b)
[10] See BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act (NEPA)* published June 22, 2022, and available at: https://www.boem.gov/sites/default/files/documents/renewable-energy/BOEM%20COP%20EIS%20Alternatives-2022-06-22.pdf.

- It is inconsistent with existing law, regulation, or policy; a state or federal agency would be prohibited from permitting activities required by the alternative.
- It does not meet the primary goals of the applicant.[11]
    - It proposes relocating a majority of the project outside of the area proposed by the applicant.
    - It results in the development of a project that would not allow the developer to satisfy contractual offtake obligations.
- There is no scientific evidence that the alternative would avoid or substantially lessen one or more significant socioeconomic or environmental effects of the project.
- It is technically infeasible or impractical, meaning implementation of the alternative is unlikely given past and current practice, technology, or site conditions as determined by BOEM's technical experts.
- It is economically infeasible or impractical, meaning implementation of the alternative is unlikely due to unreasonable costs as determined by BOEM's technical and economic experts.
- It is environmentally infeasible, meaning implementation of the alternative would not be allowed by another agency from which a permit or approval is required, or implementation results in an obvious and substantial increase in impacts on the human environment that outweighs potential benefits.
- The implementation of the alternative is remote or speculative; or it is too conceptual in that it lacks sufficient detail to meaningfully analyze impacts; or there is insufficient available information to determine whether the alternative is technically feasible.
- It has a substantially similar design to another alternative that is being analyzed in detail.
- It would have a substantially similar effect as an alternative that is analyzed in detail.

Table 2-6 presents the alternatives considered but not analyzed in detail with a brief discussion of the reasons for their elimination in accordance with CEQ regulations at 40 CFR 1502.14(a), DOI regulations at 43 CFR 46.420(b)-(c).

[11] For a project without an existing offtake agreement, such as Project 2 within the Atlantic Shores South Project, BOEM should determine whether the project is currently being reviewed as part of a competitive offtake award, or whether it plans to compete for an award during the EIS development, and identify the minimum nameplate capacity required to remain eligible for these awards. This minimum nameplate capacity may be used as an applicant's primary goal. Atlantic Shores has established a target size of 1,327 MW for Project 2, which aligns with the interconnection service agreements and interconnection construction service agreements Atlantic Shores intends to execute with PJM.

Table 2-6. Alternatives considered but not analyzed in detail

Alternative Dismissed	Justification for Dismissal
Wind Farm Location and Generating Capacity	
Project Relocation to the Hudson South Lease Area or farther offshore	Commenters suggested BOEM relocate the Project or turbines. This would be covered under the No Action Alternative. Atlantic Shores has been granted the right to submit a COP for a project located within the geographic area identified as Lease Area OCS-A 0499. Evaluating an alternate location for the wind energy facility outside of the Lease Area would constitute a new Proposed Action and would not meet BOEM's purpose and need to respond to Atlantic Shore's proposal and determine whether to approve, approve with modifications, or disapprove the COP to construct, operate and maintain, and decommission a commercial-scale offshore wind energy facility within the Lease Area. BOEM's regulations require BOEM to analyze Atlantic Shore's proposal to build commercial-scale wind energy facilities in the Lease Area. BOEM would consider proposals on other existing leases through a separate regulatory process. This alternative would effectively be the same as selecting the No Action Alternative.
Wind Turbine Array Layout and Spacing	
Realistic Minimum Design scenario required to meet the purpose and need of the Project while minimizing negative impacts on the environment	A commenter requested that BOEM analyze alternative projects of differing sizes and designs. This alternative would not address a specific environmental or socioeconomic concern and it would likely have substantially similar effects when analyzed in detail as other action alternatives (e.g., habitat and visual minimization). It is also too conceptual and speculative in that it lacks sufficient detail to enable BOEM to meaningfully analyze impacts.
Restrict WTG Locations within the Southern Portion of the Lease Area within the range of 17.3 to 19.3 miles (27.8 and 31.1 kilometers) from shore	In order to mitigate visual impacts and reduce noise in the North Atlantic right whale migration corridor, commenters suggested that BOEM restrict siting of the WTGs to between 17.3 and 19.3 miles (27.8 and 31.1 kilometers) from the shoreline. This alternative, restricting turbines between 17.3 and 19.3 miles (27.8 and 31.1 kilometers) from shore, would retain 31 turbines (Figure 2.2-1). This would lead to an 85% reduction in turbines. This alternative was not carried forward for detailed analysis because it would negate Atlantic Shore's ability to fulfill the terms of BPU Order (Docket Nos. QO20080555 and QO21050824) for 1,510 MW and would not meet the purpose and need.
Restrict WTG Locations within the Southern Portion of the Lease Area to beyond 17.3 miles (27.8 kilometers) from shore	To mitigate visual impacts, commentors suggested that BOEM prohibit placing the WTGs within 17.3 miles (27.8 kilometers) from shore. This alternative, restricting turbines to be located more than 17.3 miles (27.8 kilometers) from the shoreline, would retain 98 turbines (Figure 2.2-2). This would lead to a 51% reduction in turbines. This alternative was not carried forward for detailed analysis because it would negate Atlantic Shore's ability to fulfill the terms of BPU Order (Docket Nos. QO20080555 and QO21050824) for 1,510 MW and would not meet the purpose and need.
Minimum WTG Spacing Using a 2-Nautical-Mile (3,704-Meter) by 2-Nautical-Mile (3,704-Meter) Wind Turbine Layout to provide safe access for fishing vessels	Commenters suggested that BOEM analyze an alternative WTG layout with 2-nautical-mile (3,704-meter) spacing between WTGs. As illustrated on Figure 2.2-3, 2-nautical-mile (3,704-meter) spacing would provide for 38 WTG positions. This would lead to an 81% reduction in turbines. This alternative was not carried forward for detailed analysis because it would negate Atlantic Shore's ability to fulfill the terms of BPU Order (Docket Nos. QO20080555 and QO21050824) for 1,510 MW and would not meet the purpose and need.

Alternative Dismissed	Justification for Dismissal
Consistent Wind Turbine Spacing and Layout with Ocean Wind 1 and Adjacent Projects to provide consistent straight-line routes for mariners	One commenter requested that BOEM consider an alternative that would create a uniform turbine spacing and layout across the adjacent Atlantic Shores South and Ocean Wind 1 projects to help facilitate navigation safety, consistent and continuous marking and lighting, search and rescue, and, where necessary, other uses such as commercial fishing. However, the turbine layouts and spacing within the Atlantic Shores South and Ocean Wind 1 Lease Areas were designed to accommodate the predominant vessel traffic patterns unique to each Lease Area. Vessel traffic patterns differ for each Lease Area, and a uniform grid spacing across the adjacent projects would not maintain the predominant vessel traffic patterns established by users within each Lease Area. Atlantic Shores evaluated layout orientations that minimized impacts on existing maritime uses and evaluated the technical consideration of the wind resource and power production in determining the proposed layout. To achieve the objectives of providing a distinct visual separation and facilitating safe navigation across the two adjacent projects, while also maintaining the layout of the Proposed Action, which accommodates predominant vessel traffic patterns, BOEM, in consultation with USCG, developed Alternative E (Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1), which analyzes a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Atlantic Shores South and the WTGS in the Ocean Wind 1 Lease Areas. Alternative E addresses the need for a setback in the absence of uniform grid spacing, while maintaining a layout that accommodates the predominant vessel traffic patterns in the Lease Area. This alternative would have a substantially similar design and effect as Alternative E and would be less responsive to local traffic patterns and USCG input than Alternative E, while also requiring a disruptive and inefficient redesign of the proposed Project layout; therefore, uniform grid spacing was eliminated from detailed consideration.
2.2-Nautical-Mile (4,074-Meter) to 4-Nautical-Mile (7,408-Meter) Separation between the Atlantic Shores South and Ocean Wind 1 Projects	One commenter recommended that a 2.2-nautical-mile (4,074-meter) to 4-nautical-mile (7,408-meter) transit corridor be established between the Atlantic Shores South and Ocean Wind 1 projects to preserve traditional transit paths through the Lease Areas to access fishing grounds. BOEM evaluated separation distances between the Atlantic Shores South and Ocean Wind 1 projects. As the length traveled along the boundary between the Atlantic Shores South and Ocean Wind 1 projects would be approximately 7 nautical miles (12,964 meters) and there would be additional paths along the predominant inshore-offshore routes through the array to allow for traffic dispersal, BOEM, through coordination with USCG, determined that a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) separation between the WTGs in the Atlantic Shores South and the WTGs in the Ocean Wind 1 projects, as analyzed in Alternative E, was adequate to accommodate inshore-offshore vessel traffic, as well as changes in path or orientation as vessels transit between the two adjacent projects. According to USCG, 0.8 nautical mile (1,500 meters) to 1.08 nautical miles (2,000 meters) is also an acceptable distance for its sea and air assets to adjust their path as they move between the two adjacent projects. Alternative E analyzes a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Atlantic Shores South and Ocean Wind 1 Lease Areas with the intent that both Atlantic Shores South

Alternative Dismissed	Justification for Dismissal
	and Ocean Wind 1 would implement wind turbine layout modifications to result in a combined separation distance of 0.81 nautical mile (1,500 meters) to 1.08 nautical miles (2,000 meters). Alternative E addresses the aim to reduce impacts on navigation and access to commercial and recreational fishing grounds. In addition, as illustrated in Figures 2.2-4 and 2.2-5, this alternative would result in a 6 to 14% reduction of turbines within the Atlantic Shores South Lease Area. Alternative E analyzes a buffer while maintaining a layout orientation that accommodates the predominant vessel traffic patterns in the Atlantic Shores South Lease Area. Therefore, this alternative was not carried forward for detailed analysis.
Artificial Reef Avoidance Buffers for WTG Installation	Comments received from MAFMC and NEFMC recommended that the Project be sited to avoid the Atlantic City Reef. No WTGs would be placed within 410 feet (125 meters) of the Atlantic City Reef. This alternative would lead to the removal or relocation of 1 WTG (Figure 2.2-6). BOEM determined that this alternative would be more suitable to address as a Project mitigation measure. Refer to Appendix G for BOEM's recommended measures to avoid or minimize impacts on artificial reefs through WTG installation.
Artificial Reef Avoidance Buffers for Cable Installation	Comments received from MAFMC and NEFMC recommended that the project be sited to avoid the Atlantic City Reef. A 246-foot (75-meter) buffer would be established for cable installation around artificial reef sites to reduce potential impacts on the artificial reefs from turbidity and sedimentation (Figure 2.2-7). The export cable to the Monmouth Landing site would not be placed within 246 feet (75 meters) of the Manasquan Inlet or the Axel Carlson artificial reefs. A 246-foot (75-meter) buffer would allow a total of approximately 1,640 feet (500 meters) for Atlantic Shores to install up to five export cables as part of the proposed Monmouth ECC. However, 1,640 feet (500 meters) does not provide adequate cable spacing (328–656 feet [100–200 meters] between each cable) to account for cable repairs or localized cable routing that may be required. A 246-foot (75-meter) buffer could prevent the use of the Monmouth ECC and thereby make the interconnection of Project 1 or Project 2 to the Larrabee Substation infeasible, which in turn, would make the Project technically infeasible. The Project's proposed ECCs are sited to avoid significant marine constraints and protected resources, including the boundaries of the artificial reefs. In addition, the proposed ECCs are sited to ensure cable constructability and reliability, as well as minimize impacts on marine users. See *Export Cable Corridors that Minimize Navigational Conflicts* rationale below for additional justification.
Wind Turbine Technology	
Vertical Turbine Design in which the towers revolve without moving blades	A commenter recommended that BOEM explore the use of the vertical turbine design for the planned WTGs. As this technology is unproven and has not been fully researched or used in a commercial project, it is not technically feasible to analyze as an alternative.
Project Alteration	
Approve Only Project 1 or Only Project 2, But Not Both Projects	BOEM considered an alternative under which BOEM would approve only Project 1 or Project 2, but would not approve both projects. Atlantic Shore's proposal for two projects relies on economies of scale, coordinated contractual agreements for construction, and a continuous construction schedule (subject to seasonal restrictions, where applicable) across both

Alternative Dismissed	Justification for Dismissal
	projects to achieve efficiencies in mobilization and de-mobilization. In addition, the $314 million upgrades to the PJM grid that Atlantic Shores plans to commit to under an interconnection service agreement and related contracts for both projects would bind Atlantic Shores to pay for upgrades that would accommodate more than either project alone, at two separate POIs. If either Project 1 or Project 2 was not approved, Atlantic Shores would forgo its investments in one of the POIs. Also, New Jersey has announced an OREC solicitation schedule with a minimum award of 1,200 MW, for which Atlantic Shores intends to compete. Finally, this alternative would not meet BOEM's purpose and need "to determine whether to approve, approve with modifications, or disapprove Atlantic Shore's COP to construct and install, operate and maintain, and decommission two commercial-scale offshore wind energy projects within the Lease Area."
Offshore Export Cables	
Shared Cable Corridor routing that uses common corridors with adjacent projects such as the Atlantic Shores South and Ocean Wind 1 projects	Commenters recommended that BOEM consider ECC routing alternatives that would have adjacent projects (i.e., Atlantic Shores South and Ocean Wind 1) use a shared cable corridor. BOEM cannot dictate that a lessee use a shared cable corridor. 30 CFR 585.200(b) states that, "A lease issued under this part confers on the lessee the rights to one or more project easements without further competition for the purpose of installing, gathering, transmission, and distribution cables; pipelines; and appurtenances on the OCS as necessary for the full enjoyment of the lease." BOEM cannot limit a lessee's right to a project easement when a shared cable corridor does not exist and there is no way of determining if the use of a future shared cable corridor would be a technically and economically practical and feasible alternative for the project. Therefore, BOEM cannot require Atlantic Shores to use a future shared cable corridor for this Project. Furthermore, the Atlantic Shores South Project's export cables would connect to the power grid via different onshore substations than Ocean Wind 1. Developing a shared ECC would not be technically or economically practicable because the Atlantic Shores South and Ocean Wind 1 projects have distinct interconnection points to the electric power grid. At this time this alternative is not technically or economically feasible as the POIs associated with the cable corridors would be unable to accept the total MW capacity produced by both Atlantic Shores South and Ocean Wind 1, and the delays and costs of switching or gaining approval to upgrade the necessary POIs for a shared cable corridor would not allow Atlantic Shores to meet deadlines in its agreement with BPU. See the following *Single Cable Corridor* rationale for additional justification. There are currently potential transmission proposals under review by BPU to support the plan for 11 GW of offshore wind by 2040, which may be able to help further address this comment in the future.
Single Cable Corridor routing that uses a single ECC for Project 1 and Project 2	Comments received from the Garden State Seafood Association expressed concern about the multiple export cable routes and recommended that BOEM consider the use of a single cable corridor for Project 1 and Project 2 with the shortest route to shore. Due to electrical capacity constraints at the target POIs, Atlantic Shores determined that two POIs are needed to accommodate the expected amount of electricity that could be generated by Project 1 and Project 2 (estimated to be at least 2.8 GW). Project 1's nameplate capacity is 1,510 MW and is associated with the existing Cardiff POI. The existing Cardiff

Alternative Dismissed	Justification for Dismissal
	POI ROW does not have the physical capacity to fit the cables for both projects, thus additional cable landing location(s) and ROWs would be necessary if both projects were combined into the Cardiff POI. This, in turn, would lead to added expense and delays for Project 2, the nameplate capacity of which is not yet determined, but for which Atlantic Shores has a goal of 1,327 MW. In addition, upgrading the existing Cardiff POI would require additional interconnection studies and modifications to the onshore engineering design, which would lead to an additional 5–10-year delay and would not enable Atlantic Shores to meet its Project 1 delivery schedule, as defined by BPU Order (Docket Nos. QO20080555 and QO21050824). Thus, it would be economically infeasible to adjust the current plans to accommodate the use of a single ECC. The delays would jeopardize the viability of the Atlantic Shores South Project, ultimately causing the Project to not meet the purpose and need.
Export Cable Corridors that Minimize Navigational Conflicts	A comment received from the New York State Department of State requested that the area occupied by the ECCs be minimized within the existing vessel traffic routes. BOEM was not able to identify an alternate technically feasible route due to multiple conflicts near the POI, inclusive of fiber optic cables, ocean disposal sites, federal and state sand resource areas, and sand borrow areas, and the lack of available data that would demonstrate feasibility for cable installation and burial. Thus, an alternate technically feasible route is speculative. The Project's proposed ECCs are sited to avoid significant marine constraints and protected resources, ensure cable constructability and reliability, and minimize impacts on marine users. In addition, reduction of the risk of the potential for a vessel to snag a cable with its anchor and incur liability and other navigational conflicts could be addressed by defining the cable easement(s) within the ECCs, which typically occurs with COP approval; as well as during the final review of the Cable Burial Risk Assessment that occurs during the Final Design Report and Fabrication and Installation Report review. As a result, an alternate technically feasible route, if it exists, is unlikely to confer a substantial environmental or socioeconomic advantage over the routes included as part of the Proposed Action. Proposing a new ECC on unsurveyed areas would require additional data to be collected and a detailed analysis to be undertaken to determine the economic and environmental feasibility of the proposed cable route. This would result in a delay of a year or more, rendering the Project economically infeasible. Therefore, this alternative was not carried forward for detailed analysis.

Alternative Dismissed	Justification for Dismissal
Onshore Infrastructure	
Onshore infrastructure that Minimizes Land Use Conflicts	BOEM was not able to identify alternate technically feasible landfall locations, POIs, or onshore interconnection cable routes due to multiple physical and capacity constraints (COP Volume I, Appendix I-G; Atlantic Shores 2023). The Project's proposed landfall sites were selected based on location (within the maximum distance for HDD to reach beyond the top-of-slope of the beach), size (the amount of space needed to transition between offshore and onshore cables), and existing infrastructure and land use (i.e., undeveloped or limited to surface development [such as parking lots]). The Project's proposed POIs were selected based on location and capacity. The Project's proposed onshore interconnection cable route options were sited to avoid submerged aquatic vegetation, unsuitable terrain, existing utility corridors, and high population densities. In addition, the route options were sited to limit disturbance to existing land uses, minimize the number of hard route angles, and minimize the overall route length. As a result, alternate technically feasible landfall locations, POIs, and onshore cable routes, if they exist, are unlikely to confer a substantial environmental or socioeconomic advantage over the onshore infrastructure sites included as part of the Proposed Action. Furthermore, as explained in the *Single Cable Corridor* rationale in this table, additional interconnection studies and modifications to the onshore engineering design would lead to an additional multi-year delay, rendering the Project economically infeasible. Therefore, this alternative was not carried forward for detailed analysis.

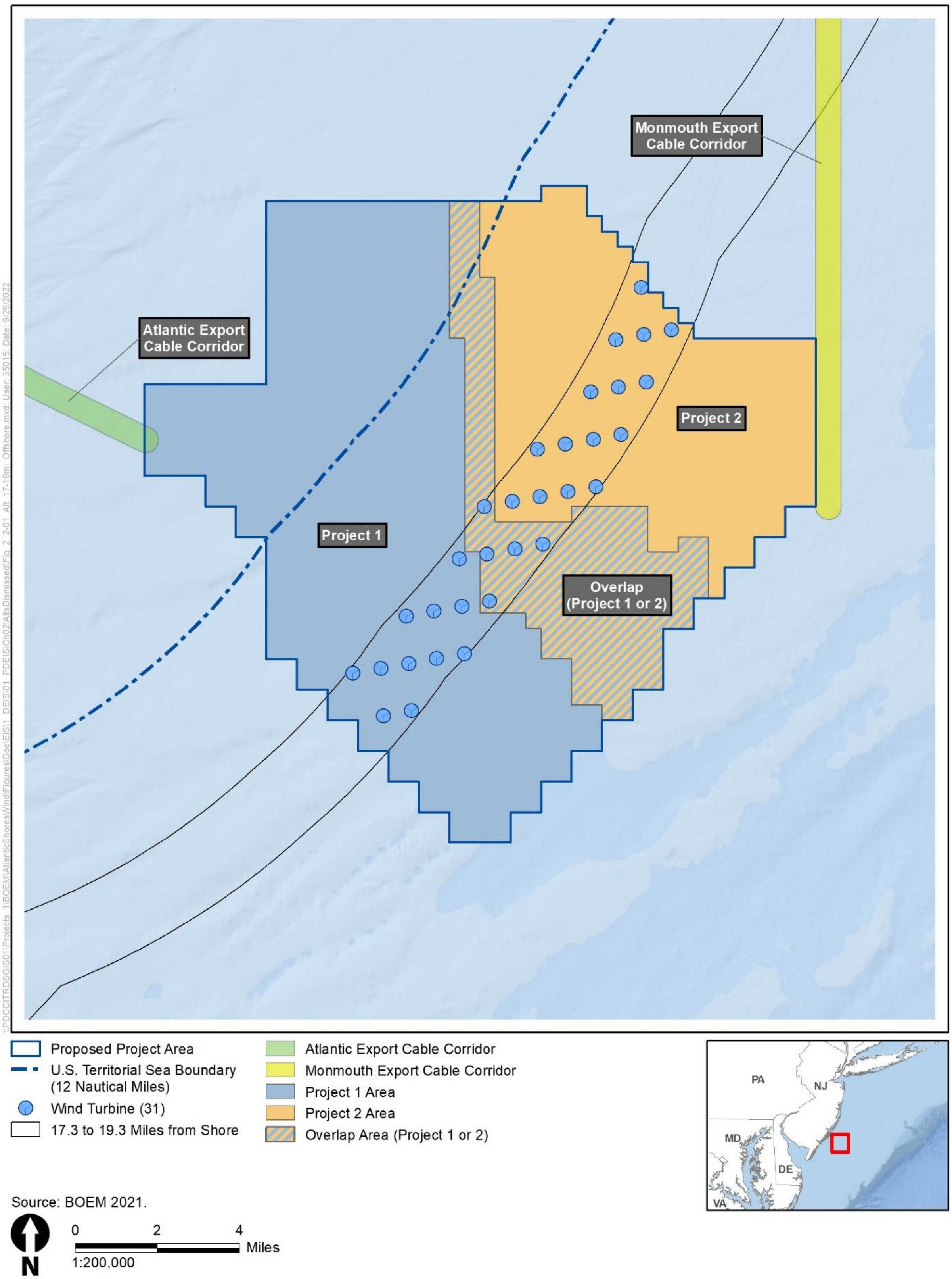


Figure 2.2-1. Restrict WTG locations within the southern portion of the Lease Area within the range of 17.3 to 19.3 miles (27.8 to 31.1 kilometers) from shore

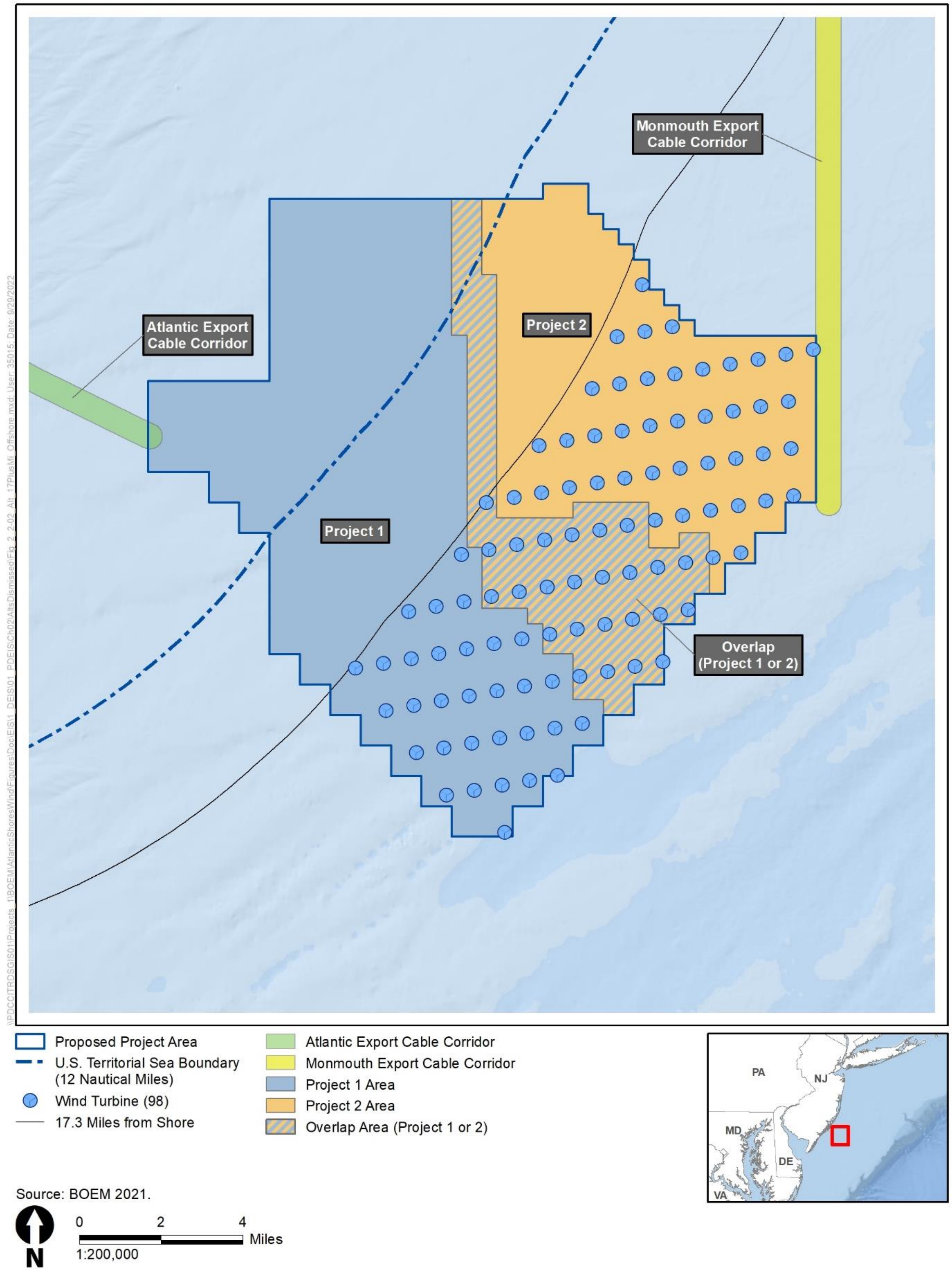


Figure 2.2-2. Restrict WTG locations within the southern portion of the Lease Area to beyond 17.3 miles (27.8 kilometers) from shore

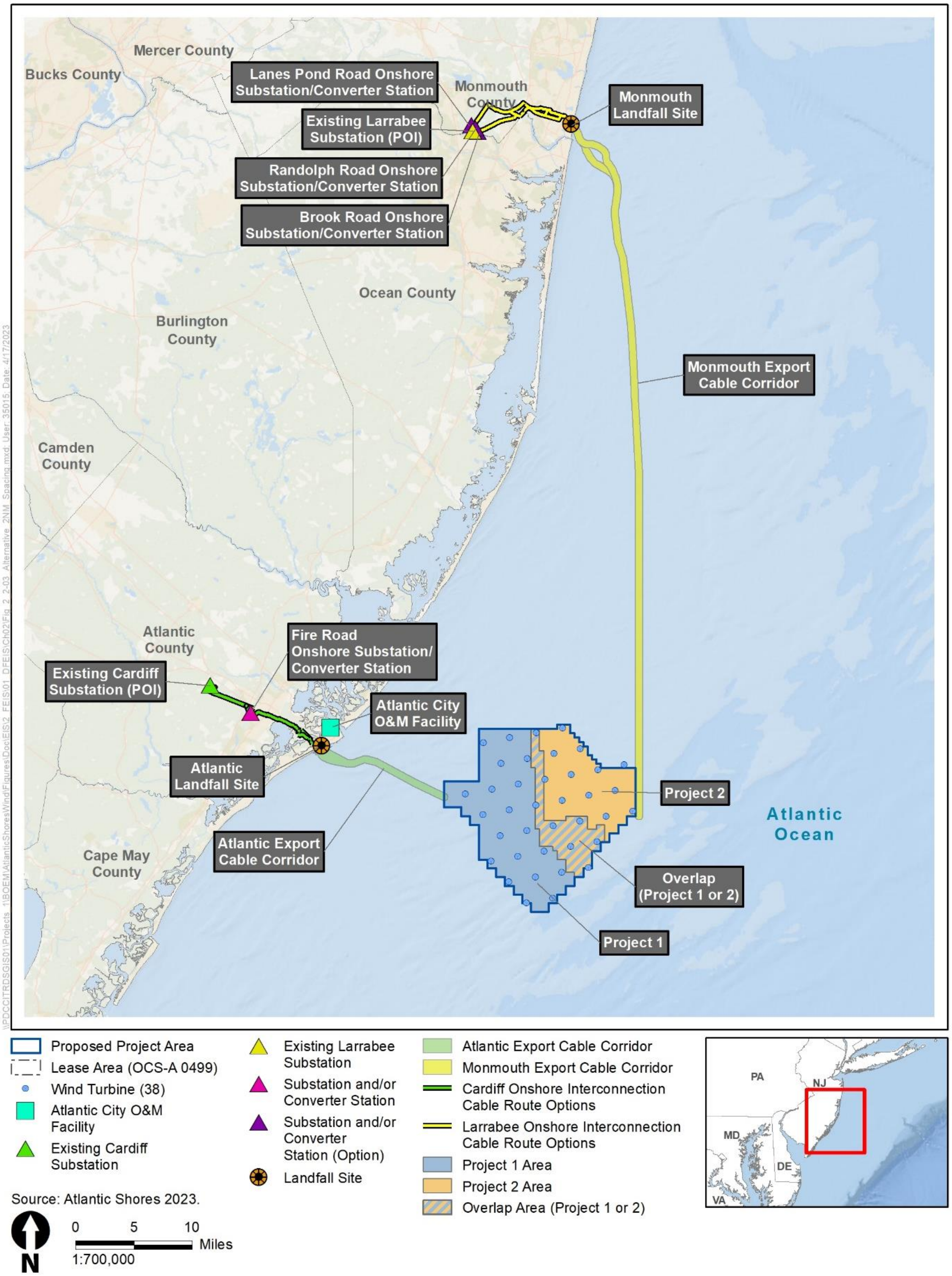


Figure 2.2-3. Minimum WTG spacing using a 2-nautical mile (3,704-meter) by 2-nautical mile (3,704-meter) wind turbine layout to provide safe access for fishing vessels

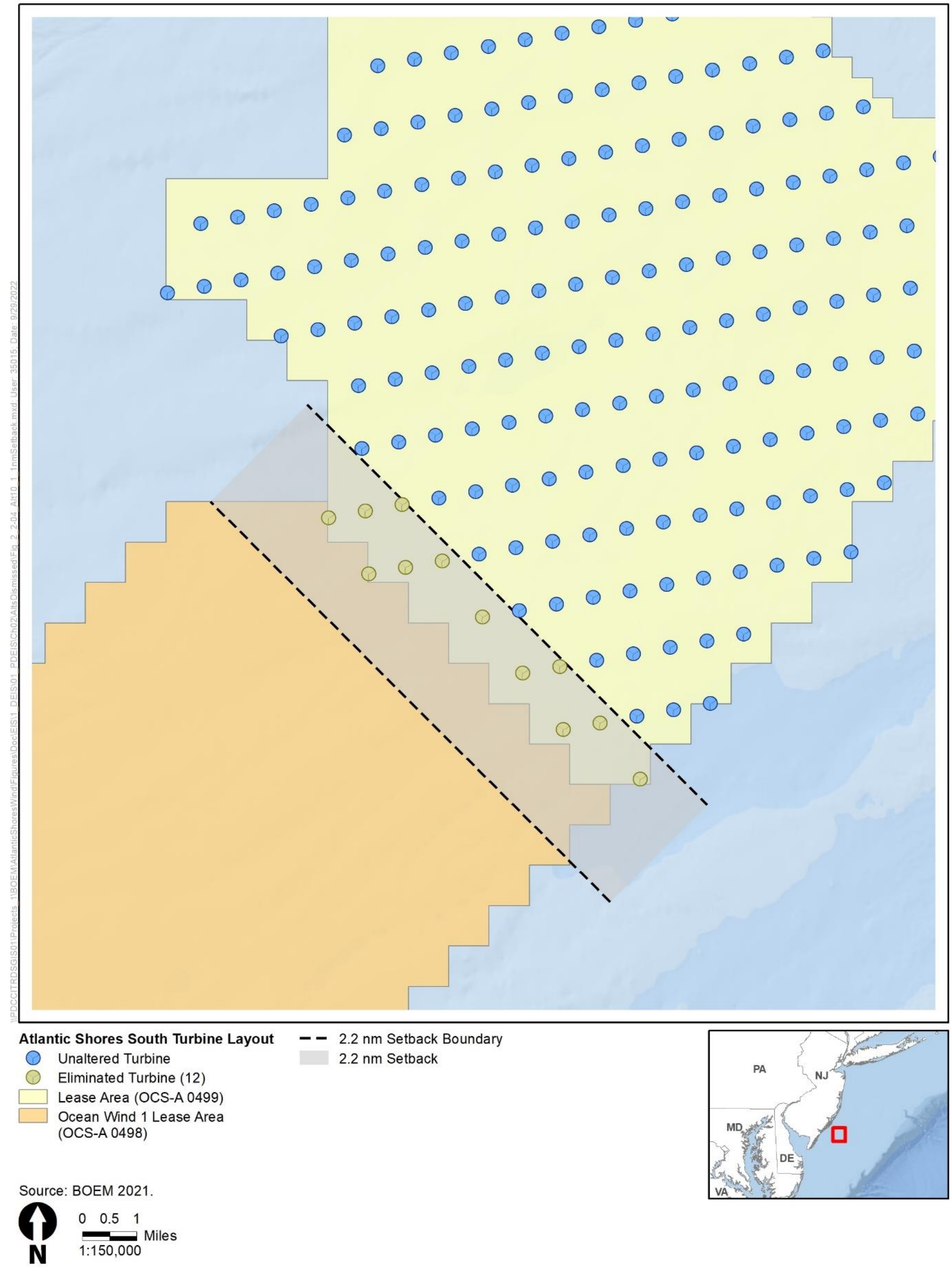


Figure 2.2-4. 2.2-nautical-mile (4,074-meter) separation between the Ocean Wind 1 and Atlantic Shores South projects

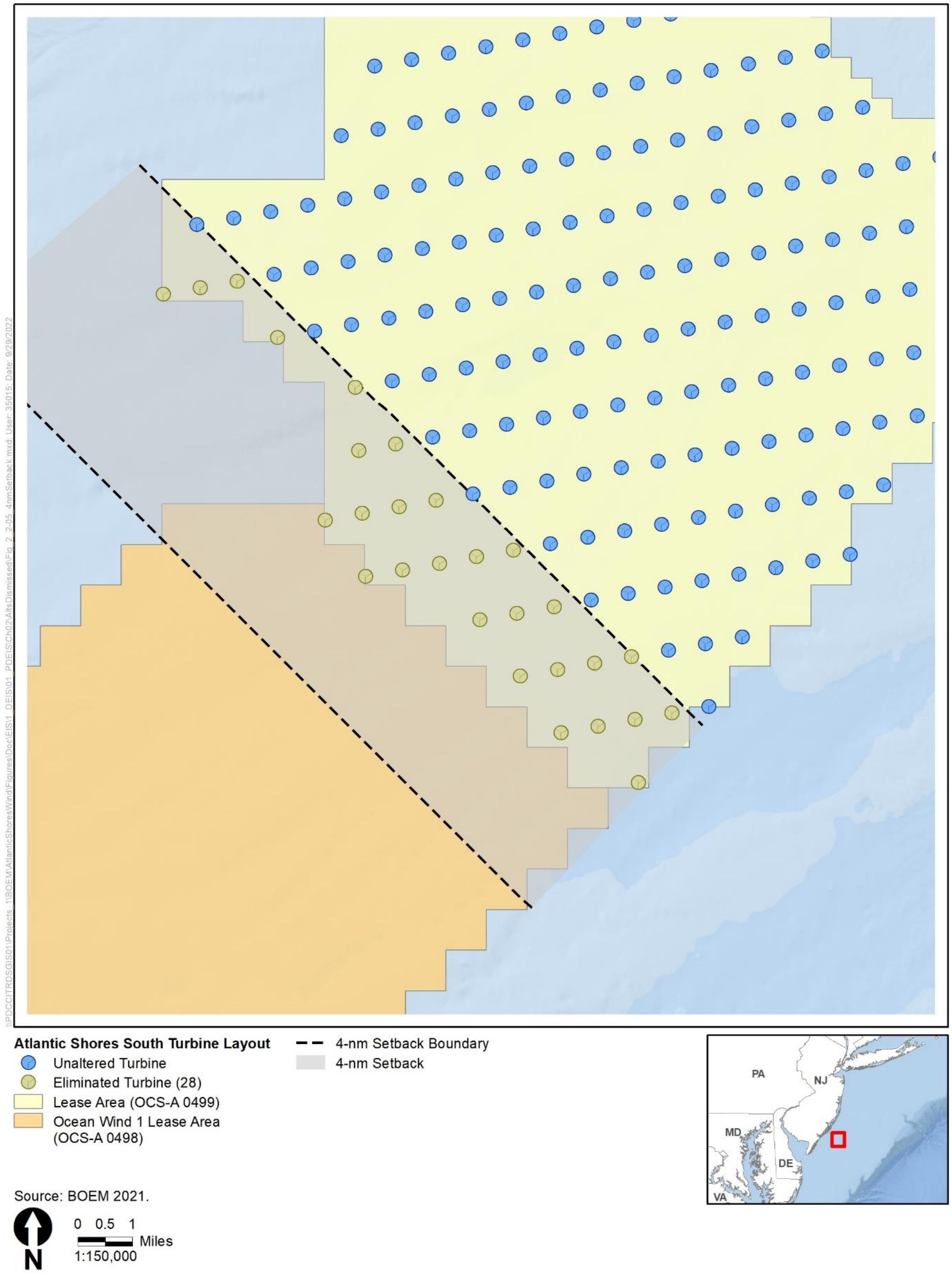
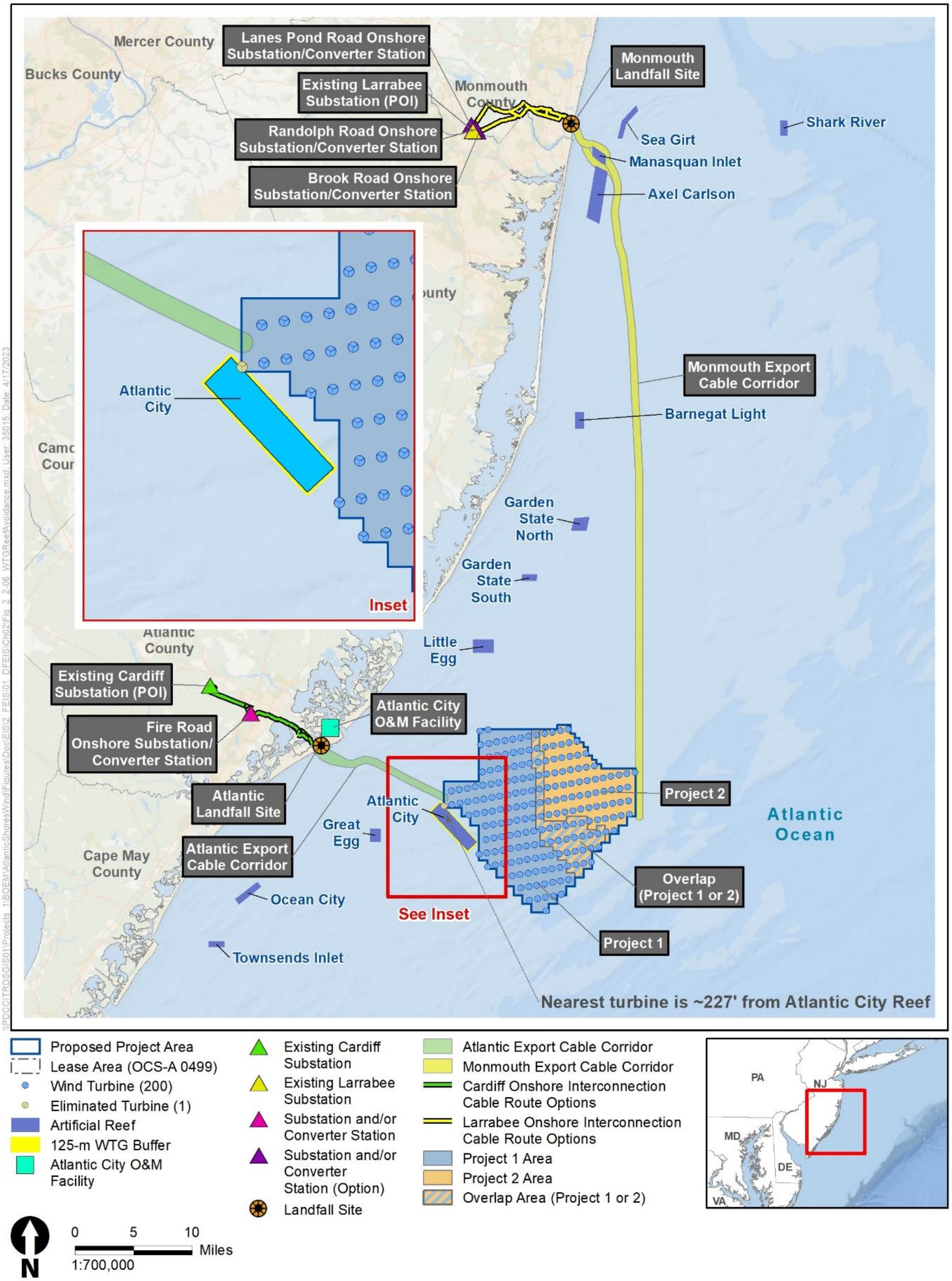
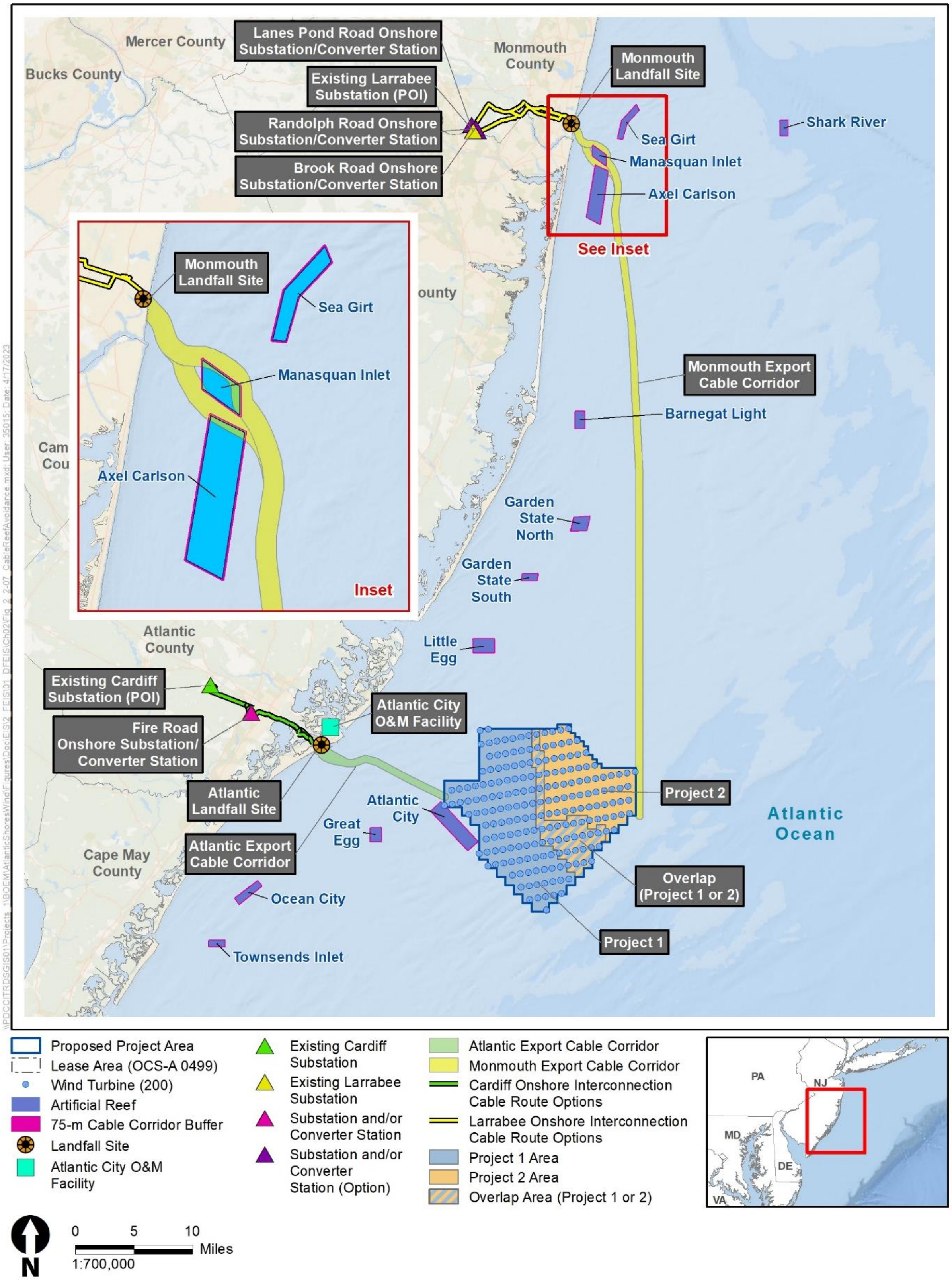


Figure 2.2-5. 4-nautical-mile (7,408-meter) separation between the Ocean Wind 1 and Atlantic Shores South projects



Source: Atlantic Shores 2023, NJGIN 2021.

Figure 2.2-6. Artificial reef avoidance buffers for WTG installation



Source: Atlantic Shores 2023, NJGIN 2021.

Figure 2.2-7. Artificial reef avoidance buffers for cable installation

2.3 Non-Routine Activities and Low-Probability Events

Non-routine activities and low-probability events associated with the proposed Project could occur during construction and installation, O&M, or decommissioning. Examples of such activities or events could include corrective maintenance activities, collisions involving vessels or vessels and marine life, allisions (a vessel striking a stationary object) involving vessels and WTGs or OSSs, cable displacement or damage by anchors or fishing gear, chemical spills or releases, severe weather and other natural events, seismic activities, and terrorist attacks. These activities or events are impossible to predict with certainty. This section provides a brief assessment of each of these potential events or activities.

- *Corrective maintenance activities:* These activities could be required as a result of other low-probability events, or as a result of unanticipated equipment wear or malfunctions. Atlantic Shores anticipates housing spare parts for key Project components at an O&M facility to initiate repairs expeditiously.
- *Collisions and allisions:* These could result in spills (described below) or injuries or fatalities to wildlife (addressed in Chapter 3, *Affected Environment and Environmental Consequences*). Collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Project:
    - USCG requirements for lighting on vessels
    - NOAA vessel speed restrictions
    - The proposed spacing of WTGs and OSSs
    - The inclusion of proposed Project components on navigation charts
- *Cable displacement or damage by vessel anchors or fishing gear:* This could result in safety concerns and economic damage to vessel operators and may require corrective action by Atlantic Shores such as the need for one or more cable splices to an export or interarray cable(s). However, such incidents are unlikely to occur because the proposed Project area would be indicated on navigational charts, and the cable would be buried to the target depth of 5 to 6.6 feet (1.5 to 2.0 meters) or protected with rock placement, concrete mattresses, rock bags, grout-filled bags, or half-shell pipes.
- *Chemical spills or releases:* For offshore activities, these include inadvertent releases from refueling vessels, spills from routine maintenance activities, and any more significant spills as a result of a catastrophic event. All vessels would be certified by the Project to conform to vessel O&M protocols designed to minimize risk of fuel spills and leaks. Atlantic Shores has prepared an Oil Spill Response Plan (OSRP) and would be expected to comply with USCG and Bureau of Safety and Environmental Enforcement (BSEE) regulations relating to prevention and control of oil spills. Onshore, releases could potentially occur from construction equipment or HDD activities. All wastes generated onshore would comply with applicable state and federal regulations, including the

Resource Conservation and Recovery Act and the Department of Transportation Hazardous Materials regulations.

- *Severe weather and natural events:* The Atlantic Shores Offshore and Onshore Project areas are subject to extreme weather, such as storms and hurricanes, which may impose hydrodynamic load and sediment scouring (COP Volume II, Section 2.2.1.5, Atlantic Shores 2023). The return rate of hurricanes may become more frequent than the historical record, and the future probability of a major hurricane will likely be higher than the historical record of these events due to climate change (see Appendix B.1.4, *Hurricanes and Tropical Storms*). The engineering specifications of the WTGs and their ability to sufficiently withstand weather events is independently evaluated by a certified verification agent when reviewing the Facility Design Report and Fabrication and Installation Report according to international standards, which include withstanding hurricane-level events. One of these standards calls for the structure to be able to withstand a 50-year return interval event. An additional standard includes withstanding 3-second gusts of a 500-year return interval event, which would correspond to Category 5 hurricane windspeeds. If severe weather caused a spill or release, the actions outlined above would help reduce potential impacts. Severe flooding or coastal erosion could require repairs, with impacts associated with repairs being similar to those outlined in Chapter 3 for construction activities. While highly unlikely, structural failure of a WTG (i.e., loss of a blade or tower collapse) would result in temporary hazards to navigation for all vessels, similar to the construction and installation impacts described in Chapter 3.
- *Seismic activity:* The Project area is located along the Western Atlantic continental margin, which is not an area considered tectonically active (USGS 2019). The impacts from seismic activity would be similar to those assessed for other non-routine events or activities.
- *Terrorist attacks:* BOEM considers these unlikely, but impacts could vary depending on the magnitude and extent of any attacks. The actual impacts of this type of activity would be the same as the outcomes listed above for severe weather and natural events. An Emergency Response Plan would be prepared by Atlantic Shores, in coordination with USCG, to provide clear instructions regarding procedures to be followed during emergency incident scenarios, including terrorist attacks.

2.4 Summary and Comparison of Impacts between Alternatives

Table 2-7 provides a summary and comparison of the impacts under the No Action Alternative and each action alternative assessed in Chapter 3. Under the No Action Alternative, any potential environmental and socioeconomic impacts, including benefits, associated with the proposed Project would not occur; however, impacts could occur from other ongoing and planned activities. The impacts associated with Alternatives F1, F2, and F3 will be comparable to one another during O&M. During construction and installation and decommissioning, the timing and level of disturbance of the three sub-alternatives will differ depending on the foundation type(s) selected. Section 3.1, *Impact-Producing Factors,* provides definitions for **negligible**, **minor**, **moderate**, and **major** impacts.

This page intentionally left blank.

Table 2-7. Summary and comparison of impacts by action alternative with no mitigation measures[12]

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
3.4.1 Air Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on air quality. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **moderate** adverse impacts due to emissions of criteria pollutants, volatile organic compounds, hazardous air pollutants (HAPs), and greenhouse gases (GHG), mostly released during construction and installation and decommissioning, and **minor** to **moderate beneficial** impacts on regional air quality after offshore wind projects are operational.	*Proposed Action:* The Proposed Action would have **minor** adverse impacts attributable to air pollutant, GHG emissions and accidental releases. The Project may lead to reduced emissions from fossil-fueled power-generating facilities and consequently **minor beneficial** impacts on air quality and climate. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would result in **moderate** adverse impacts and **moderate beneficial** impacts.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* Emissions from construction and installation of different foundation types would not differ substantially among the sub-alternatives and would be similar to the Proposed Action. The impact magnitude would remain **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.4.2 Water Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** impacts on water quality. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** to **moderate** impacts primarily driven by the unlikely event of a large-volume, catastrophic release.	*Proposed Action:* The Proposed Action would result in **minor** impacts on water quality primarily due to sediment resuspension, discharges, and accidental releases. The impacts are likely to be temporary or small in proportion to the geographic analysis area. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **minor** to **moderate** primarily due to short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* Water quality impacts from construction and installation of different foundation types would not differ substantially among the sub-alternatives and would be similar to the Proposed Action. The impact magnitude would remain **minor**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.

[12] All sub-alternatives were deemed to have similar impacts unless otherwise stated within the applicable column.

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
		sedimentation during operations due to the presence of structures.				
3.5.1 Bats	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** impacts on bats. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** impacts on bats because bat presence on the OCS is anticipated to be limited and onshore bat habitat impacts are expected to be minimal.	*Proposed Action:* The Proposed Action would result in **negligible** impacts on bats. The most significant sources of potential impact would be collision mortality from operation of the offshore WTGs (although BOEM anticipates this to be rare because offshore occurrence of bats is low) and potential onshore removal of habitat. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **negligible**.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **negligible**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **negligible**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **negligible**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the proposed Action.	*Alternative F:* This alternative would not change the number of structures within the OCS, and thereby would not have the potential to significantly reduce or increase impacts on bats. The overall impact level would be the same as for the Proposed Action: **negligible**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.5.2 Benthic Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** adverse impacts on benthic resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** adverse impacts from habitat degradation and conversion and **moderate beneficial** impacts from emplacement of structures (habitat conversion to hard substrate).	*Proposed Action:* The Proposed Action would result in **negligible** to **moderate** adverse impacts from habitat disturbance; permanent habitat conversion; and behavioral changes, injury, and mortality of benthic fauna. **Moderate beneficial** impacts would result from new hard surfaces that could provide new benthic habitat. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would range from **negligible** to **moderate** and **moderate beneficial**.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. The removal, or micrositing of up to 29 WTGs and 1 OSS under Alternative C would result in a proportional decrease in the amount of electromagnetic field (EMF) and noise impacts and benthic habitat disturbance and conversion related to the installation of foundations, interarray cables, and scour protection. With Alternatives C1 and C2, the Project could avoid impacts on one or both (if Alternatives C1 and C2 were combined) NMFS AOCs, both of which have pronounced bottom features and produce habitat value. Although impacts on benthic resources would be reduced under Alternative C, overall impacts on benthic resources would be similar to those under the Proposed Action: **negligible** to **moderate**	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. The removal of up to 31 WTGs under Alternative D would result in a proportional decrease in the amount of EMF and noise impacts and benthic habitat disturbance and conversion related to the installation of foundations, interarray cables, and scour protection. However, the overall impact level would be the same as for the Proposed Action: **negligible** to **moderate** adverse impacts, with some **moderate beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. The removal of up to 5 WTGs under Alternative E would result in a proportional decrease in the amount of EMF and noise impacts and benthic habitat disturbance and conversion related to the installation of foundations, interarray cables, and scour protection. However, the overall impact level would be the same as for the Proposed Action: **negligible** to **moderate** adverse impacts, with some **moderate beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* Alternative F1 would result in similar impacts as the Proposed Action from installing only piled foundations: **negligible** to **moderate** adverse impacts, with some **moderate beneficial** impacts. Under Alternatives F2 and F3, there would be no underwater noise impacts on benthic resources due to impact pile driving. The avoidance of impact pile-driving noise impacts would reduce overall construction and installation impacts on benthic resources under Alternatives F2 and F3 compared to the Proposed Action. Alternatives F2 and F3 would avoid pile-driving noise impacts from installing suction bucket and gravity-based foundations but would result in increased habitat conversion from larger

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
			adverse impacts, with some **moderate beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.			foundations. The overall impact level for Alternatives F2 and F3 would be **negligible** to **minor** adverse impacts. Due to the reduction in scour protection and the beneficial hard-bottom habitat it provides, Alternatives F2 and F3 could include only **minor beneficial** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would range from **negligible to moderate** adverse impact and **minor to moderate beneficial** impacts.
3.5.3 Birds	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on birds primarily through construction of ongoing activities and climate change. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** adverse impacts on birds due to habitat loss from increased onshore construction and interactions with offshore developments, and **moderate beneficial** impacts because of the presence of offshore structures.	*Proposed Action:* The Proposed Action would result in **moderate** adverse impacts on birds. The most significant sources of potential impact would be collision mortality from operation of the offshore WTGs and long-term but minimal habitat loss and conversion from onshore construction. The Proposed Action would also result in potential **minor beneficial** impacts associated with foraging opportunities for marine birds. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **moderate**, as well as **moderate beneficial**, primarily through the permanent impacts from the presence of structures.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **moderate** adverse impacts and **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **moderate** adverse impacts and **minor beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **moderate** adverse impacts and **minor beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* This alternative would not change the number of structures within the OCS, and thereby would not have the potential to significantly reduce or increase impacts on birds. The overall impact level would be the same as for the Proposed Action: **moderate** adverse impacts and **minor beneficial** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
3.5.4 Coastal Habitat and Fauna	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** impacts on coastal habitat and fauna, primarily through onshore construction and climate change. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** impacts on coastal habitat and fauna through onshore construction and climate change.	*Proposed Action:* The Proposed Action would result in **negligible** to **minor** impacts on coastal habitats and fauna due to the developed and urbanized landscape that dominates the geographic analysis area and measures taken to avoid sensitive habitat. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **negligible** to **moderate** due to impacts on wildlife habitat in the geographic analysis area.	*Alternative C:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for coastal habitat and fauna. Thus, the overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **minor**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action, ranging from **negligible** to **moderate**.	*Alternative D:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for coastal habitat and fauna. Thus, the overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **minor**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action, ranging from **negligible** to **moderate**.	*Alternative E:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for coastal habitat and fauna. Thus, the overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **minor**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action, ranging from **negligible** to **moderate**.	*Alternative F:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for coastal habitat and fauna. Thus, the overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **minor**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action, ranging from **negligible** to **moderate**.
3.5.5 Finfish, Invertebrates, and Essential Fish Habitat	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** impacts on finfish, invertebrates, and essential fish habitat. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** adverse and **minor beneficial** impacts on finfish, invertebrates, and essential fish habitat.	*Proposed Action:* The Proposed Action would result in **negligible** to **moderate** adverse and **minor beneficial** impacts on finfish, invertebrates, and essential fish habitat, primarily due to the disturbance of seafloor during cable emplacement and the presence of structures. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would range from **negligible** to **moderate** adverse and **minor beneficial**.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **moderate** adverse and **minor beneficial**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **moderate** adverse and **minor beneficial**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **moderate** adverse and **minor beneficial**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* This alternative would not change the number of structures within the OCS, and thereby would not have the potential to significantly reduce or increase impacts on finfish, invertebrates, and essential fish habitat. The overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **moderate** adverse and **minor beneficial**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.5.6 Marine Mammals	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** impacts on	*Proposed Action:* The Proposed Action would result in **negligible** to **minor** adverse impacts on pinnipeds and odontocetes and **negligible** to **moderate** adverse	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action:	*Alternative F:* Alternative F1 would not result in measurably different impacts from the Proposed Action: ranging from **negligible** to **minor** adverse

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
	pinnipeds, odontocetes, and mysticetes other than NARW and **negligible** to **major** impacts on NARW. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** adverse impacts on pinnipeds, odontocetes, and mysticetes other than NARW and **negligible** to **major** adverse impacts on NARW and could include **minor beneficial** impacts due to increased foraging opportunities for odontocetes and pinnipeds. However, these effects may be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species.	impacts on mysticetes, primarily due to pile-driving noise, vessel noise, and presence of structures. **Minor beneficial** impacts on small odontocetes and pinnipeds could result from the presence of structures. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would range from **negligible** to **minor** for odontocetes and pinnipeds, **negligible** to **moderate** for mysticetes other than NARW, and **negligible** to **major** for NARW and would also include **minor beneficial** impacts on small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species.	same as for the Proposed Action: ranging from **negligible** to **minor** adverse impacts on pinnipeds and odontocetes and **negligible** to **moderate** adverse impacts on mysticetes, with some **minor beneficial** impacts on small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	Proposed Action: ranging from **negligible** to **minor** adverse impacts on pinnipeds and odontocetes and **negligible** to **moderate** adverse impacts on mysticetes, with some **minor beneficial** impacts on small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	ranging from **negligible** to **minor** adverse impacts on pinnipeds and odontocetes and **negligible** to **moderate** adverse impacts on mysticetes, with some **minor beneficial** impacts on small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	impacts on pinnipeds and odontocetes and **negligible** to **moderate** adverse impacts on mysticetes, with some **minor beneficial** impacts on small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. Alternatives F2 and F3 would result in measurably different impacts from the Proposed Action due to the avoidance of impact pile-driving noise. However, given that impacts are still expected due to vessel noise and displacement of marine mammals into higher-risk areas associated with the presence of structures, construction and installation, O&M, and decommissioning of Alternatives F2 and F3 would still result in **negligible minor** adverse impacts on pinnipeds and odontocetes and **negligible** to **moderate** adverse impacts on mysticetes and could include **minor beneficial** impacts on small odontocetes and pinnipeds. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.5.7 Sea Turtles	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in	*Proposed Action:* The Proposed Action would result in **negligible** to **minor** adverse impacts on sea turtles, primarily due to pile-driving	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the	*Alternative F:* Alternative F1 would not result in measurably different impacts from the Proposed Action: ranging from

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
	negligible to **minor** impacts on sea turtles. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **minor** adverse impacts on sea turtles and could include **minor beneficial** impacts. Adverse impacts would result mainly from pile-driving noise, presence of structures, and vessel traffic. Beneficial impacts could result from the presence of structures allowing for increased foraging opportunities.	noise, vessel noise, and presence of structures. **Minor beneficial** impacts could result from the presence of structures allowing for increased foraging opportunities. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would range from **negligible** to **minor** and would also include **minor beneficial** impacts.	overall impact level would be the same as for the Proposed Action: ranging from **negligible** to **minor**, with some **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	would be the same as for the Proposed Action: ranging from **negligible** to **minor** adverse impacts, with some **minor beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	same as for the Proposed Action: ranging from **negligible** to **minor**, with some **minor beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	**negligible** to **minor**, with some **minor beneficial** impacts. Alternatives F2 and F3 would result in measurably different impacts from the Proposed Action due to the avoidance of impacts associated with pile-driving noise. However, given that impacts are still expected due to vessel noise, displacement of sea turtles into higher-risk areas associated with the presence of structures, and vessel traffic, construction and installation, O&M, and decommissioning of Alternatives F2 and F3 would still result in **negligible** to **minor** adverse impacts on sea turtles and could include **minor beneficial** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.5.8 Wetlands	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on wetlands, primarily driven by land disturbance. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts, primarily driven by land disturbance.	*Proposed Action:* The Proposed Action would result in **moderate** impacts on wetlands, primarily due to land disturbance. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **moderate,** primarily due to cable emplacement and onshore construction activities.	*Alternative C:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for wetlands. Thus, the overall impact level would be the same as for the Proposed Action: **moderate**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for wetlands. Thus, the overall impact level would be the same as for the Proposed Action: **moderate**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for wetlands. Thus, the overall impact level would be the same as for the Proposed Action: **moderate**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for wetlands. Thus, the overall impact level would be the same as for the Proposed Action: **moderate**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
						activities, would be the same as the Proposed Action.
3.6.1 Commercial Fisheries and For-Hire Recreational Fishing	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** to **major** impacts on commercial fisheries and for-hire recreational fishing. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** to **major** adverse impacts on commercial fisheries and **minor to moderate** adverse impacts on for-hire recreational fishing. These impacts would primarily result from fisheries use and management and the increased presence of offshore structures. The impacts could also include **minor beneficial** impacts for some for-hire recreational fishing operations due to the presence of structures and the artificial reef effect.	*Proposed Action:* The Proposed Action would result in **moderate** to **major** adverse impacts on commercial fisheries and **minor** to **moderate** adverse impacts on for-hire recreational fisheries, primarily due to long-term impacts from the presence of structures, including navigational hazards, gear loss and damage, and space use conflicts. **Minor beneficial** impacts could result from the presence of structures and the artificial reef effect. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **major** and would also include **minor beneficial** impacts.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact levels would be the same as for the Proposed Action: ranging from **moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fisheries, with the potential for **minor beneficial** impacts on for-hire recreational fisheries. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact levels would be the same as for the Proposed Action: ranging from **moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fisheries, with the potential for **minor beneficial** impacts on for-hire recreational fisheries. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact levels would be the same as for the Proposed Action: ranging from **moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fisheries, with the potential for **minor beneficial** impacts on for-hire recreational fisheries. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* Alternative F2 (suction bucket foundations) would result in the greatest area of habitat conversion from scour protection and was evaluated under the Proposed Action. Alternative F1 (piled foundations) and Alternative F3 (gravity-based foundations) would result in a reduction in scour protection compared to the Proposed Action. However, the overall impact levels under Alternatives F1, F2, and F3 would be the same as for the Proposed Action: ranging from **moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fisheries, with the potential for **minor beneficial** impacts on for-hire recreational fisheries. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.6.2 Cultural Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on cultural resources, primarily through the presence of structures. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would	*Proposed Action:* The Proposed Action would result in **major** impacts on cultural resources because a notable and measurable impact requiring mitigation is anticipated. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **major**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **major.**	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. As a result, the overall impact level would be decreased (D1, D2) or the same (D3) as the Proposed Action: **moderate** to **major**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **major.**	*Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **major**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **major.**	*Alternative F:* The severity of impacts on cultural resources increases with the size of the foundation type and anticipated seabed disturbance. However, the nature of physical activities proposed under this alternative would result in the same level of impacts as for the Proposed Action: **major**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
	result in **major** adverse impacts on cultural resources.	offshore wind activities, would be **major**.				with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **major.**
3.6.3 Demographics, Employment, and Economics	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics, primarily driven by land disturbance and additional employment opportunities. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **minor** adverse and **moderate beneficial** impacts, the latter of which would be on ocean-based employment and economics.	*Proposed Action:* The Proposed Action would result in **negligible** adverse and **minor beneficial** impacts on demographics, employment, and economics, primarily due to job and revenue creation. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **negligible** to **minor** adverse and **moderate beneficial**. The beneficial impacts would primarily be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the adverse impacts would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions/allisions during construction, and land disturbance.	*Alternative C:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for demographics, employment, and economics. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for demographics, employment, and economics. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for demographics, employment, and economics. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for demographics, employment, and economics. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.6.4 Environmental Justice	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on environmental justice populations, primarily driven by ongoing population growth and new development. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** adverse	*Proposed Action:* The Proposed Action would result in **minor** to **moderate** adverse impacts on environmental justice populations, primarily due to land disturbance, and noise. The Proposed Action would result in **negligible** to **minor beneficial** impacts on environmental justice populations, primarily due to port utilization and presence of structures. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined	*Alternative C:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for environmental justice populations. Thus, the overall impact level would be the same as for the Proposed Action: **minor** to **moderate** adverse and **negligible** to **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from	*Alternative D:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for environmental justice populations. Thus, the overall impact level would be the same as for the Proposed Action: **minor** to **moderate** adverse and **negligible** to **minor beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from	*Alternative E:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for environmental justice populations. Thus, the overall impact level would be the same as for the Proposed Action: **minor** to **moderate** adverse and **negligible** to **minor beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the	*Alternative F:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for environmental justice populations. Thus, the overall impact level would be the same as for the Proposed Action: **minor** to **moderate** adverse and **negligible** to **minor beneficial** impacts. *Cumulative Impacts of Alternative F:* Impacts of

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
	impacts, primarily due to short-term impacts from cable emplacement, construction-phase noise and vessel traffic, as well as the long-term presence of structures. **Minor beneficial** impacts could result through economic activity, job opportunities, and reductions in air emissions.	with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **moderate** adverse impacts and **minor** to **moderate beneficial** impacts. The adverse effects are primarily driven by land disturbance, and noise and the beneficial impacts are primarily driven by port utilization, presence of structures, and air emissions	ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	connected action and other offshore wind activities, would be the same as the Proposed Action.	Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.6.5 Land Use and Coastal Infrastructure	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **minor** adverse and **minor beneficial** impacts on land use and coastal infrastructure. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts, primarily driven by land disturbance, accidental releases during onshore construction, and traffic, as well as from the lighting and views of offshore structures that could affect the use and value of onshore properties. **Minor beneficial** impacts would result from productive use of ports and related infrastructure for offshore wind activity.	*Proposed Action:* The Proposed Action would result in **negligible** to **minor** adverse and **minor beneficial** impacts on land use and coastal infrastructure. Adverse impacts are primarily due to port utilization, and accidental releases and traffic during onshore construction. Beneficial impacts are primarily due to supporting designated uses and infrastructure improvements at ports. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **minor** adverse and **moderate beneficial**. The adverse impacts would primarily be driven by land disturbance and changes to the viewshed. The beneficial impacts would primarily be associated port utilization.	*Alternative C:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for land use and coastal infrastructure. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** to **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for land use and coastal infrastructure. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** to **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative would differ only in terms of the offshore components which would be outside of the geographic analysis area for land use and coastal infrastructure. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** to **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* This alternative would differ only in terms of the offshore components, which would be outside of the geographic analysis area for land use and coastal infrastructure. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** to **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.6.6 Navigation and Vessel Traffic	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on navigation and vessel traffic. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other	*Proposed Action:* The Proposed Action would result in **moderate** adverse impacts on navigation and vessel traffic, primarily due to changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore search and rescue or surveillance missions.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **moderate**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **moderate**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities,	*Alternative E:* This alternative would involve a 0.81-nautical mile (1,500-meter) to 1.08-nautical mile (2,000-meter) setback between WTGs in the Ocean Wind 1 Lease Area (OCS-A 0498) and the Atlantic Shores South Lease Area (OCS-A 0499). This alternative would result in the exclusion or micrositing of up to 5 WTGs. The setback would be an	*Alternative F:* This alternative would involve installing a range of foundation types, which has little to no impact on navigation and traffic. Furthermore, the number of structures within the OCS would not change under this alternative. Thus, the overall impact level would be the

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
	offshore wind activities) would result in **moderate** impacts primarily due to the presence of offshore wind structures, which would increase the risk of collisions, allisions, and accidental releases, as well due to port utilization and vessel traffic.	*Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would range from **moderate** to **major**, primarily due to the increased possibility for marine accidents.	ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as for the Proposed Action.	including the connected action and other offshore wind activities, would be the same as the Proposed Action.	improvement to vessel navigation and search and rescue considerations and would lead to reduced impacts when compared to the Proposed Action: **negligible** to **minor**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **minor** to **moderate**, less than the cumulative impacts associated with the Proposed Action.	same as for the Proposed Action: **moderate**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.
3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** impacts for military and national security uses, aviation and air traffic, cables and pipelines, and radar systems; and **moderate** impacts for scientific research and surveys. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **minor** impacts for marine mineral extraction, military and national security uses except for USCG SAR operations, aviation and air traffic, and cables and pipelines; **minor** impacts for radar systems; and **major** impacts for USCG SAR operations and scientific research and surveys.	*Proposed Action:* The Proposed Action would result in **negligible** to **minor** impacts for marine mineral extraction, military and national security uses except for USCG SAR operations, aviation and air traffic, and cables and pipelines; **moderate** impacts for radar systems; and **major** impacts for USCG SAR operations and scientific research and surveys. The presence of structures associated with the Proposed Action and increased risk of allisions are the primary drivers for impacts on SAR operations. Impacts on scientific research and surveys would qualify as **major** because entities conducting surveys and scientific research would have to make significant investments to change methodologies to account for unsampleable areas, with potential long-term and irreversible impacts on fisheries and protected-species research as a whole, as well as on the commercial fisheries community. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **negligible** to **major**. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* This alternative could have up to 31 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **negligible** to **major**. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E:* This alternative would involve a 0.81-nautical mile (1,500-meter) to 1.08-nautical mile (2,000-meter) setback between WTGs in the Ocean Wind 1 Lease Area (OCS-A 0498) and the Atlantic Shores South Lease Area (OCS-A 0499). This alternative would result in the exclusion or micrositing of up to 5 WTGs. The overall impacts would be the same as for the Proposed Action except for USCG SAR operations. The setback would be an improvement to vessel navigation and SAR considerations and would lead to reduced impacts for USCG SAR operations when compared to the Proposed Action: **moderate**. The overall impact range would remain **negligible to major**. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would the same as for the Proposed Action except for USCG SAR operations, which would be **moderate**. The overall impact range would remain **negligible** to **major**.	*Alternative F:* This alternative would involve installing a range of foundation types, which has little to no impact on navigation and traffic. Furthermore, the number of structures within the OCS would not change under this alternative. Thus, the overall impact level would be the same as for the Proposed Action: **negligible** to **major**. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
		connected action and other offshore wind activities, would be **negligible** to **minor** for marine mineral extraction, military and national security uses except for USCG SAR operations, aviation and air traffic, and cables and pipelines; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys.				
3.6.8 Recreation and Tourism	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on recreation and tourism. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts, primarily driven by land disturbance, cable emplacement and maintenance, noise, traffic, anchoring, lighting, and the presence of structures. **Minor beneficial** impacts would result from the anticipated artificial reef effect resulting from installation of offshore structures.	*Proposed Action:* The Proposed Action would result in **minor** adverse and **minor beneficial** impacts on recreation and tourism. Adverse impacts are primarily due to anchoring, land disturbance, lighting, cable emplacement and maintenance, noise, traffic, and the presence of structures. Beneficial impacts are primarily due to the presence of structures and the potential for the artificial reef effect. *Cumulative Impacts of the Proposed Action:* Impacts of the Proposed Action when combined with the impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be **minor** adverse and **minor beneficial**.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* Alternative D1 would exclude placement of WTGs up to 12 miles (19.3 kilometers) from shore, resulting in the removal of up to 21 WTGs. Alternative D2 would exclude placement of WTGs up to 12.75 miles (20.5 kilometers) from shore, resulting in the removal of up to 31 WTGs. Alternative D3 would exclude placement of WTGs up to 10.8 miles (17.4 kilometers) from shore, resulting in the removal of up to six WTGs. Alternatives D1 and D2 may substantially reduce the visual impacts on historic aboveground resources. Alternative D3 is not anticipated to result in a substantial reduction. Though the visual impact may be reduced for Alternatives D1 and D2, the overall impact level for Alternative D would be the same as for the Proposed Action: **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E: Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* This alternative would involve installing a range of foundation types, which would not have measurable impacts on recreation and tourism that are materially different from the impacts of the Proposed Action: **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.

Resource	Alternative A No Action	Alternative B Proposed Action	Alternative C Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Alternative D No Surface Occupancy at Select Locations to Reduce Visual Impacts	Alternative E Wind Turbine Layout Modification to Establish a Setback between Atlantic Shores South and Ocean Wind 1	Alternative F Foundation Structures
3.6.9 Scenic and Visual Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **major** impacts on scenic and visual resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **major** impacts due to the addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.	*Proposed Action:* Effects of Offshore Project elements on high- and moderate-sensitivity seascape character units, open ocean character units, and landscape character units would be **negligible** to **major**. Onshore facilities would result in **negligible** to **major** impacts on scenic and visual resources. *Cumulative Impacts of the Proposed Action:* Overall, impacts from ongoing and planned activities, including other offshore wind activities, would be **major**.	*Alternative C:* This alternative could have up to 29 fewer WTGs and 1 fewer OSS compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **negligible** to **major** impacts. *Cumulative Impacts of Alternative C:* Impacts of Alternative C when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative D:* Alternative D1 would exclude placement of WTGs up to 12 miles (19.3 kilometers) from shore, resulting in the removal of up to 21 WTGs. Alternative D2 would exclude placement of WTGs up to 12.75 miles (20.5 kilometers) from shore, resulting in the removal of up to 31 WTGs. Alternative D3 would exclude placement of WTGs up to 10.8 miles (17.4 kilometers) from shore, resulting in the removal of up to 6 WTGs. Alternatives D1 and D2 may substantially reduce the visual impacts on historic aboveground resources. Alternative D3 is not anticipated to result in a substantial reduction. Though the visual impact may be reduced for Alternatives D1 and D2, the overall impact level for Alternative D would be the same as for the Proposed Action: **negligible** to **major** impacts. *Cumulative Impacts of Alternative D:* Impacts of Alternative D when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative E: Alternative E:* This alternative could have up to 5 fewer WTGs compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **negligible** to **major** impacts. *Cumulative Impacts of Alternative E:* Impacts of Alternative E when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.	*Alternative F:* This alternative would involve installing a range of foundation types, which would not have measurable impacts on scenic and visual resources that are materially different from the impacts of the Proposed Action: **negligible** to **major** impacts. *Cumulative Impacts of Alternative F:* Impacts of Alternative F when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be the same as the Proposed Action.

Chapter 3

Affected Environment and Environmental Consequences

This chapter addresses the affected environment, also known as the existing condition, for each resource area and the potential environmental consequences to those resources from implementation of the alternatives described in Chapter 2, *Alternatives*. In addition, this section addresses the impact of the alternatives when combined with other past, present, or reasonably foreseeable planned activities using the methodology and assumptions outlined in Chapter 1, *Introduction*, and Appendix D, *Ongoing and Planned Activities Scenario*. Appendix D describes other ongoing and planned activities within the geographic analysis area for each resource. These actions may be occurring on the same time scale as the proposed Project or could occur later in time but are still reasonably foreseeable.

In accordance with Section 1502.21 of the CEQ regulations implementing NEPA, BOEM identified information that was incomplete or unavailable for the evaluation of reasonably foreseeable impacts analyzed in this chapter. The identification and assessment of incomplete or unavailable information is presented in Appendix E, *Analysis of Incomplete or Unavailable Information*.

3.1 Impact-Producing Factors

BOEM completed a study on the North Atlantic OCS that identified the impact-producing factors (IPFs) to consider in an offshore wind development planned activities scenario (2019). This document incorporates that study by reference. The study provides the following information:

- Identifies cause-and-effect relationships between renewable energy projects and the human environment (includes but is not limited to physical and biological resources, socioeconomic conditions, scenic and visual resources, and cultural resources) potentially affected by such projects.
- Classifies those relationships into IPFs through which renewable energy projects could affect resources.
- Identifies the types of actions and activities for consideration in a cumulative impacts analysis.
- Identifies actions and activities that may affect the same resources as renewable energy projects and states that such actions and activities may produce the same IPFs.

The BOEM study identifies the relationships between IPFs associated with specific past, present, and reasonably foreseeable future actions in the North Atlantic OCS. As also discussed in the study, reasonably foreseeable actions other than offshore wind projects may also affect the same resources as the proposed offshore wind Project or other offshore wind projects, possibly via the same or additional IPFs (BOEM 2019). BOEM determined the relevance of each IPF to each resource analyzed in this Draft EIS. If BOEM found an IPF not associated with the proposed Project, it did not include it in the analysis.

Table 3.1-1 provides brief descriptions of the primary IPFs involved in this analysis, including examples of sources or activities that result in each IPF. The IPFs cover all phases of the proposed Project, including construction and installation, O&M, and decommissioning.

Table 3.1-1. Primary IPFs addressed in this analysis

IPF	Sources and Activities	Description
Accidental releases	• Mobile sources (e.g., vessels) • Installation, operation, and maintenance of onshore or offshore stationary sources (e.g., wind turbine generators, offshore substations, transmission lines, and interarray cables)	Refers to unanticipated releases or spills into receiving waters of a fluid or other substance, such as fuel, hazardous materials, suspended sediment, invasive species, trash, or debris. Accidental releases are distinct from routine discharges, consisting of authorized operational effluents, and they are restricted via treatment and monitoring systems and permit limitations.
Air emissions	• Combustion related stationary or mobile emission sources (e.g., generators [both on- and offshore], or support vessels, vehicles, and aircraft) • Non-combustion related sources, such as leaks from tanks and switchgears	Refers to emission sources that emit regulated air pollutants (gaseous or particulate matter) into the atmosphere. Releases can occur on- and offshore.
Anchoring	• Anchoring of vessels • Attachment of a structure to the sea bottom by use of an anchor, mooring, or gravity-based weighted structure (i.e., bottom-founded structure)	Refers to seafloor disturbance (anything below Mean Higher High Water [MHHW]) related to any offshore construction or maintenance activities. Refers to an activity or action that disturbs or attaches objects to the seafloor.
Cable emplacement and maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Cable protection of concrete mattress and rock placement	Refers to seafloor disturbances (anything below MHHW) related to the installation and maintenance of new offshore submarine cables. Cable placement methods include trenchless installation (such as HDD, direct pipe, and auger bore), jetting, vertical injection, control flow excavation, trenching, and plowing.
Discharges/intakes	• Vessels • Structures • Onshore point and non-point sources • Dredged material • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure • HVDC converter cooling system	Refers to routine permitted operational effluent discharges of pollutants to receiving waters. Types of discharges may include: bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, seawater cooling system intake and effluent, and HDD fluid. Water pollutants include produced water, manufactured or processed hydrocarbons, chemicals, sanitary waste, and deck drainage. Rainwater, freshwater, or seawater mixed with any of these constituents is also considered a pollutant. These discharges are restricted to uncontaminated or properly treated effluents that require best management practice and/or numeric pollutant concentration limitations as required through USEPA

IPF	Sources and Activities	Description
		National Pollutant Discharge Elimination System permits or USCG regulations. Refers to the discharge of solid materials, such as the deposition of sediment at approved offshore disposal or nourishment sites and cable protection. Discharge of dredged and/or fill material may be regulated through the Clean Water Act. Refers to entrainment/impingement as a result of intakes used by cable laying equipment and in HVDC converter cooling systems.
Electric and magnetic fields and cable heat	• Substations • Power transmission cables • Interarray cables • Electricity generation	Power generation facilities and cables produce electric fields (proportional to the voltage) and magnetic fields (proportional to flow of electric current) around the power cables and generators. Three major factors determine levels of the magnetic and induced electric fields from offshore wind energy projects: (1) the amount of electrical current being generated or carried by the cable, (2) the design of the generator or cable, and (3) the distance of organisms from the generator or cable. Refers to thermal effects of the transmission of electrical power, dependent on cable design and burial depth.
Gear utilization	• Monitoring surveys	Refers to entanglements and bycatch during monitoring surveys.
Land disturbance	• Vegetation clearance • Excavation • Grading • Placement of fill material	Refers to land disturbances (anything above MHHW) during onshore construction activities.
Lighting	• Vessels or offshore structures above or under water • Onshore infrastructure	Refers to lighting associated with offshore wind development and activities that utilize offshore vessels, and which may produce light above the water onshore and offshore, as well as underwater.
Noise	• Aircraft • Vessels • Turbines • Geophysical and geotechnical surveys • Operations and maintenance • Onshore and offshore construction and installation • Vibratory and impact pile driving • Dredging and trenching • Unexploded ordnances (UXO) detonations	Refers to noise from various sources. Commonly associated with construction activities, geophysical and geotechnical surveys, and vessel traffic. May be impulsive (e.g., pile driving) or broad spectrum and continuous (e.g., from Project-associated marine transportation vessels). May also be noise generated from turbines themselves or interactions of the turbines with wind and waves.

IPF	Sources and Activities	Description
Port utilization	• Expansion and construction • Maintenance • Use • Revitalization	Refers to an activity or action associated with port activity, upgrades, or maintenance that occur only as a result of the Project from increased economic activity. Includes activities related to port expansion and construction such as placement of dredged materials, dredging to deepen channels for larger vessels, and maintenance dredging.
Presence of structures	• Onshore structures including towers and transmission cable infrastructure • Offshore structures including wind turbine generators, offshore substations, and scour/cable protection	Refers to the post-construction, long-term presence of on- or offshore structures.
Traffic	• Aircraft • Vessels (construction, operation and maintenance, surveys) • Vehicles • Towed arrays/equipment	Refers to marine and onshore vessel and vehicle use, including use in support of surveys such as geophysical and geotechnical, fisheries monitoring, and biological monitoring surveys.

3.2 Mitigation Identified for Analysis in the Environmental Impact Statement

During the development of the Draft EIS and in coordination with cooperating agencies, BOEM considered potential additional mitigation measures that could further avoid, minimize, or mitigate impacts on the physical and biological resources, socioeconomic conditions, scenic and visual resources, and cultural resources assessed in this document. These potential additional mitigation measures are described in Table G-2 in Appendix G, *Mitigation and Monitoring*, and are analyzed in the relevant resource sections in Chapter 3. BOEM may choose to incorporate one or more of these additional mitigation measures in the preferred alternative. In addition, other mitigation measures may be required through consultations, authorizations, and permits with respect to several environmental statutes such as the MMPA, Section 7 of the ESA, or the MSA. Those additional mitigation measures presented in Appendix G, Table G-2, may not all be within BOEM's statutory and regulatory authority to require; however, other jurisdictional governmental agencies may potentially require them. Mitigation measures for completed consultations, authorizations, and permits will be included in the Final EIS. BOEM may choose to incorporate one or more additional measures in the ROD and adopt those measures as conditions of COP approval. As previously discussed, all Atlantic Shores-committed measures are part of the Proposed Action (see Section 2.1.2 for details).

This page intentionally left blank.

3.3 Definition of Impact Levels

Based on previous environmental reviews, subject-matter expert input, consultation efforts, and public involvement to date, BOEM has identified the resources addressed in Section 3.4, *Physical Resources*, 3.5, *Biological Resources,* and 3.6, *Socioeconomic Conditions and Cultural Resources,* as those potentially affected by the Project. Each resource section includes impact-level definitions and geographic analysis area descriptions and maps.

In this section, BOEM identifies and defines terminology used in the Draft EIS impact analysis.

3.3.1 Activities Terminology

When assessing impacts on the resources, BOEM considers all ongoing and planned activities within the geographic analysis area. For the purposes of analysis, these activities are grouped into two categories: non-offshore wind and offshore wind. The following definitions are used in this Draft EIS:

- **Non-offshore wind**: Activities include the following: (1) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (2) tidal energy projects; (3) marine minerals use and ocean-dredged material disposal; (4) military use; (5) marine transportation (commercial, recreational, and research-related) and port development; (6) fisheries use, management, and monitoring surveys; (7) global climate change; (8) oil and gas activities; (9) onshore development activities; and (10) research, monitoring, and survey activities. For more detailed definitions of these activities, refer to Appendix D.
- **Offshore wind**:
  - *Proposed offshore wind*: Offshore wind energy activities associated with the Proposed Action or any of the alternatives presented in this Draft EIS.
  - *Ongoing offshore wind*: Other offshore wind energy development activities that meet the following criteria: (1) the activity is not a part of the Proposed Action or any of the alternatives presented in this Draft EIS; and (2) the activity is currently under construction, operation, or has an approved COP in place.
  - *Planned offshore wind*: other reasonably foreseeable future offshore wind energy development activities that meet the following criteria: (1) the activity is not a part of the Proposed Action or any of the alternatives presented in this Draft EIS; and (2) a renewable energy lease has been executed for a project, but there is not an approved COP at the time of publication of this Draft EIS.

3.3.2 Impact Terminology

In accordance with the most recent CEQ NEPA regulations (40 CFR 1501.3), federal agencies are required to evaluate the potentially affected environment and degree of the effects of the action when considering if effects are significant.

This Draft EIS uses a four-level classification scheme to characterize the potential adverse and beneficial impacts of the Proposed Action and alternatives. Impact levels described in BOEM's *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf* (MMS 2007) were used as the initial basis for establishing adverse impacts specific to each resource. These resource-specific adverse impact-level definitions were then further refined based on prior NEPA analyses, scientific literature, and best professional judgement and are presented in each resource section.

When evaluating beneficial impacts and assigning an impact level to each resource, BOEM used a more general impact definition. Table 3.3-1 provides the definition of potential beneficial impact levels across all resources in the Draft EIS.

Overall determinations consider the context, intensity, directionality (adverse or beneficial), and duration of the effects and provide the basis for the impact-level determination by resource. When considering the magnitude of impacts, the analysis should identify if the impacts are geographically local, regional, or widespread. With regard to temporal extent, the Draft EIS assumes that potential construction effects generally diminish once construction ends; however, ongoing O&M activities could result in additional impacts during the 30-year life of the Project. Additionally, Atlantic Shores would have up to an additional 2 years to complete conceptual decommissioning activities. Therefore, the Draft EIS considers the time frame beginning with construction and installation and ending when the Project's conceptual decommissioning is complete, unless otherwise noted.

When considering duration of impacts under NEPA, this Draft EIS uses the following terms:

- **Short-term effects**: Effects lasting less than 3 years. An example would be clearing of onshore shrubland vegetation for a construction staging area; the area would be revegetated when the construction is complete, and, after revegetation is successful, this effect would end.
- **Long-term effects**: Effects lasting longer than 3 years, but less than the life of the Project (34 years). An example would be the loss of habitat where a foundation has been installed and would be removed during decommissioning.
- **Permanent effects**: Effects lasting the life of the Project and beyond. An example would be the conversion of land to support new onshore facilities.

The main body of this Draft EIS identifies or describes in detail the impacts for resources of most concern, while Appendix F, *Assessment of Resources with Minor (or Lower) Impacts*, provides the analysis of other resources consisting of only negligible to minor Proposed Action impacts. Some impacts of the Proposed Action may not be measurable at the project level, such as the beneficial impacts on benthic resources due to artificial habitat or climate change due to a reduction in greenhouse gas emissions. Where relevant, the impacts are discussed under each resource, while a more comprehensive analysis can be found in Appendix D.

The following definitions are used to describe the incremental impact of the Proposed Action and each alternative in relation to ongoing and planned non-offshore and other offshore wind activities:

- **Undetectable**: The incremental impact contributed by the Proposed Action or the alternative to ongoing and planned non-offshore and other offshore wind activities is so small that it is extremely difficult or impossible to discern or measure.
- **Noticeable**: The incremental impact contributed by the Proposed Action or the alternative, while evident and measurable, is still relatively small in proportion to the impacts from the Proposed Action or the alternative when combined with ongoing and planned non-offshore and other offshore wind activities.
- **Appreciable**: The incremental impact contributed by the Proposed Action or the alternative is measurable and constitutes a relatively large portion of the impacts from the Proposed Action or the alternative when combined with ongoing and planned non-offshore and other offshore wind activities.

Table 3.3-1. Definitions of potential beneficial impact levels

Impact Level	Physical, Biological, and Cultural Resources	Socioeconomic Resources
Negligible	Either no effect or impacts would be so small that it is extremely difficult or impossible to discern or measure.	Either no effect or impacts would be so small that it is extremely difficult or impossible to discern or measure them.
Minor	Small and measurable effects comprising at least one of the following: • Improvement in ecosystem health; • Increase in the extent and quality of habitat for both special-status species and species common to the proposed Project area; • Increase in populations of species common to the proposed Project area; • Improvement in air or water quality; or • Limited spatial extent or short-term duration of improved protection of physical cultural resources.	Small and measurable effects comprising at least one of the following: • Improvement in human health; • Increase in employment (job creation and workforce development); • Improvement to infrastructure/facilities and community services; • Economic improvement (increase in local business expenditure, gross domestic product, labor income, housing demand, supply chain needs, and tax revenue); • Increase in tourism; or • Improvement for individuals and/or communities that result from enhanced protection of cultural resources.
Moderate	Notable and measurable effects comprising at least one of the following: • Improvement in ecosystem health; • Increase in the extent and quality of habitat for both special-status species and species common to the proposed Project area; • Increase in populations of species common to the proposed Project area; • Improvement in air or water quality; or • Extensive/complete spatial extent, or long-term duration of, improved protection of physical cultural resources.	Notable and measurable effects comprising at least one of the following: • Improvement in human health; • Increase in employment (job creation and workforce development); • Improvement to infrastructure/facilities and community services; • Economic improvement (increase in local business expenditures, gross domestic product, labor income, housing demand, supply chain needs, and tax revenue); • Increase in tourism; or • Improvement for individuals and/or communities that result from enhanced protection of cultural resources.

Impact Level	Physical, Biological, and Cultural Resources	Socioeconomic Resources
Major	Regional or population-level effects comprising at least one of the following: • Improvement in ecosystem health; • Increase in the extent and quality of habitat for both special-status species and species common to the proposed Project Area; • Increase of populations of species common to the proposed Project Area; • Improvement in air or water quality; or • Permanent protection of physical cultural resources.	Large local, or notable regional effects comprising at least one of the following: • Improvement in human health; • Increase in employment (job creation and workforce development); • Improvement to infrastructure/facilities and community services; • Economic improvement (increase in local business expenditures, gross domestic product, labor income, housing demand, supply chain needs, and tax revenue); • Increase in tourism; or • Improvement for individuals and/or communities that result from enhanced protection of cultural resources.

This page was intentionally left blank.

3.4 Physical Resources

3.4.1 Air Quality

This section discusses potential impacts on air quality from the proposed Project, alternatives, and ongoing and planned activities in the air quality geographic analysis area. The air quality geographic analysis area, as shown on Figure 3.4.1-1, includes the airshed within 25 miles (40 kilometers) of the WTA (corresponding to the OCS permit area) and the airshed within 15.5 miles (25 kilometers) of onshore construction areas and ports that may be used for the Project. The geographic analysis area encompasses the geographic region subject to USEPA review as part of an OCS permit for the Project under the Clean Air Act (CAA). The geographic analysis area also considers potential air quality impacts associated with the onshore construction areas and the mustering port(s) outside of the OCS permit area. Given the dispersion characteristics of emissions from marine vessels, equipment and similar emission sources that would be used during proposed construction activities, the maximum potential air quality impacts would likely occur within a few miles of the source. BOEM selected the 15.5-mile (25-kilometer) distance to assure that the locations of maximum potential air quality impact would be considered.

3.4.1.1 Description of the Affected Environment and Future Baseline Conditions

The overall geographic analysis area for air quality covers much of southern New Jersey and the adjacent portions of the Atlantic Ocean. This includes the air above the WTA and adjacent OCS area, the offshore export cable routes, onshore cable routes, the onshore substations, the construction staging areas, the onshore construction and proposed Project-related sites, and the ports in New Jersey, Virginia, and Texas used to support proposed Project activities. COP Volume II, Section 3.1.1 (Atlantic Shores 2023), provides further description of the air quality geographic analysis area. Appendix B, *Supplemental Information and Additional Figures and Tables,* provides information on climate and meteorological conditions in the Project region.

Air quality within a region is measured in comparison to the National Ambient Air Quality Standards (NAAQS), which are standards established by the USEPA pursuant to the CAA (42 USC 7409) for several common air pollutants, known as criteria pollutants, to protect human health and welfare. The criteria pollutants are carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone (O_3), particulate matter 10 microns in diameter and smaller (PM_{10}), particulate matter 2.5 microns in diameter and smaller ($PM_{2.5}$), and sulfur dioxide (SO_2). New Jersey has established ambient air quality standards (AAQS) that are similar to the NAAQS. Table 3.4.1-1 shows the NAAQS and the New Jersey AAQS. Emissions of lead from Project-associated sources would be negligible because lead is not a component of liquid or gaseous fuels; accordingly, lead is not analyzed in this Draft EIS. Ozone is not emitted directly but is formed in the atmosphere from precursor chemicals, primarily nitrogen oxides (NO_X), and volatile organic compounds (VOC), in the presence of sunlight. Potential impacts of a project on ozone levels are evaluated in terms of NO_X and VOC emissions.

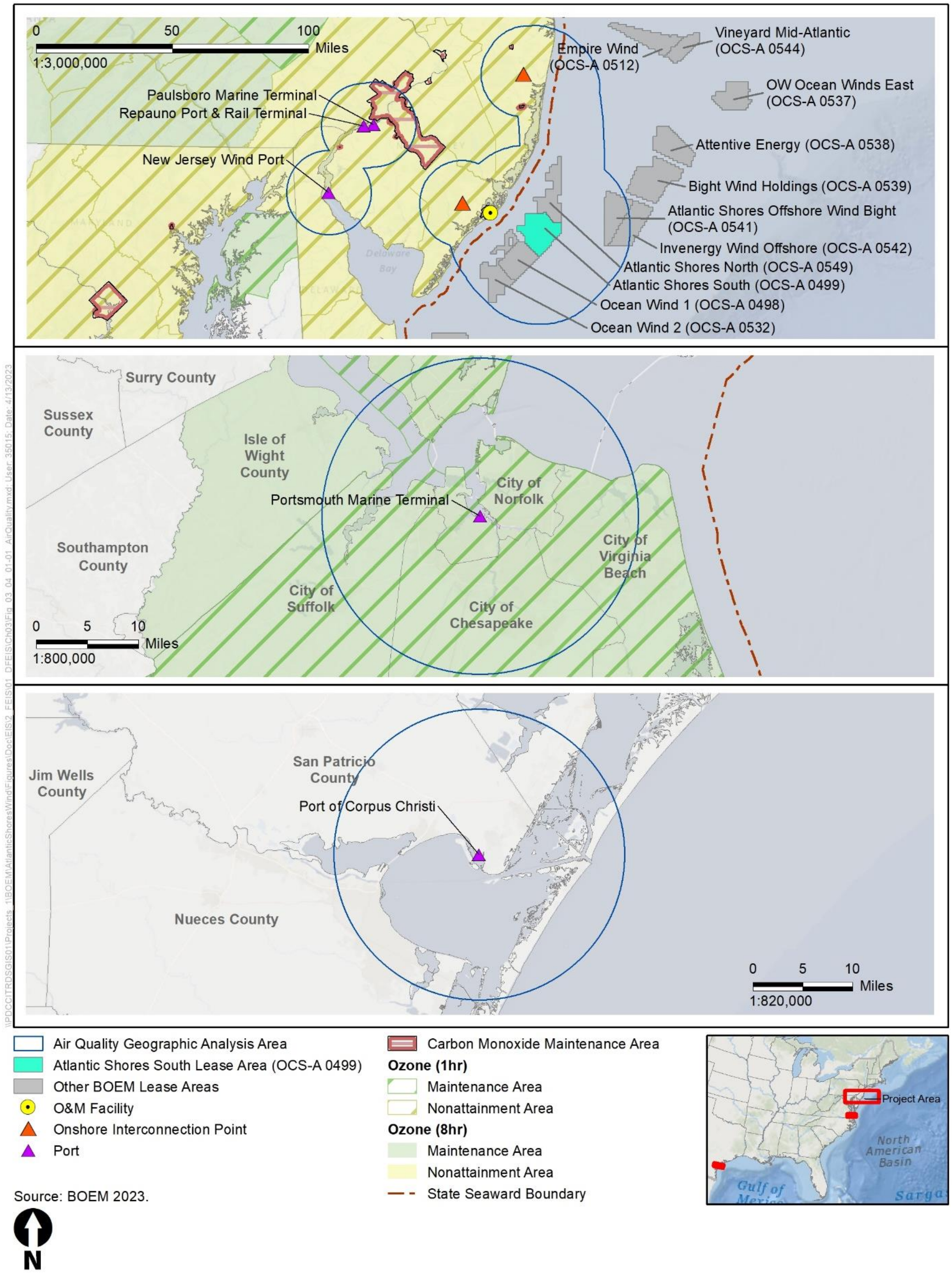


Figure 3.4.1-1. Air quality geographic analysis area and attainment status

Table 3.4.1-1. National and New Jersey ambient air quality standards

Pollutant	Averaging Period	National Ambient Air Quality Standards (µg/m³)		New Jersey Ambient Air Quality Standards (µg/m³)	
		Primary	Secondary	Primary	Secondary
Carbon Monoxide (CO)	8-hour[1]	10,000	None	10,000	10,000
	1-hour[1]	40,000	None	40,000	40,000
Lead (Pb)	Rolling 3-month average[2]	0.15	0.15	1.5	1.5
Nitrogen Dioxide (NO_2)	Annual[2]	100	100	100	100
	1-hour[3]	188	None	None	None
Ozone (O_3)	8-hour[4]	137	137	None	None
	1-hour[1]	None	None	235	160
Particulate Matter (PM_{10})	24-hour[5]	150	150	None	None
Particulate Matter ($PM_{2.5}$)	Annual[6]	12	15	None	None
	24-hour[7]	35	35	None	None
Sulfur Dioxide (SO_2)	Annual[2]	80	None	80	60
	24-hour[1]	None	None	365	260
	3-hour[1]	None	1300	None	1,300
	1-hour[8]	196	None	None	None
Suspended Particulate Matter	24-hour[3]	None	None	260	150
	Annual[9]	None	None	75	60

Sources: National – 40 CFR 50, New Jersey – NJAC 7:27-13.
µg/m³ = micrograms of pollutant per cubic meter of air.
[1] Not to be exceeded more than once per year.
[2] Not to be exceeded.
[3] 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
[4] Annual 4th-highest daily maximum 8-hour concentration, averaged over 3 years.
[5] Not to be exceeded more than once per year on average over 3 years.
[6] Annual mean, averaged over 3 years.
[7] 98th percentile, averaged over 3 years.
[8] 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
[9] Not to be exceeded (geometric mean).

USEPA designates all areas of the country as attainment, nonattainment, or unclassified for each criteria pollutant. An attainment area is an area where all criteria pollutant concentrations are within all NAAQS. A nonattainment area does not meet the NAAQS for one or more pollutants. Unclassified areas are those where attainment status cannot be determined based on available information and that are regulated as attainment areas. An area can be in attainment for some pollutants and nonattainment for others. If an area was nonattainment at any time in the last 20 years but is currently attainment or is unclassified, then the area is designated a maintenance area. States are required to prepare a State Implementation Plan (SIP) for nonattainment and maintenance areas. The SIP describes the region’s program to attain and maintain compliance with the NAAQS. The attainment status of an area can be found at 40 CFR Part 81 and in the USEPA Green Book, which the agency revises from time to time

(USEPA 2021a). Attainment status is determined through evaluation of air quality measurement data from a network of monitors.

The nearest onshore designated areas to the proposed WTA are Monmouth, Gloucester, Ocean, Atlantic, and Cape May Counties in New Jersey. These counties are designated nonattainment for ozone. Figure 3.4.1-1 displays the nonattainment and maintenance areas that intersect the geographic analysis area. The nonattainment areas encompass ports and facilities that the Project could use including the Paulsboro Marine Terminal, the Repauno Port and Rail Terminal, and the future New Jersey Wind Port for construction, and Atlantic City for O&M. Atlantic City also is in an area designated as maintenance for CO. More distant ports that could be used for construction include the Portsmouth Marine Terminal in Virginia and the Port of Corpus Christi in Texas. The Portsmouth Marine Terminal and the Port of Corpus Christi are located in attainment areas. Figure 3.4.1-1 shows the locations of all of these ports.

The CAA prohibits federal agencies from approving any activity that does not conform to a SIP. This prohibition applies only with respect to nonattainment or maintenance areas (i.e., areas that were previously nonattainment and for which a maintenance plan is required). Conformity to a SIP means conformity to a SIP's purpose of reducing the severity and number of violations of the NAAQS to achieve attainment of such standards. The activities for which BOEM has authority are outside of any nonattainment or maintenance area and therefore not subject to the requirement to show conformity.

The CAA defines Class I areas as certain national parks and wilderness areas where very little degradation of air quality is allowed. Class I areas consist of national parks larger than 6,000 acres (2,428 hectares) and wilderness areas larger than 5,000 acres (2,023 hectares) that were in existence before August 1977. Projects subject to federal air quality permits are required to notify the federal land managers responsible for designated Class I areas within 62 miles (100 kilometers) of a project.[1] The federal land manager identifies appropriate air quality–related values for the Class I area and evaluates the impact of a project on air quality–related values. The Brigantine National Wilderness Area ("Brigantine"), approximately 9 miles (14 kilometers) northwest of the nearest boundary of the Project, is the only Class I area within 62 miles (100 kilometers) of the Project. Air quality–related values (AQRV) identified by the U.S. Fish and Wildlife Service (USFWS) for Brigantine include acid deposition, mercury, ozone, and visibility (CSU 2022).

The CAA amendments (42 USC 7401 et seq., Section 328) directed USEPA to establish requirements to control air pollution from OCS oil- and gas-related activities along the Pacific, Arctic, and Atlantic Coasts and along the U.S. Gulf Coast offshore Florida, east of 87° 30' west longitude. The OCS Air Regulations (40 CFR Part 55) establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement for facilities subject to the CAA. These regulations apply to OCS sources that are beyond state seaward boundaries. Projects within 25 nautical miles (46 kilometers) of a state seaward boundary are required to comply with the air quality

[1] The 62-mile (100-kilometer) distance applies to notification and is not a threshold for use in evaluating impacts. Impacts at Class I areas at distances greater than 62 miles (100 kilometers) may need to be considered for larger emission sources if there is reason to believe that such sources could affect the air quality in the Class I area (USEPA 1992).

requirements of the nearest or corresponding onshore area, including applicable permitting requirements.

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere and contribute to global climate change by retaining heat in the atmosphere (IPCC 2021). The primary GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and certain industrial gases. The GHG emissions from the Project are a result of fuel combustion that produces emissions of CO_2, CH_4, and N_2O, as well as leakage of sulfur hexafluoride (SF_6) from gas-insulated switchgear. Because each GHG constituent has a different heat-trapping ability, GHG emissions typically are expressed as CO_2 equivalent (CO_2e) based on the specific global warming potential (GWP) for each gas. The GWP of each GHG reflects how strongly it absorbs energy compared to CO_2. CO_2e is calculated based on the sum of the individual GHG emissions weighted by their respective GWPs.[2]

3.4.1.2 Impact Level Definitions for Air Quality

Definitions of adverse impact levels are provided in Table 3.4.1-2. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions. Impact levels are intended to serve NEPA purposes only, and are not intended to establish thresholds or other requirements with respect to permitting under the CAA.

Table 3.4.1-2. Impact level definitions for air quality

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

3.4.1.3 Impacts of Alternative A – No Action on Air Quality

When analyzing the impacts of the No Action Alternative on air quality, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for air quality. The cumulative impacts of the No Action Alternative considered the

[2] The GWPs used to calculate CO_2e were taken from Table A-1 of 40 CFR Part 98, Subpart A. The GWPs are 1 for CO_2, 25 for CH_4, 298 for N_2O, and 22,800 for SF_6.

impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for air quality described in Section 3.4.1.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on air quality are generally associated with existing onshore land uses, including residential, commercial, industrial, and transportation activities, as well as onshore construction activities. Other ongoing activities that could contribute to air quality impacts include construction of undersea transmission lines, gas pipelines, and other submarine cables; marine minerals use and ocean-dredged material disposal; military use; marine transportation; and oil and gas activities. These activities and associated impacts are expected to continue at current trends and have the potential to affect air quality through their emissions. Impacts associated with climate change could affect ambient air quality through increased formation of ozone and particulate matter associated with increasing air temperatures. See Appendix D, Table D.A1-1 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for air quality. There are no ongoing offshore wind activities within the geographic analysis area for air quality.

NJDEP has projected that under a scenario of continuation of current regulations and policies, emissions from electricity generation would decline slowly through 2050 due to improvements in efficiency and switching to cleaner fuels (NJDEP 2019). Under the No Action Alternative, without implementation of other offshore wind projects, the electricity that would have been generated by offshore wind would likely be provided by fossil-fuel fired facilities.[3] As a result, a continuation of activities under the No Action Alternative could lead to less decline in emissions than would occur with offshore wind development. An overall mix of natural gas, solar, wind, and energy storage would likely occur in the future due to market forces and state energy policies. New Jersey EO 307 (September 22, 2022) sets a goal of developing 11 GW of offshore wind energy off the coast of New Jersey by 2040. The New Jersey Energy Master Plan (New Jersey Board of Public Utilities 2019) sets a goal of transitioning New Jersey to 100 percent renewable electricity by 2050.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

---

[3] In 2020, the generation mix of the PJM Interconnection, the regional grid that serves New Jersey, was approximately 40 percent natural gas, 34 percent nuclear, 19 percent coal, 3 percent wind, 2 percent hydroelectric, and 2 percent other sources, on an annual average basis (Monitoring Analytics 2021).

Planned non-offshore wind activities within the geographic analysis area that contribute to cumulative impacts on air quality are generally associated with existing onshore land uses, including residential, commercial, industrial, and transportation activities, as well as onshore construction activities. Other planned non-offshore activities that could contribute to air quality impacts include construction of undersea transmission lines, gas pipelines, and other submarine cables; marine minerals use and ocean-dredged material disposal; military use; marine transportation; oil and gas activities; and onshore development activities (Appendix D). These planned non-offshore wind activities have the potential to affect air quality through their emissions. Impacts associated with climate change could affect ambient air quality through increased formation of ozone and particulate matter associated with increasing air temperatures.

Planned offshore wind activities within the geographic analysis area that could contribute to impacts on air quality include construction and installation of:

- Ocean Wind 1 (OCS-A 0498) (98 WTGs), expected 2024–2025,
- Ocean Wind 2 (OCS-A 0532) (111 WTGs), expected 2026–2030, and
- Atlantic Shores North (OCS-A 0549) (157 WTGs), expected 2026–2030[4].

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

Air emissions: Most air pollutant emissions and air quality impacts from planned offshore wind projects would occur during construction, potentially from multiple projects occurring simultaneously. The only projects currently proposed in the air quality analysis area for which construction could occur simultaneously with the Project are the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would shift spatially and temporally across the air quality geographic analysis area.

All projects would be required to comply with the CAA. Primary emission sources would include vessel traffic, increased public and commercial vehicular traffic, air traffic, combustion emissions from construction equipment, and fugitive[5] particle emissions from construction-generated dust. During operations, emissions from planned offshore wind projects within the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. COP Appendix II-C (Atlantic Shores 2023)

---

[4] Atlantic Shores Offshore Wind Bight (OCS-A 0539) and Invenergy Wind Offshore (OCS-A 0542) are within the geographic analysis area; however, annual air emission estimates are not yet available for these two projects (both of which are in the planning stage). If available, air emission estimates will be incorporated into the Final EIS.

[5] Fugitive emissions are emissions that are not emitted from a stack, vent, or other specific point that controls the discharge. For example, windblown dust is fugitive particulate matter.

provides details of these emission sources for construction and operations, as well as regulatory applicability of emissions by geographic area for purposes of NEPA and permitting.

The aggregate O&M emissions for all projects within the air quality geographic analysis area would vary by year as successive projects begin operation. As wind energy projects come online, power generation emissions overall would decrease to the extent that wind energy would displace emissions from fossil-fueled electric generating facilities, and the region as a whole would realize a net benefit to air quality. The planned offshore wind projects other than the Proposed Action that may result in air pollutant emissions and air quality impacts within the air quality geographic analysis area include projects within all or portions of the following Lease Areas: OCS-A-0549, OCS-A-0498, and OCS-A-0532 (Appendix D, Table D.A2-4). Projects currently proposed in these Lease Areas are Atlantic Shores North, Ocean Wind 1, and Ocean Wind 2, respectively. These projects would produce 5,009 MW of renewable power from the installation of 366 WTGs (Appendix D, Table D.A2-1). Based on the assumed offshore construction schedule in Appendix D, Table D.A2-1, two of the three projects within the geographic analysis area would have overlapping construction periods in 2026 through 2030.

During the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than Atlantic Shores South (Atlantic Shores North and Ocean Wind 1 and 2) proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 6,602 tons of CO, 32,088 tons of NO_X, 1,061 tons of PM_{10}, 1,013 tons of $PM_{2.5}$, 274 tons of SO_2, 787 tons of VOCs, and 1,959,192 tons of CO_2 (Appendix D, Table D.A2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would be minor, shifting spatially and temporally across the air quality geographic analysis area.

During operations, emissions from planned offshore wind projects within the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from O&M vessel traffic and emergency diesel generators. The aggregate operational emissions from planned offshore wind projects other than Atlantic Shores South would vary by year as successive projects begin operation. Estimated operational emissions would be 40–180 tons per year of CO, 159–746 tons per year of NO_X, 6–25 tons per year of PM_{10}, 5-24 tons per year of $PM_{2.5}$, 1–3 tons per year of SO_2, 4-15 tons per year of VOCs, and 11,752-51,412 tons per year of CO_2 (Appendix D, Table D.A2-4). Operational emissions would overall be intermittent and dispersed throughout the 241,609-acre (97,776-hectare) Lease Area (for Ocean Wind 1 and 2 and Atlantic Shores North combined) and the vessel routes from the onshore O&M facility and would generally contribute to small and localized air quality impacts.

Offshore wind energy development, by displacing fossil-fuel energy, would help offset emissions from fossil fuels, improving regional air quality and reducing GHG emissions. An analysis by Katzenstein and

Apt (2009), for example, estimates that CO_2 emissions can be reduced by up to 80 percent and NO_X emissions can be reduced up to 50 percent by implementing wind energy projects. An analysis by Barthelmie and Pryor (2021) calculated that, depending on global trends in GHG emissions and the amount of wind energy expansion, development of wind energy could reduce predicted increases in global surface temperature by 0.5–1.4 degrees Fahrenheit (°F) (0.3–0.8 degrees Celsius [°C]) by 2100.

Estimations and evaluations of potential health and climate benefits from offshore wind activities for specific regions and project sizes rely on information about the air pollutant emission contributions of the existing and projected mixes of electric power generation sources, and generally estimate the annual health benefits of an individual commercial scale offshore wind project to be valued in the hundreds of millions of dollars (Kempton et al. 2005; Buonocoure et al. 2016).

Construction and operation of other (not the proposed Project) planned offshore wind projects would produce GHG emissions that would contribute incrementally to climate change. CO_2 is relatively stable in the atmosphere and, for the most part, mixed uniformly throughout the troposphere and stratosphere. As such, the impact of GHG emissions does not depend upon the CO_2 source location. Increasing energy production from offshore wind projects would likely reduce regional and overall GHG emissions by displacing energy from fossil fuels. This reduction would be greater than the construction and operation GHG emissions from offshore wind projects (Appendix D, Table D.A2-4). This reduction in regional GHG emissions would be noticeable in the regional context, would contribute incrementally to reducing climate change, and would represent a moderate beneficial impact in the regional context but a negligible beneficial impact in the global context.

Accidental releases: Planned offshore wind activities could release hazardous air pollutants (HAPs) in the event of accidental chemical spills within the air quality geographic analysis area. Section 3.4.2, *Water Quality*, includes a discussion of the nature of releases that could occur. Based on Appendix D, Table D.A2-3, up to about 1,030,582 gallons (3.9 million liters) of coolants, 2,092,564 gallons (7.9 million liters) of oils and lubricants, and 906,768 gallons (3.4 million liters) of diesel fuel would be contained in the 377 wind turbine and substation structures for the wind energy projects within the air quality geographic analysis area (Atlantic Shores North, and Ocean Wind 1 and 2). If accidental releases occur, they would most likely occur during construction but could occur during operations and decommissioning of offshore wind facilities. These may lead to short periods (hours to days)[6] of HAP emissions through surface evaporation. HAP emissions would consist of VOCs, which may be important for ozone formation. By comparison, the smallest tanker vessel operating in these waters (a general-purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million and 30.3 million liters). Tankers are relatively common in these waters, and the total WTG chemical storage capacity within the geographic analysis area for air quality is much less than the volume of hazardous liquids transported by ongoing activities (U.S. Energy Information Administration 2014). Moreover, liquids associated with the Project would be distributed among hundreds of independent marine-grade containers spread out over many different structures, thus making any kind of full release extremely unlikely. BOEM expects air

[6] For example, small diesel fuel spills (500–5,000 gallons) usually will evaporate and disperse within a day or less (NOAA 2006).

quality impacts from accidental releases would be negligible because they would be short term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 34-year period with a higher probability of spills during future project construction, but they would not be expected to contribute appreciably to cumulative impacts on air quality.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, air quality would continue to be affected by existing environmental trends and ongoing activities. Additional, higher-emitting, fossil-fuel energy facilities would be kept in service to meet electric power demand, fired by natural gas, oil, or coal. Although the proposed Project would not be built under the No Action Alternative, BOEM expects ongoing non-offshore wind activities and offshore wind activities to have continuing regional air quality impacts primarily through air pollutant emissions and accidental releases.

BOEM anticipates that the impacts of ongoing non-offshore wind activities associated with the No Action Alternative, such as air pollutant emissions and GHGs, would be **moderate** because they would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS or New Jersey AAQS. Although the proposed Project would not be built under the No Action Alternative, BOEM expects ongoing non-offshore wind activities would continue to have regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change.

Cumulative Impacts of Alternative A – No Action. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Under the No Action Alternative, existing environmental trends and activities would continue, and air quality would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on air quality. BOEM anticipates that the No Action Alternative combined with all other planned activities (including offshore wind) in the geographic analysis area would result in **moderate adverse** impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Impacts would be moderate because these emissions would incrementally increase ambient pollutant concentrations (more than would activities without offshore wind or offshore wind alone), though not by enough to cause a violation of the NAAQS or New Jersey AAQS. Most air pollutant emissions and air quality impacts from offshore wind would occur during multiple overlapping project construction phases from 2026 through 2030 (Appendix D, Table D.A2-4). Pollutant emissions associated with offshore wind operations would be generally lower and more transient.

BOEM expects **minor** to **moderate beneficial** impacts on regional air quality after offshore wind projects are operational because these projects likely would lead to reduced emissions from fossil-fueled power generating facilities.

3.4.1.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on air quality:

- Emission ratings of construction equipment and vehicle engines;
- Location of construction laydown areas;
- Choice of cable-laying locations and pathways;
- Choice of marine traffic routes to and from the WTA and offshore export cable routes;
- Soil characteristics at onshore excavation areas, which may affect fugitive emissions; and
- Emission control strategy for fugitive emissions due to onshore excavation and hauling operations.

Changes to the design capacity of the WTGs would not alter the maximum potential air quality impacts for the Proposed Action and other action alternatives because the maximum-case scenario involved the maximum number of WTGs (200) allowed in the PDE.

3.4.1.5 Impacts of Alternative B – Proposed Action on Air Quality

Air emissions: The Project would generate emissions that may affect air quality in the New Jersey region and nearby coastal waters during construction, O&M, and decommissioning activities. Onshore emissions would occur at the Monmouth and Atlantic Landfall Sites, in the onshore cable corridors, and at the Larrabee and Cardiff Substation POIs. Offshore emissions would be within the OCS and state offshore waters. Offshore emissions would occur in the Lease Area and the offshore export cable corridors. COP Volume I, Section 1.1 (Atlantic Shores 2023) provides additional information on the landfall locations and onshore cable routes.

Air quality in the geographic analysis area may be affected by emissions of criteria pollutants from sources involved in the construction or maintenance of the proposed Project and, potentially, during operations. These impacts, while generally localized to the areas near the emission sources, may occur at any location associated with the proposed Project, be it offshore in the WTA or at any of the onshore construction or support sites. Ozone levels in the region also could be affected.

The proposed Project’s WTGs, OSSs, offshore and onshore cable corridors, and onshore substations and/or converter stations would not themselves generate air pollutant emissions during normal operations. (Equipment containing SF_6 could generate GHG emissions that contribute to climate change.) However, air pollutant emissions from equipment used in the construction, O&M, and decommissioning phases could affect air quality in the proposed Project area and nearby coastal waters and shore areas. Most emissions would occur temporarily during construction, offshore in the WTA, onshore at the landfall sites, along the offshore and onshore cable routes, at the onshore substations, and at the construction staging areas. Additional emissions related to the proposed Project could also occur at ports used to transport material and personnel to and from the Project site. However, the proposed Project would provide beneficial impacts on the air quality near the proposed Project location and the surrounding region to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants in the region.

The majority of air pollutant and GHG emissions from the Proposed Action alone would come from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during offshore construction activities and during offshore O&M activities. All engines would meet or exceed applicable emissions standards (AQ-01; Appendix G, Table G-1). Atlantic Shores would endeavor to minimize air emissions by using the cleanest vessel engines available for the task (subject to meeting the safety, efficacy, scheduling, and contracting needs for the task) (AQ-01 – AQ-04; Appendix G, Table G-1). Atlantic Shores is actively evaluating opportunities to use liquefied natural gas or hydrogen as the primary fuel for vessels to be used for routine O&M (AQ-03; Appendix G, Table G-1). Clean fuels would be used to the maximum extent practicable (AQ-04; Appendix G, Table G-1). Marine diesel fuel and onshore Ultra Low Sulfur Diesel will comply with the USEPA fuel sulfur limit of 15 parts per million (ppm) (AQ-04, Appendix G, Table G-1). For heavier residual fuel oils used in heavier marine engines, and for engines on foreign vessels, the Project would comply with the fuel oil sulfur content limit of 1,000 ppm set in the International Convention for the Prevention of Pollution from Ships, Annex VI protocol (MARPOL VI) and corresponding USEPA regulations (AQ-04; Appendix G, Table G-1). Atlantic Shores would use best management practices (BMPs) to minimize air emissions from vessel operations, including optimizing construction and O&M activities to minimize vessel operating times and loads (AQ-05; Appendix G, Table G-1). Atlantic Shores would develop dust-control plans for onshore construction areas to minimize effects from fugitive dust resulting from construction activities (GEO-14; Atlantic Shores; Appendix G, Table G-1).

Fuel combustion and solvent use would cause construction-related emissions. Excavation and related earthworks would cause construction-related fugitive dust emissions. The air pollutants would include criteria pollutants, VOCs, and HAPs, as well as GHGs. During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses also could have impacts on air quality. Because the specific combination of ports to be used and the amount of activity that would occur at each port are unknown, construction emissions were calculated for a maximum-emissions scenario with heavy vessels using the New Jersey Wind Port and the Paulsboro Marine Terminal, and Crew Transfer Vessels using the port of Atlantic City (COP, Volume II, Section 3.1.2; Atlantic Shores 2023). For purposes of calculating emissions from vessels, the full travel distance from the applicable port to the Project area was used. Atlantic Shores has committed to EPMs to minimize construction emissions and associated air quality impacts. Appendix G, *Mitigation and Monitoring,* Table G-1 lists the Applicant-Proposed EPMs. Table 3.4.1-3 summarizes estimated construction emissions of each pollutant by year.

Table 3.4.1-3. Atlantic Shores South construction emissions (U.S. tons)

Year	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
2024	503	2,089	70	68	7	40	142,818	4	27	144,850
2025	503	2,089	70	68	7	40	142,818	4	27	144,850
2026	503	2,089	70	68	7	40	142,818	4	27	144,850
2027	503	2,089	70	68	7	53	142,818	4	27	144,850
Total	**2,012**	**8,356**	**280**	**272**	**28**	**173**	**571,270**	**4.1**	**26.9**	**579,398**

Source: Appendix D, Table D.A2-4; Atlantic Shores 2023.
Sum of individual values may not equal total due to rounding.

Onshore activities of the Proposed Action would consist primarily of cable installation (using trenching, HDD, or other technologies), duct bank construction, cable-pulling operations, and onshore substation or converter station construction, POI construction, and onshore O&M facility construction.

Atlantic Shores is evaluating three potential sites for the proposed Larrabee substation and/or converter station. The potential cable routes from the landfall location to the Larrabee substation and/or converter station would differ for each site. Construction emissions could differ for each site depending on the distance from the landfall site and local conditions along each cable route. Construction of the O&M facility would involve a new building and associated parking structure, repairs to the existing docks, and installation of a communication antenna.

Emissions from onshore construction would primarily be from operation of diesel-powered equipment and vehicle activity such as bulldozers, excavators, and heavy trucks, and fugitive particulate emissions from excavation and hauling of soil.

These onshore emissions would be highly variable and limited in spatial extent at any given period and would result in minor impacts, as they would be short term in nature. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Emissions from offshore construction activities would vary throughout the construction and installation of offshore components. Emissions from offshore activities would occur during pile and scour protection installation, offshore cable laying, turbine installation, and offshore substation installation. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and offshore substations so that workers could operate lights, controls, and other equipment before cabling is in place. There also would be emissions from engines used to power pile-driving hammers and air compressors used to supply compressed air to noise-mitigation devices during pile driving (if used). Emissions from vessels used to transport workers, supplies, and equipment to and from the construction areas would result in additional air quality impacts. The Project may need to operate emergency generators at times, potentially resulting in increased emissions for limited periods.

During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. The proposed Project's contribution would be additive with the impact(s) of any and all other operational activities, including offshore wind activities, that occur within the air quality geographic analysis area. COP Section 5.4 (Atlantic Shores 2023) provides a more detailed description of offshore and onshore O&M activities. The annual estimated emissions for O&M are summarized in Table 3.4.1-4.

Table 3.4.1-4. Atlantic Shores South operations and maintenance emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
Annual	121	519	17	16	1	9	33,631	0.20	1.60	34,872
Lifetime (30 years)	3,630	15,570	510	480	30	270	1,008,930	6	48	1,046,160

Sources: COP Volume II, Table 3.1-3; Atlantic Shores 2023.

Atlantic Shores has committed to Applicant-Proposed EPMs to minimize O&M emissions and associated air quality impacts. Appendix G, Table G-1 lists these measures.

BOEM anticipates that air quality impacts from O&M of the Proposed Action alone would be minor, occurring for short periods of time several times per year during the proposed 30-year Project operating life.

Emissions from onshore O&M activities would be limited to periodic use of construction vehicles and equipment. Onshore O&M activities would include occasional inspections and repairs to the onshore substation and splice vaults, which would require minimal use of worker vehicles and construction equipment. Atlantic Shores intends to use port facilities at Atlantic City, New Jersey, to support O&M activities. BOEM anticipates that air quality impacts due to onshore O&M from the Proposed Action alone would be minor, intermittent, and occurring for short periods.

Offshore O&M activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance and repairs. The WTGs operating under the Proposed Action would themselves have no air pollutant emissions. (Equipment containing SF_6 could produce GHG emissions that contribute to climate change.) Emergency generators on the WTGs and the substations would operate only during emergencies or testing, so emissions from these sources would be small and transient. Pollutant emissions from O&M would be mostly the result of operations of ocean vessels and helicopters used for maintenance activities. Crew transfer vessels and helicopters would transport crews to the WTA for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would travel infrequently to the WTA for significant maintenance and repairs.

Increases in renewable energy production could lead to reductions in emissions from fossil-fueled power plants. Atlantic Shores estimated the emissions avoided as a result of the Proposed Action. The avoided emissions estimate is based on the annual power generation and the associated grid emissions for each pollutant. The annual power generation was based on the Project capacity (2,837 MW), the capacity factor (assumed as 50%), a transmission loss factor (assumed as 4%), and annual operating hours (assumed as 8,760 hours per year). The capacity is multiplied by the capacity factor and hours per year and then adjusted down by the transmission loss factor. For the Proposed Action this would be 2,837 MW x 50 percent capacity factor x 8,760 hour/year x (1 minus 4 percent transmission loss factor)

= approximately 11,930,000 MWh generated to the grid. The total annual power generated to the grid is then multiplied by the grid average non-baseload annual factors for each pollutant for the Reliability First Corporation – East grid region as found in the USEPA eGRID 2018 v2 data set to get annual emissions displacement per year for each pollutant.

Once operational, the Proposed Action would result in annual avoided emissions of 3,536 tons of NO_X, 250 tons of $PM_{2.5}$, 4,170 tons of SO_2, and 6,484,000 tons (5,882,155 metric tons) of CO_2e (COP Volume II, Table 3.1-7; Atlantic Shores 2023). This estimate is derived assuming the electricity generation mix for 2018. If renewable energy sources make up more of the electricity generation mix in the future, the amount of avoided emissions would be less. The avoided CO_2 emissions are equivalent to the emissions generated by about 1,279,000 passenger vehicles in a year (USEPA 2020a). Through its addition to regional generating capacity and the avoided GHG emissions the Project would contribute toward meeting New Jersey's goals of developing 11 GW of offshore wind energy off the coast of New Jersey by 2040 and transitioning New Jersey to 100 percent renewable electricity by 2050. Accounting for construction emissions and assuming decommissioning emissions would be the same, and including emissions from future operations, operation of the Proposed Action would offset emissions related to its development and eventual decommissioning within different time periods of operation depending on the pollutant: NO_X would be offset in approximately 5 years of operation, $PM_{2.5}$ in approximately 2 years, SO_2 in 1 month, and CO_2 in 2 months. If emissions from future operations and decommissioning were not included, the times required for emissions to "break even" would be shorter. From that point, the Project would be offsetting emissions that would otherwise be generated from another source.

The potential health benefits of avoided emissions can be evaluated using USEPA's Co-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool (USEPA 2020b). COBRA is a tool that estimates the health and economic benefits of clean energy policies. COBRA was used to analyze the avoided emissions that were calculated for the Proposed Action. Table 3.4.1-5 presents the estimated avoided health effects.

Table 3.4.1-5. COBRA estimate of annual avoided health effects with the Proposed Action

Discount Rate[1] (2023)	Avoided Mortality (cases per year)		Monetized Total Health Benefits (million U.S. dollars per year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3%	22.223	50.307	243.3	550.5
7%	22.233	50.307	216.7	490.3

[1] The discount rate is used to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the "time value of money" preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2021b).
[2] The low and high estimates are derived using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2021b).

The overall impacts of GHG emissions can be assessed using "social costs." The "social cost of carbon," "social cost of nitrous oxide," and "social cost of methane"—together, the "social cost of greenhouse gases" (SC-GHG)—are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year. NEPA does not require monetizing costs and benefits but allows the use of the social cost of carbon, SC-GHG, or other monetized costs and benefits of GHGs in weighing the merits and drawbacks of alternative actions. In January 2023, CEQ issued interim guidance (CEQ 2023) that updates its 2016 guidance document (CEQ 2016) on consideration of GHGs and climate change under NEPA. The interim guidance recommends that agencies provide context for GHG emissions, including through the use of SC-GHG estimates, to translate climate impacts into the more accessible metric of dollars.

For federal agencies, the best currently available estimates of SC-GHG are the interim estimates of the social costs of CO_2, CH_4, and N_2O developed by the Interagency Working Group (IWG) on SC-GHG and published in its Technical Support Document (IWG 2021). IWG's SC-GHG estimates are based on complex models describing how GHG emissions affect global temperatures, sea level rise, and other biophysical processes; how these changes affect society through, for example, agricultural, health, or other effects; and monetary estimates of the market and nonmarket values of these effects. The IWG developed monetary estimates based on models that use damage functions to express mathematically a simplified relationship between climate variables, such as temperature change, and economic losses. One key parameter in the models is the discount rate, which is used to estimate the present value of the stream of future damages associated with emissions in a particular year. The discount rate accounts for the "time value of money," i.e., a general preference for receiving economic benefits now rather than later, by discounting benefits received later. A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (i.e., future benefits or costs are less valuable or are a less significant factor in present-day decisions). IWG developed the current set of interim estimates of SC-GHG using three different annual discount rates: 2.5 percent, 3 percent, and 5 percent (IWG 2021).

There are multiple sources of uncertainty inherent in the SC-GHG estimates. Some sources of uncertainty relate to physical effects of GHG emissions, human behavior, future population growth and economic changes, and potential adaptation (IWG 2021). To better understand and communicate the quantifiable uncertainty, the IWG method generates several thousand estimates of the social cost for a specific gas, emitted in a specific year, with a specific discount rate. These estimates create a frequency distribution based on different values for key uncertain climate model parameters. The shape and characteristics of that frequency distribution demonstrate the magnitude of uncertainty relative to the average or expected outcome.

To further address uncertainty, IWG recommends reporting four SC-GHG estimates in any analysis. Three of the SC-GHG estimates reflect the average damages from the multiple simulations at each of the three discount rates. The fourth value represents higher-than-expected economic impacts from climate change. Specifically, it represents the 95^{th} percentile of damages estimated, applying a 3 percent annual discount rate for future economic effects. This is a low-probability but high-damage scenario and represents an upper bound of damages within the 3 percent discount rate model. The estimates below follow the IWG recommendations.

Table 3.4.1-6 presents the SC-GHG associated with estimated emissions from the Proposed Action. These estimates represent the present value of future market and nonmarket costs associated with CO_2,

CH_4, and N_2O emissions. In accordance with the IWG's recommendation, four estimates were calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and Atlantic Shores' estimates of emissions in each year. In Table 3.4.1-6, negative values represent social benefits of avoided GHG emissions. The negative values for net SC-GHG indicate that the impact of the Proposed Action on GHG emissions and climate would be a net benefit in terms of SC-GHG. This benefit would be realized during Project operations.

Table 3.4.1-6. Estimated social cost of GHGs associated with the Proposed Action

Description	Social Cost of GHGs (2020$)			
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
SC-CO_2				
Construction, Operation, and Decommissioning	$19,598,000	$79,999,000	$123,362,000	$243,298,000
Avoided Emissions	-$1,753,806,000	-$7,297,950,000	-$11,275,395,000	-$22,312,482,000
Net SCC- CO_2	-$1,734,208,000	-$7,217,951,000	-$11,152,033,000	-$22,069,184,000
SC-CH_4				
Construction, Operation, and Decommissioning	$993,000	$2,747,000	$3,783,000	$7,302,000
Avoided Emissions	-$90,168,000	-$254,516,000	-$350,859,000	-$678,873,000
Net SCC-CH_4	-$89,175,000	-$251,769,000	-$347,076,000	-$671,571,000
SC-N_2O				
Construction, Operation, and Decommissioning	$19,365,000	$73,374,000	$112,575,000	$195,089,000
Avoided Emissions	-$1,736,888,000	-$6,715,843,000	-$10,327,014,000	-$17,898,146,000
Net SCC-N_2O	-$1,717,523,000	-$6,642,469,000	-$10,214,439,000	-$17,703,057,000
SC-GHG				
Construction, Operation, and Decommissioning	$39,956,000	$156,121,000	$239,719,000	$445,688,000
Avoided Emissions	-$3,580,863,000	-$14,268,309,000	-$21,953,268,000	-$40,889,501,000
Net SC-GHG	-$3,540,907,000	-$14,112,189,000	-$21,713,548,000	-$40,443,813,000

Estimates are the sum of the social costs for CO_2, CH_4, and N_2O over the Project lifetime. Negative costs indicate benefits. Estimates are rounded to the nearest $1,000.

Table 3.4.1-7 presents the annual emissions, avoided emissions, and net emissions of CO_2 over the operational lifetime[7] of the Project for each alternative. Net emissions are the Project emissions minus the avoided emissions. The emissions avoided by the Proposed Action, 5,882,155 metric tons CO_2 per year (Table 3.4.1-7), would be equivalent to about 1,279,000 additional passenger vehicles removed from the road per year (USEPA 2020a). Each action alternative is assumed to have the same nameplate capacity for each WTG. Alternatives with fewer WTGs than the Proposed Action would reduce the construction and O&M emissions, but also would reduce the net benefits to the grid because less energy from renewables would be produced compared to the Proposed Action. The estimates of avoided

[7] The assumed Project operational lifetime is 30 years, while Lease OCS-A 0499 has an operation term of 25 years. Atlantic Shores would need to request and be granted lease renewal from BOEM in order to operate the proposed Project for 30 years.

emissions assume the 2018 grid configuration as noted above, but the actual annual quantity of avoided emissions attributable to this proposed facility is expected to diminish over time if the electric grid becomes lower-emitting due to the addition of other renewable energy facilities and retirement of high-emitting generators.

The No Action Alternative would result in no emissions during construction and O&M because the Project would not be built, but would also offer no avoided emissions, resulting in higher GHG emissions over the Project duration due to not displacing fossil-fueled power generation via offshore wind. The emissions not avoided relative to the Proposed Action, 5,882,155 metric tons CO_2 per year (Table 3.4.1-7), would be equivalent to about 1,279,000 additional passenger vehicles per year.

Table 3.4.1-7. Net emissions of CO_2 for each alternative

Alternative	CO_2 Emissions (metric tons)[1]									
	Construction 2024–2027					Operation 2028–2057				Construction + Operation 2024–2057
	2024	2025	2026	2027	Total Construction	O&M Emissions (Annual)	Avoided Emissions (Annual)	Net Emissions (Annual)	Operational Lifetime Net Emissions[2]	Total Lifetime Net Emissions
A (No Action)	0	0	0	0	0	0	0	0	0	176,464,654 [3]
B (Proposed Action)	129,562	129,562	129,562	129,562	518,247	30,450	-5,882,155	-5,851,705	-175,551,141	-175,032,895
C1 [4]	119,123	119,123	119,123	119,123	476,492	27,997	-5,408,237	-5,380,240	-161,407,211	-160,930,719
C2	121,579	121,579	121,579	121,579	486,317	28,574	-5,519,747	-5,491,173	-164,735,194	-164,248,878
C3	125,877	125,877	125,877	125,877	503,510	29,585	-5,714,890	-5,685,306	-170,559,166	-170,055,656
C4	129,562	129,562	129,562	129,562	518,247	30,450	-5,882,155	-5,851,705	-175,551,141	-175,032,895
D1	116,667	116,667	116,667	116,667	466,667	27,420	-5,296,727	-5,269,308	-158,079,227	-157,612,559
D2	110,527	110,527	110,527	110,527	442,106	25,977	-5,017,952	-4,991,976	-149,759,268	-149,317,162
D3	125,877	125,877	125,877	125,877	503,510	29,585	-5,714,890	-5,685,306	-170,559,166	-170,055,656
E	126,491	126,491	126,491	126,491	505,966	29,729	-5,742,768	-5,713,039	-171,391,162	-170,885,196
F1	129,562	129,562	129,562	129,562	518,247	30,450	-5,882,155	-5,851,705	-175,551,141	-175,032,895
F2	129,562	129,562	129,562	129,562	518,247	30,450	-5,882,155	-5,851,705	-175,551,141	-175,032,895
F3	129,562	129,562	129,562	129,562	518,247	30,450	-5,882,155	-5,851,705	-175,551,141	-175,032,895

[1] Positive values are emissions increases; negative values are emissions decreases.
[2] Emissions from decommissioning are not included.
[3] Represents emissions from the grid in the absence of the Project.
[4] Emissions for Alternatives C through F are estimated as the Proposed Action emissions times the ratio of the number of foundations for the alternative to the number of foundations for the Proposed Action.

At the end of the operational lifetime of the Atlantic Shores South Project, it would be decommissioned. Atlantic Shores anticipates that all structures above the seabed level or aboveground would be completely removed. The decommissioning sequence would generally be the reverse of the construction sequence, involve similar types and numbers of vessels, and use similar equipment.

Emissions from Project decommissioning were not quantified but are expected to be less than for construction. The Project anticipates pursuing a separate OCS Air Permit for those activities because it is assumed that marine vessels, equipment, and construction technology will change substantially in the next 34 years and in the future will have lower emissions than current vessels and equipment. BOEM anticipates minor and short-term air quality impacts from the Proposed Action due to decommissioning.

Onshore decommissioning activities would include removal of facilities and equipment and restoration of the sites to pre-Project conditions, where warranted. Because the emissions related to onshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. If decommissioning activities for projects overlap in time, then impacts could be greater for the duration of the overlap.

The dismantling and removal of the turbine components (blades, nacelles, and towers) and other offshore components would largely be a “reverse installation” process subject to the same constraints as the original construction phase. BOEM expects that air quality impacts would be similar in nature to construction impacts but lesser in magnitude.

Ambient pollutant concentrations that could result from emissions associated with the Project are compared to the NAAQS, USEPA Prevention of Significant Deterioration (PSD) increments, and other criteria. As part of its OCS air quality permit application (Atlantic Shores 2022), Atlantic Shores used air quality dispersion modeling to estimate pollutant concentrations. The following summarizes the regulatory requirements that are satisfied using air quality dispersion modeling, the modeling techniques used, and the results. The modeling analysis documents compliance with all relevant regulatory standards and demonstrates that the Project would not cause or contribute to any condition of unhealthy air. The OCS air permit application (Atlantic Shores 2022) provides further information on the ambient concentrations analysis.

PSD increments are the amount of increase in air pollution an area is allowed and are intended to prevent the air quality in clean areas from deteriorating to the level set by the NAAQS. For projects subject to PSD review, the PSD increments set the maximum allowable increase in concentration that is acceptable to occur above a baseline concentration for a pollutant. Separate increments apply for Class I and Class II areas (all areas other than Class I). As noted above, the nearest Class I area to the WTA is the Brigantine National Wilderness Area.

Atlantic Shores used the Coupled Ocean-Atmosphere Response Experiment (COARE) bulk flux algorithm, as implemented within the AERCOARE program for use in the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The AERCOARE-AERMOD modeling system is an alternative for assessing compliance with air quality standards when emission sources and dispersion occur over water. Prognostic data from the Weather Research and Forecast Model was used to derive the hourly surface data and upper air data (i.e., humidity, temperature, and water surface temperature) that is used for meteorological observations. When modeling impacts of NO_2, the analysis used the Ambient Ratio Method (ARM2) screening technique to account for the fact that not all Project NO_X emissions will form NO_2.

The AECOARE-AERMOD modeling system does not address secondary pollutant formation. For secondary formation of $PM_{2.5}$, Atlantic Shores used the View QLIK Modeled Emission Rate Precursor

(MERP) methodology stack modeling results to derive a project-specific MERP in accordance with USEPA guidance.

When documenting compliance with NAAQS or New Jersey AAQS, modeled concentrations are added to the appropriate measured background concentration, and the total is compared to the standard. Table 3.4.1-8 presents the maximum modeled concentrations across all construction activities and shows that all estimated concentrations associated with construction would be less than the NAAQS and New Jersey AAQS. Because emissions from O&M would be less than those for construction, concentrations during O&M would be lower than the values shown in Table 3.4.1-8. In addition, the modeling determined that the maximum impacts would occur entirely over water miles from shore, where the public is extremely unlikely to remain for any extended period. Concentrations over land, where most human exposure occurs, would be lower than the values shown in Table 3.4.1-8.

Table 3.4.1-8. Estimated ambient concentrations for construction (μg/m³) compared to NAAQS

Pollutant[1]	Averaging Time	Maximum Modeled Concentration	Secondary[2] Impact Concentration	Background Concentration	Total Concentration	NAAQS	Exceeds NAAQS?
CO	1-hour	4,271	N/A	2,865	7,136	40,000	No
	8-Hour	780	N/A	2,636	3,416	10,000	No
NO_2	1-Hour	124.2	N/A	63.4	187.6	188	No
	Annual	13.82	N/A	11.87	25.69	100	No
PM_{10}	24-Hour	10.7	N/A	38	48.7	150	No
$PM_{2.5}$	24-Hour	7.53	0.016	14.0	21.5	35	No
	Annual	0.36	0.015	5.66	6.04	12	No

Source: Atlantic Shores 2022.

[1] Concentrations of SO_2 were not modeled because Project SO_2 emissions would be less than the PSD Significant Emission Rate established by USEPA.

[2] Secondary PM is formed by chemical reactions of emissions in the atmosphere and is additional to the modeled PM concentrations which reflect directly-emitted PM.N/A = not applicable

The modeled concentrations in Table 3.4-10 do not include potential contributions from concurrent construction of projects other than Atlantic Shores South. Such contributions potentially could increase concentrations if construction of other projects were to occur at sufficiently high activity levels and in sufficiently close proximity to Atlantic Shores South, at times when Atlantic Shores South construction activity is also occurring.

Table 3.4.1-9 presents the maximum modeled PSD increment results across all construction activities. Because emissions from O&M would be less than those for construction, concentrations during O&M would be lower than the values shown in Table 3.4.1-9.

Table 3.4.1-9. Estimated ambient concentration increases for construction (μg/m³) compared to PSD increments

Pollutant[1]	Averaging Time	Form[2]	Maximum Modeled Concentration	Secondary[3] Impact Concentration	Total Concentration	PSD Increment	Exceeds Increment?
Class I Increments[4]							
NO_2	Annual	H	0.26	N/A	0.26	2	No
PM_{10}	24-Hour	H	0.25	N/A	0.25	8	No
$PM_{2.5}$	24-Hour	H	0.25	0.069	0.32	2	No
Class II Increments							
NO_2	Annual	H	13.82	N/A	13.82	25	No
PM_{10}	24-Hour	H2H	8.86	N/A	8.86	30	No
$PM_{2.5}$	24-Hour	H2H	8.72	0.016	8.73	9	No
	Annual	H	0.36	0.015	0.38	4	No

Source: Atlantic Shores 2022.
[1] Concentrations of CO and SO_2 were not modeled because USEPA has not established PSD increments for these pollutants.
[2] Statistic used for calculation of concentration for the averaging time.
[3] Secondary PM is formed by chemical reactions of emissions in the atmosphere and is additional to the modeled PM concentrations which reflect directly emitted PM.
[4] Class I increments apply to Brigantine National Wilderness Area only.
H = highest daily average; H2H = highest second-highest daily average

As part of its OCS air quality permit application (Atlantic Shores 2022), Atlantic Shores also assessed project impacts on AQRV as required under the USEPA PSD regulations (40 CFR 52.21(o)). AQRVs assessed include acidic deposition, visibility, impacts on soils and vegetation, and impacts from associated growth. Associated growth is industrial, commercial, and residential growth that would occur in the area due to the OCS emission sources, and is discussed in Section 3.6.3, *Demographics, Employment, and Economics*. The OCS air permit application (Atlantic Shores 2022) provides further information on the AQRV analysis.

Modeling to assess the impacts on AQRV in Brigantine was conducted using the CALPUFF non-steady-state air dispersion model. CALPUFF is well suited for situations involving complex flows including spatial changes in meteorological fields due to factors such as the presence of complex terrain or the influence of water bodies, urbanization, plume fumigation (coastal fumigation or inversion break-up conditions), light wind speed or calm wind impacts, or other factors for which a steady-state-straight-line modeling approach is not appropriate (Scire et al. 2000). CALPUFF can account for the cumulative impacts of multiple spatially distributed sources within a large region, transport time, and the potential for stagnation and recirculation. CALPUFF contains a module to compute visibility effects as well as wet and dry acid deposition fluxes. Computation of visibility effects is based on the impact of particulate matter concentration on light extinction (the reduction due to pollutants in the amount of light that reaches the observer) and enhanced by the hydroscopic property of particulate matter.

The visibility modeling was conducted in accordance with procedures in the Federal Land Managers' Air Quality Related Values Work Group (FLAG) (2010) guidance document using CALPUFF version 5.8.5. Version 5.8.5 is the most recent regulatory version of CALPUFF approved and recommended by USEPA and Federal Land Managers (FLM). CALPOST regulatory version 6.221 and POSTUTIL version 1.56 were used for postprocessing. This version of CALPOST implements FLAG's 2010 recommendations for visibility modeling.

To assess potential impacts of acidic deposition on soil and vegetation, modeling of deposition due to the Project's emissions was conducted in accordance with FLAG (2010). The deposition of nitrogen and sulfur was predicted in terms of kilograms per hectare per year (kg/ha/yr). The predicted deposition rate for each species is compared to the applicable deposition analysis threshold (DAT) appropriate for eastern areas, 0.010 kg/ha/yr (FLAG 2010) for each species. These nitrogen and sulfur DATs are not adverse impact thresholds, but do represent conservative screening criteria that allow the FLMs to identify potential deposition fluxes requiring further consideration on a case-by-case basis. Table 3.4.1-10 summarizes the maximum modeled deposition rates during Project construction. Because emissions from O&M would be less than those for construction, deposition rates during O&M would be lower than the values shown in Table 3.4.1-10.

Table 3.4.1-10. Modeled deposition rates at Brigantine National Wilderness Area (kg/ha/yr)

Modeled Year	Maximum Annual Nitrogen Deposition Rate	Maximum Annual Sulfur Deposition Rate	Nitrogen and Sulfur Deposition Analysis Threshold
2018	0.024	0.0005	
2019	0.018	0.0003	0.010
2020	0.023	0.0004	

Source: Atlantic Shores 2022.

The FLAG Method 8 procedure (FLAG 2010) was applied to determine the impacts on visibility within Brigantine. Natural visibility is affected by Rayleigh scattering (scattering of light by air molecules) and by naturally occurring aerosols. Most natural and anthropogenic aerosols that can affect light extinction fall into the following categories: sulfates ($(NH_4)_2SO_4$), nitrates (NH_4NO_3), organic mass, elemental carbon, soil, sea salt, and coarse particle mass. The FLAG (2010) procedures examine thresholds of visibility degradation as measured in terms of light extinction to evaluate source impacts on haze. Visibility conditions are based on the average of the extinction efficiencies of several individual constituents that affect total extinction.

The analysis used the CALPOST postprocessor for visibility extinction calculations. In the visibility impact analysis, background extinction coefficients were calculated using annual average natural concentration values for Brigantine (FLAG 2010). Monthly relative humidity adjustment factors were used to account for hygroscopic effects (FLAG 2010). Under the FLAG (2010) guidance, the visibility threshold of concern is the annual 98th percentile (8th highest daily impact per year) maximum 24-hour change in light extinction compared to clean natural visibility conditions. The visibility threshold is exceeded if the 98th percentile change in light extinction is equal to or greater than 5 percent for each year modeled when compared to the annual average natural conditions value for the Class I area.

Table 3.4.1-11 summarizes the maximum modeled visibility impacts during project construction. Results are presented in terms of percentage and in *deciviews* (a measure of the perceptibility of light extinction). Because emissions from O&M would be less than those for construction, visibility impacts during O&M would be lower than the values shown in Table 3.4.1-11. The modeling results in Table 3.4.1-11 show the number of threshold exceedances if the maximum 24-hour emissions were emitted every day from the closest emission sources, which is a very conservative scenario. Actual impacts likely would be much less. The Brigantine Class I area is sufficiently representative of nearby onshore areas that the analysis specific to Brigantine also indicates the likely maximum visibility impacts in the rest of the Project region.

Table 3.4.1-11. Modeled visibility impacts at Brigantine National Wilderness Area

	Percentage Change			Change in Deciviews		
Modeled Year	98th Percentile 24-Hour Change in Light Extinction	Number of Days with Extinction Change > 5%	Number of Days with Extinction Change > 10%	98th Percentile 24-Hour Delta-Deciview	Number of Days with Delta-Deciview > 0.5	Number of Days with Delta-Deciview > 1.0
2018	15.5%	41	19	1.44	41	16
2019	9.2%	31	6	0.88	30	5
2020	17.0%	36	17	1.57	36	16

Source: Atlantic Shores 2022.
delta-deciview = change in deciviews.

Evaluation of impacts on sensitive vegetation is performed by comparing predicted impacts with screening levels set by USEPA (1980). Most of the designated vegetation screening levels are equivalent to or exceed NAAQS and PSD increments, so that impacts less than the NAAQS and PSD increments also indicate compliance with the sensitive vegetation screening levels. Atlantic Shores has committed to EPMs to avoid, minimize, and mitigate air quality impacts of the Project. These measures include, among others, compliance with all applicable emissions and fuel-efficiency standards to minimize combustion emissions and associated air quality impacts, as discussed in COP Volume II, Section 3.1.2.7 (Atlantic Shores 2023) and in Appendix G, Table G-1, under AQ-01 through AQ-05.

Atlantic Shores will comply with the requirements of the OCS air permit, when issued, for emissions' reduction and mitigation. The OCS air permit requirements are discussed in Appendix G, Table G-1, under AQ-06 and AQ-07. In addition, the OCS air permit requirements may include emission controls that meet Best Available Control Technology or Lowest Achievable Emission Rate criteria, development of emission offsets, or other mitigation measures. The OCS air permit requirements will be enforced by USEPA and NJDEP.

Accidental releases: The proposed Project could release VOCs or HAPs because of accidental chemical spills. Based on Appendix D, Table D.A2-3, the Proposed Action would have up to about 830,300 gallons (3.1 million liters) of coolants, 976,250 gallons (3.7 million liters) of oils and lubricants, and 155,000 gallons (586,737 liters) of diesel fuel in its 210 wind turbine and offshore substation structures. Accidental releases including spills from vessel collisions and allisions may lead to short periods of VOC and HAP emissions through evaporation. VOC emissions also would be a precursor to ozone formation. Air quality impacts would be short term and limited to the local area at and around the accidental release location. BOEM anticipates that a major spill is very unlikely due to vessel and offshore wind energy industry safety measures, as discussed in Section 3.4.2, as well as the distributed nature of the material. BOEM anticipates that potential accidental releases would have a negligible air quality impact as a result of the Proposed Action alone.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives*, as part of the Proposed Action, an O&M facility would be constructed in Atlantic City, New Jersey, on a site previously used for vessel docking or other port activities. Construction of the O&M facility would involve a new building and associated parking structure, repairs to the existing docks, and installation of a new bulkhead and new dock facilities. Installation of a new bulkhead and maintenance dredging in coordination with Atlantic City's dredging of the adjacent basins would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead and dredging activities are considered to be a connected action under NEPA and are evaluated in this section.

The connected action would affect air quality in the geographic analysis area through the following IPF.

Air emissions: Similar to other construction activities, emissions from bulkhead repair or replacement and dredging activities would primarily be from operation of diesel-powered equipment and vehicle activity such as the dredging vessel, bulldozers, excavators, and heavy trucks, and fugitive particulate emissions from excavation and hauling of soil. Air quality impacts from these emissions would be similar to the impacts of other construction activities.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action.

Air emissions: Table 3.4.1-12 summarizes the total construction emissions over all years of construction and provides a comparison to regional emissions levels.

Table 3.4.1-12. Offshore wind projects construction emissions (U.S. tons)

Project	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
Atlantic Shores South										
Total Construction	2,012	8,356	280	272	28	173	571,270	4	27	579,398
Average Annual	503	2,089	70	68	7	43	142,818	1	7	144,850
Ocean Wind 1 and 2 plus Atlantic Shores North										
Total Construction	6,182	30,388	1,000	959	265	748	1,848,134	12	89	1,875,088
Average Annual	883	4,341	143	137	38	107	264,019	2	13	267,870
Total Atlantic Shores South, Ocean Wind 1 and 2, and Atlantic Shores North										
Total Construction	8,194	38,744	1,280	1,231	293	921	2,419,404	16	116	2,394,696
Average Annual	1,024	4,843	160	154	37	115	406,837	3	19	299,337
Regional Emissions										
Region (Project Counties)[1]	288,743	44,686	18,514	9,965	2,345	100,678	NA	NA	NA	108,576,550
Atlantic Shores South Average Percent of Region During Construction Period	0.2%	4.7%	0.4%	0.7%	0.3%	0.04%	NA	NA	NA	0.1%
Offshore Wind[2] Average Percent of Region During Construction Period	0.4%	10.8%	0.9%	1.5%	1.6%	0.1%	NA	NA	NA	0.3%

Sources: Appendix D, Table D.A2-4; COP, Section 3.1.2, Atlantic Shores 2023; USEPA 2022; NJDEP 2022.
[1] New Jersey counties that are the nearest onshore areas to the WTA or in which Project facilities or ports would be located. Includes Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Monmouth, Ocean, and Salem Counties.
[2] Includes Atlantic Shores South, Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North.
NA = not available

The incremental impacts contributed by the Proposed Action to cumulative air quality impacts from ongoing and planned activities associated with onshore construction would be minor. Emissions from ongoing and planned activities, including the Proposed Action, would be highly variable and limited in spatial extent at any given period. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Air quality impacts due to offshore wind projects within the air quality geographic analysis area are anticipated to be small relative to those of combined impacts of larger emission sources in the region, such as fossil-fueled power plants. The largest air quality impacts of offshore wind projects are anticipated during construction, with smaller and more infrequent impacts anticipated during decommissioning. For the period during which offshore wind construction could occur (2023–2030), the total construction and O&M emissions of criteria pollutants, ozone precursors, and GHGs from all offshore wind projects, including the Proposed Action, that are proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 8,797 tons of CO, 41,255 tons of NO_X, 1,367 tons of PM_{10}, 1,309 tons of $PM_{2.5}$, 302 tons of SO_2, 972 tons of VOCs, and 2,565,906 tons of CO_2e (Appendix D, Table D.A2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases.

The Proposed Action alone would contribute an average of approximately 22 percent of the total emissions from Ocean Wind 1 and 2, Atlantic Shores South, and Atlantic Shores North that may generate impacts, depending on the pollutant, due to construction activities within the air quality geographic analysis area. This suggests that the majority of the air quality impacts, on a regional basis, resulting from offshore wind development would be due to other offshore wind projects in total, though the addition of the Proposed Action would contribute to the total air quality impacts.

Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would vary spatially and temporally across the air quality geographic analysis area. The largest combined air quality impacts from offshore wind would occur during overlapping construction and decommissioning of multiple offshore wind projects. The construction schedule of the Proposed Action is anticipated to overlap with that of the Ocean Wind 2 and Atlantic Shores North projects for 2 years in 2026 and 2027 (Appendix D, Tables D.A2-1 and D.A2-4). Most air quality impacts would remain offshore because the highest emissions would occur in the offshore region, and the westerly prevailing winds would result in most emission plumes remaining offshore for some distance. Although air quality offshore is subject to the NAAQS in federal waters and the OCS permit area, the amount of human exposure offshore is typically very low. Ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land.

The incremental impacts contributed by the Proposed Action to the cumulative impacts on air quality from ongoing and planned activities including other offshore wind would be noticeable during construction. During overlapping construction activities, there could be higher levels of impacts, but these effects would be short term in nature, as the overlap in the air quality geographic analysis area would be limited in duration.

The annual estimated emissions for O&M once all projects are operating are summarized in Table 3.4.1-13.

Table 3.4.1-13. Offshore wind projects operations and maintenance emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2	CH_4	N_2O	CO_2e
Atlantic Shores South										
Annual	121	519	17	16	1	9	33,631	0.20	1.60	34,872
Lifetime (30 years)	3,630	15,570	510	480	30	270	1,008,930	6	48	1,046,160
Ocean Wind plus Atlantic Shores North										
Annual	180	746	25	24	3	15	51,465	0.3	2.3	52,779
Lifetime (35 years)	6,300	26,110	875	840	105	525	1,801,287	12	81	1,847,252
All Projects										
Annual	301	1,265	42	40	4	24	85,096	1	4	87,651
Lifetime (35 years)	9,930	41,680	1,385	1,320	135	795	2,810,217	18	129	2,893,412

Sources: Appendix D, Table D.A2-4; COP Volume II, Section 3.1.2; Atlantic Shores 2023.

The incremental impacts contributed by the Proposed Action to the cumulative impacts of ongoing and planned activities would be noticeable. Using the assumptions in Appendix D, Table D-3, O&M emissions from ongoing and planned activities, including the Proposed Action, could begin in 2025. Emissions would largely be due to the same source types as for the Proposed Action, including commercial vessel traffic, air traffic such as helicopters, and operation of emergency diesel generators. Such activity would result in intermittent, and widely dispersed, emissions. Planned O&M activities, including the Proposed Action, are estimated to emit 301 tons per year of CO, 1,265 tons per year of NO_X, 42 tons per year of PM_{10}, 40 tons per year of $PM_{2.5}$, 4 tons per year of SO_2, 24 tons per year of VOCs, and 84,978 tons per year of CO_2 when all projects are operating (Table 3.4.1-13). Anticipated impacts on air quality from O&M emissions would be transient, small in magnitude, and localized. Additionally, some emissions associated with O&M activities could overlap with other projects' construction-related emissions. Comparison of the combined O&M emissions from all offshore wind projects to the emissions contributions from the Proposed Action alone (as provided in Table 3.4.1-13) shows that the increases in air quality impacts from the Proposed Action would be less than the combined impacts of the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects. In summary, the largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the offshore wind projects within the air quality geographic analysis area. However, a net improvement in air quality is expected on a regional scale as the Project begins operation and displaces emissions from fossil-fueled sources.

The incremental impacts contributed by decommissioning of the Proposed Action to the cumulative air quality impacts from ongoing and planned activities including offshore wind are likely to be noticeable, though the magnitude and extent of impacts from ongoing and planned activities at the time of decommissioning of the Proposed Action are speculative.

Accidental releases: The Proposed Action would contribute an undetectable increment to the cumulative accidental release impacts on air quality, which would be negligible due to the short-term nature and localized potential effects. Accidental spills would occur infrequently over the 34-year period with a higher probability of spills during construction of projects, but they would not be expected to contribute appreciably to overall impacts on air quality, as the total storage capacity within the air quality geographic analysis area is considerably less than the existing volumes of hazardous liquids being transported by ongoing activities and is distributed among many different locations and containers.

Conclusions

Impacts of Alternative B – Proposed Action. The Proposed Action would result in a net decrease in overall emissions over the region compared to the installation of a conventional fossil-fueled power plant. Although there would be some air quality impacts due to various activities associated with construction, O&M, and eventual decommissioning, including fugitive dust emissions from construction, emissions from equipment operation, and potential emissions from accidental releases, these emissions would be relatively small and limited in duration. The Proposed Action would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation (Table 3.4.1-5). **Minor** air quality impacts would be anticipated for a limited time because of emissions during construction, O&M, and decommissioning, but there would be a **minor beneficial** impact on air quality near the WTA and the surrounding region overall to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants. Atlantic Shores has committed to EPMs that would reduce potential impacts through complying with applicable emissions standards (AQ-01, AQ-02, and AQ-03), potential use of alternative fuels where feasible (AQ-03), complying with applicable fuel sulfur content standards (AQ-04), implementing BMPs to reduce emissions (e.g., optimizing construction and O&M activities to minimize vessel operating times and loads) (AQ-05), development of fugitive dust-control plans for onshore construction areas (AQ-05), and complying with all air quality permit conditions (AQ-06 and AQ-07) (COP Volume II, Section 3.1.2.7; Atlantic Shores 2023; Appendix G, Table G-1). Because of the amounts of emissions, the fact that emissions are spread out in time (4 years for construction and then lesser emissions annually during 30-year Project operation), and the large geographic area over which they would be dispersed (throughout the 102,124-acre [41,328-hectare] Atlantic Shores South Lease Area and the vessel routes from the onshore facilities), air pollutant concentrations associated with the Proposed Action are not expected to exceed the NAAQS and the New Jersey AAQS.

BOEM expects that the connected action alone would have **negligible** to **minor** impacts on air quality due to air pollutant emissions and accidental releases, because all concentrations would be below the NAAQS and New Jersey AAQS.

Cumulative Impacts of Alternative B – Proposed Action. The incremental impacts contributed by the Proposed Action and the connected action to the cumulative impacts on air quality would range from undetectable to noticeable, with minor beneficial impacts. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with the Proposed Action and the connected action when combined with the impacts from ongoing and planned activities including offshore wind would result in noticeable adverse impacts and moderate beneficial impacts. The main driver for this impact rating is emissions related to construction activities, increasing commercial vessel traffic, air traffic, and truck and worker vehicle traffic. Combustion emissions from construction equipment, and fugitive emissions, would be higher during overlapping construction activities but short term in nature, as the overlap would be limited in time. Therefore, cumulative adverse impacts on air quality in combination with other ongoing and planned activities would likely be **moderate** because the impact that would occur would be small and pollutant concentrations associated with offshore wind development are not expected to exceed the NAAQS and New Jersey AAQS. The Proposed Action and connected action and other offshore wind projects would benefit air quality in the region surrounding the projects to the extent that energy produced by the projects would displace energy produced by fossil-fueled power plants. Though the benefit would be regional, BOEM anticipates an overall **moderate beneficial** impact because the magnitude of the potential reduction in emissions from displacing fossil-fuel generated electric power would be small relative to total energy generation emissions in the area.

The Proposed Action would produce GHG emissions, primarily from O&M activities, including vessel and equipment operation, and leakage of SF_6 from SF_6-containing electrical equipment that contributes to climate change; however, its contribution would be less than the emissions displaced during operation of the Project. The GHG emissions estimates provided in this analysis include estimated loss of SF_6 from switchgear, which is conservatively based on 0.5 percent loss of the initial charge of SF_6 every year of operation with an initial charge of 1,500 kilograms of SF_6 to each of the two OSS switchgears (COP

Volume II, Appendix II-C; Atlantic Shores 2023). Because GHG emissions disperse and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are largely a function of global emissions. Consequently, the Proposed Action would have negligible impacts on climate change during construction and operation, and an overall net beneficial impact on criteria pollutant and ozone precursor emissions as well as GHGs, compared to a similarly sized fossil-fueled power plant or to the generation of the same amount of energy by the existing grid.

Overall, BOEM anticipates that there would be a net reduction in GHG emissions, and a net beneficial impact on climate change as a result of offshore wind projects, to the extent that wind energy would displace fossil-fuel energy. Additional offshore wind projects would likely contribute a relatively small increase in GHG emissions due to construction, O&M, and eventual decommissioning activities. The additional GHG emissions anticipated from the planned activities including the Proposed Action over the next 34-year period would have a negligible incremental contribution to existing GHG emissions. The incremental impacts contributed by the Proposed Action to the cumulative GHG impacts on air quality from ongoing and planned activities including offshore wind would be beneficial from the net decrease in GHG emissions, to the extent that fossil-fueled generating facilities would reduce operations as a result of increased energy generation from offshore wind projects.

3.4.1.6 Impacts of Alternatives C, D, and E on Air Quality

Impacts of Alternatives C, D, and E. The air quality impacts associated with Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) including Alternatives C1 through C4, D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) including Alternatives D1 through D3, and E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would be similar to those of the Proposed Action.

Construction and installation, O&M, and decommissioning of Alternatives C, D, and E would follow the same methods and procedures and would use similar equipment and vessels as for the Proposed Action. In addition, these alternatives would include the same onshore substations, converter stations, onshore interconnection cables, and other onshore facilities as the Proposed Action, and so would have the same emissions from construction, O&M, and decommissioning of these facilities.

Alternatives C (except Alternative C4), D, and E could have fewer WTGs and OSSs compared to the Proposed Action. Offshore construction and installation, O&M, and decommissioning emissions could be less than for the Proposed Action to the extent that these alternatives would reduce the number of WTGs and OSSs. Avoided emissions and the associated benefits also could be less than for the Proposed Action to the extent that these alternatives would reduce the number of WTGs. For Alternative C4, avoided emissions and the associated benefits would be similar to those of the Proposed Action.

If Alternatives C, D, and E were to use higher-capacity WTGs to provide similar total generating capacity with fewer WTGs, then, to the extent those total annual MW-hours generated were diminished due to differing wind cut-in speeds of higher-capacity WTGs, avoided emissions and the associated benefits also would be diminished.

Alternatives D1 and D2 could include restrictions on the height of the WTGs. To the extent that height restrictions could require use of WTGs with less generating capacity, avoided emissions and the associated benefits also would be diminished.

The climate impacts of Alternatives C, D, and E would be similar to those of the Proposed Action. To the extent that Alternatives C, D, and E would reduce the number of WTGs or their generating capacity, the avoided emissions could be less than for the Proposed Action, and accordingly the net reductions in regional GHG emissions could be less.

The impacts of accidental releases with Alternatives C, D, and E would be similar to those of the Proposed Action. Alternatives C, D, and E would reduce the number of WTGs, and thus the potential for accidental releases could be less than for the Proposed Action.

Cumulative Impacts of Alternatives C, D, and E. The contributions of Alternatives C, D, and E to the cumulative impacts of ongoing and planned activities would be similar to those of the Proposed Action.

Conclusions

Impacts of Alternatives C, D, and E. Expected **minor** impacts associated with the Proposed Action alone would not change under Alternatives C, D, and E. Similar construction and decommissioning activities, and the same O&M activities would still occur, albeit at slightly differing scales, as identified. Alternatives C, D, and E could have slightly less, but not materially different, **minor** impacts on air quality compared to the Proposed Action due to a reduced number of WTGs. Like the Proposed Action, the other action alternatives would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

Overall, the differences in emissions among the Alternatives C, D, and E and the Proposed Action are not expected to be substantial, and the air quality and climate impacts from all action alternatives are expected to be substantially similar to those described for the Proposed Action.

Similarly, the quantities of coolants, oils and lubricants, and diesel fuel under Alternatives C, D, and E would be similar to those of the Proposed Action, and therefore the impacts on air quality from accidental releases are expected to be similar to those of the Proposed Action.

Cumulative Impacts of Alternatives C, D, and E. The incremental impacts contributed by Alternatives C, D, and E to the cumulative impacts on air quality would be similar to those of the Proposed Action, ranging from undetectable to noticeable with minor impacts. Considering all the IPFs together, BOEM anticipates that the impacts associated Alternatives C, D, and E when combined with the impacts from ongoing and planned activities including offshore wind would likely result in **moderate** adverse impacts and **moderate beneficial** impacts overall due to reduced emissions from fossil-fueled power plants.

3.4.1.7 Impacts of Alternative F on Air Quality

Impacts of Alternative F. The air quality impacts associated with Alternative F (Foundation Structures) would be generally similar to those of the Proposed Action. This alternative would have the same number of WTGs as the Proposed Action. However, there would be some differences among the Alternative F subalternatives due to the types of foundations proposed.

Construction and installation of subalternatives F1, F2, and F3 would follow the same methods and procedures and would use similar equipment and vessels as for the Proposed Action, with some differences among the alternatives due to the types of foundations proposed.

Alternative F would include the same onshore substations, converter stations, onshore interconnection cables, and other onshore facilities as the Proposed Action, and so would have the same emissions from construction of these facilities.

Alternative F would have the same number of WTGs as the Proposed Action. However, the subalternatives would use different types of WTG, OSS, and met tower foundation structures. Alternative F1 would use piled foundations (monopile or piled jacket), Alternative F2 would use suction bucket foundations (mono-bucket, suction bucket jacket, or suction bucket tetrahedron base), and Alternative F3 would use gravity-based foundations (gravity-pad tetrahedron or GBS foundations). Atlantic Shores may use more than one foundation type within a given alternative. Construction emissions could differ among these foundation types because of differences in the types of equipment used, the numbers of vessel trips, and the duration of certain construction tasks. Based on the expected types of vessels to be used, numbers of vessel trips, and number of operating days in the WTA, BOEM anticipates that emissions from foundation construction are likely to be greatest for Alternative F3 (gravity-based foundations), less for Alternative F1 (piled foundations), and least for Alternative F2 (suction bucket foundations). However, the total offshore construction emissions are not expected to differ substantially among Alternatives F1, F2, and F3 from the offshore construction emissions for the Proposed Action.

O&M and decommissioning for Alternative F would follow the same methods and procedures and would use similar equipment and vessels as for the Proposed Action. Alternative F includes the same onshore substations, converter stations, onshore interconnection cables, and other onshore facilities as the Proposed Action, so emissions from O&M and decommissioning are expected to be the same as for the Proposed Action.

Alternative F would have the same number of WTGs and OSSs as the Proposed Action, and the O&M requirements of the subalternative foundation types are expected to be similar, as are the methods and procedures for decommissioning of the subalternative foundation types. Accordingly, offshore O&M emissions are expected to be similar to the emissions for the Proposed Action.

Alternative F would have the same number of WTGs and OSSs and the same onshore facilities as the Proposed Action, so the climate impacts of the alternative would be the same as for the Proposed Action.

Alternative F would have the same number of WTGs and OSSs and the same onshore facilities as the Proposed Action, so the potential for accidental releases for the alternative would be the same as for the Proposed Action.

Cumulative Impacts of Alternative F. The contributions of Alternative F to the cumulative impacts of ongoing and planned activities would be similar to those of the Proposed Action.

Conclusions

Impacts of Alternative F. Alternative F would have the same number of WTGs and OSSs, although with differences in foundation types for subalternatives F1, F2, and F3, and therefore similar **minor** impacts on air quality to those of the Proposed Action. Like the Proposed Action, Alternative F would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

Overall, the differences in emissions between Alternative F and the Proposed Action are not expected to be substantial, and the air quality and climate impacts from all action alternatives are expected to be substantially similar to those described for the Proposed Action.

Similarly, the quantities of coolants, oils and lubricants, and diesel fuel under Alternative F would be similar to those of the Proposed Action, and therefore the impacts on air quality from accidental releases are expected to be similar to those of the Proposed Action.

Cumulative Impacts of Alternative F. The incremental impacts contributed by Alternative F to the overall impacts on air quality would be similar to those of the Proposed Action, ranging from undetectable to noticeable with minor impacts. Considering all the IPFs together, BOEM anticipates that the impacts associated with Alternative F when combined with the impacts from ongoing and planned activities including offshore wind would likely result in **moderate** adverse impacts and **moderate beneficial** cumulative impacts due to reduced emissions from fossil-fueled power plants.

3.4.1.8 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of federal permitting, or through agency-to-agency negotiations, are described in Appendix G, Table G-2 and addressed in more detail in Table 3.4.1-14. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.4.1-14. Proposed mitigation measures – air quality

Mitigation Measure	Description	Effect
SF_6-free switchgear	BOEM would require Atlantic Shores to use switchgear that does not contain SF_6 but uses alternative insulating materials and technologies, to eliminate leakage of SF_6 as a source of GHG emissions. BOEM proposes this measure to address emissions of SF_6, which is the most potent GHG known. SF_6 is a synthetic gas that has been used as an anti-arcing insulator in electrical systems for 70 years. Emissions are the result of leaks in switchgear that contains SF_6. Switchgear is available that does not contain SF_6; however, it tends to be more costly and require more space compared to conventional switchgear, and must be evaluated on a project-specific basis. in the event that the applicant is not able to use SF_6-free switch gear, the following mitigation will be required: • Follow manufacturer recommendations for limiting leaks and for service and repair of the affected breakers and switches. • Perform repairs promptly when significant leaks are detected. • Conduct visual inspections of the switchgear and monitoring equipment according to manufacturer recommendations. • Create alarms based on the pressure readings in the breakers and switches, so leaks can be detected when substantial SF_6 leakage occurs. Upon a detectable pressure drop that is greater than 10% of the original pressure (accounting for ambient air conditions), perform maintenance to fix seals as soon as feasible. If an event requires removal of SF_6, the affected major component(s) will be replaced with new component(s). • Capture and recycle any SF_6 removed from breakers and switches during maintenance. • Keep a log of all detected leaks and maintenance procedures potentially affecting SF_6 emissions from circuit breakers/switches.	Use of SF_6-free switchgear would reduce GHG emissions and thereby reduce the impact of the Project on climate change.

3.4.1.9 Comparison of Alternatives

This section provides a summary comparison of the anticipated impacts of ongoing activities, planned activities, and Project impacts.

Under the No Action Alternative, air quality would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing and planned non-offshore wind activities and offshore wind activities would have continuing regional impacts primarily through air pollutant emissions and accidental releases. Combined impacts of ongoing and planned non-offshore wind activities as well as offshore wind activities, including air pollutant emissions and GHGs, would be

moderate because the emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS or New Jersey AAQS. Offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequently **minor** to **moderate beneficial** impacts on air quality and climate.

Under the Proposed Action, air quality impacts would occur due to emissions associated with construction, O&M, and eventual decommissioning, but these impacts would be relatively small and limited in duration. Impacts would be **minor** because the emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS or New Jersey AAQS. There would be a **minor beneficial** impact on air quality in the region overall to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants. The Proposed Action would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation.

Alternatives C (except Alternative C4), D, and E could have fewer WTGs and OSSs compared to the Proposed Action. Construction, O&M, and decommissioning emissions, and the associated impacts, could be less than for the Proposed Action to the extent that the number of WTGs and OSSs are reduced. Regional benefits due to reduced emissions associated with fossil-fueled energy generation could be less than with the Proposed Action to the extent that a reduced number of WTGs would reduce total generating capacity. For Alternative C4, impacts and benefits would be similar to those of the Proposed Action.

Alternative F would have the same number of WTGs and OSSs as the Proposed Action, but there would be some differences among subalternatives F1, F2, and F3 due to the types of foundations proposed. As a result, construction and decommissioning emissions could differ from those for the Proposed Action. O&M emissions would be similar to those for the Proposed Action. Overall, impacts under Alternative F are expected to be similar to those for the Proposed Action.

BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would result in **moderate** adverse impacts and **moderate beneficial** impacts. The overall adverse impact on air quality would likely be moderate because pollutant concentrations are not expected to exceed the NAAQS and New Jersey AAQS. The Proposed Action and other offshore wind projects would benefit air quality in the region surrounding the projects to the extent that energy produced by the projects would displace energy produced by fossil-fueled power plants. BOEM anticipates a cumulative **moderate beneficial** impact because the magnitude of this potential reduction would be small relative to total energy generation emissions in the area. Cumulative impacts with Alternatives C, D, and E would be similar to those with the Proposed Action, except that impacts could be less than for the Proposed Action to the extent that the number of WTGs and OSSs are reduced. Cumulative impacts with Alternative F would be similar to those with the Proposed Action.

3.4.2 Water Quality

This section discusses potential impacts on water quality from the proposed Project, alternatives, and ongoing and planned activities in the water quality geographic analysis area. The water quality geographic analysis area, as shown on Figure 3.4.2-1, includes the coastal and marine waters within a 10-mile (16-kilometer) buffer around the Offshore Project area and a 15.5-mile (25-kilometer) buffer around the ports in New Jersey, Virginia, and Texas that may be used by the Project. In addition, the geographic analysis area includes an onshore component that includes any sub-watershed that is intersected by the Onshore Project area. The offshore geographic analysis area accounts for some transport of water masses due to ocean currents. The onshore geographic analysis area was chosen to capture the extent of the natural network of waterbodies that could be affected by construction and operation activities of the proposed Project.

3.4.2.1 Description of the Affected Environment and Future Baseline Conditions

The affected environment with respect to potential Project-related water quality impacts includes the marine waters of the Offshore Project area encompassing the OCS waters of the WTA to the nearshore and intertidal waters along the ECCs to each of the two landfall sites. The affected environment also includes water supplies within the area of Onshore Project components. The characterization of water quality in the affected environment is based on available scientific literature, published state and federal agency research, online data portals, and online mapping databases.

Surface waters in the geographic analysis area comprise: (1) coastal onshore waterbodies that generally include freshwater ponds, streams, and rivers; and (2) coastal marine waters that generally include saline and tidal/estuarine waters, such as Silver Bay, Manahawkin Bay, Great Egg Harbor Bay, Delaware River, Upper Bay, Lower Bay, East River, Toms River, and the Atlantic Ocean. Surface waters within most of the geographic analysis area and all of the Onshore Project area are coastal marine waters.

The following key parameters characterize water quality. Some of these parameters are accepted proxies for ecosystem health (e.g., dissolved oxygen [DO], nutrient levels), while others delineate coastal onshore waters from coastal marine waters (e.g., temperature, salinity):

- *Nutrients*: Key ocean nutrients include nitrogen and phosphorous. Photosynthetic marine organisms need nutrients to thrive (with nitrogen being the primary limiting nutrient), but excess nutrients can cause problematic algal blooms. Algal blooms can significantly lower DO concentration, and toxic algal blooms can contaminate human food sources. Both natural and human-derived sources of pollutants contribute to nutrient excess.

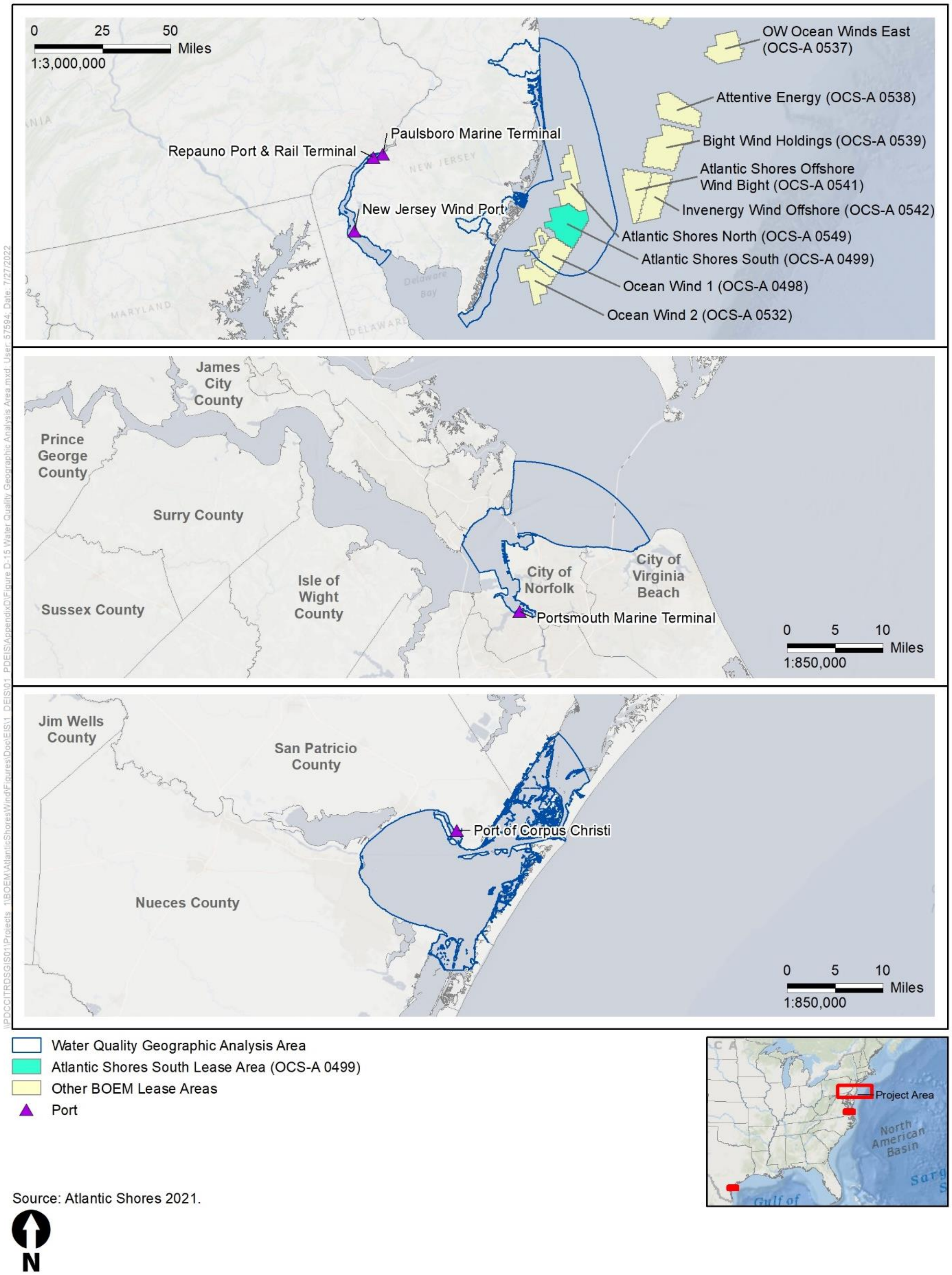


Figure 3.4.2-1 Water quality geographic analysis area

- *Dissolved oxygen*: The amount of DO in water determines the amount of oxygen that is available for marine life to use. Temperature strongly influences DO content, which is further influenced by local biological processes. For a marine system to maintain a healthy environment, DO concentrations should be above 5 milligrams per liter (mg/L); lower levels may affect sensitive organisms (USEPA 2000).

- *Chlorophyll a*: Chlorophyll *a* is a measure of how much photosynthetic life is present. Chlorophyll *a* levels are sensitive to changes in other water parameters, making it a good indicator of ecosystem health. USEPA considers estuarine and marine levels of chlorophyll *a* under 5 micrograms per liter (µg/L) to be good, 5 to 20 µg/L to be fair, and over 20 µg/L to be poor (USEPA 2015).

- *Salinity*: Salinity, or salt concentration, also affects species distribution. In general, seasonal variation in the region is smaller than year-to-year variation and less predictable than temperature changes (Kaplan 2011).

- *Water temperature*: Water temperature heavily affects species distribution in the ocean. Large-scale changes to water temperature may affect seasonal phytoplankton blooms.

- *Turbidity*: Turbidity is a measure of water clarity, which is typically expressed as a concentration of total suspended solids (TSS) in the water column but can also be expressed as nephelometric turbidity units. Turbid water lets less light reach the seafloor, which may be detrimental to photosynthetic marine life (CCS 2017). In estuaries, a turbidity level of 0 to 10 nephelometric turbidity units is healthy while a turbidity level over 15 nephelometric turbidity units is detrimental (NOAA 2018). Marine waters generally have less turbidity than estuaries.

States also assess a variety of other water quality parameters as part of state requirements to evaluate and list state waters as impaired under CWA Section 303(d) requirements. Other water quality parameters assessed typically include, but are not limited to, concentrations of metals, pathogens, bacteria, pesticides, biotoxins, polychlorinated biphenyls (PCBs), and other chemicals. If a surface water is considered non-attaining under the assessment, this means a designated beneficial use (e.g., recreation, fish consumption) is impaired by an exceedance of one or more water quality parameters.

Water Quality Geographic Analysis Area: Marine Waters

Influences on water quality within the Offshore Project area include the bays and rivers that drain into the ocean, the composition of atmospheric deposition, and the influx of constituents from sediments (BOEM 2012). The dispersal, dilution, and biological uptake of inorganic and organic matter deposited in the ocean is driven by oceanic circulation (influenced by tides), currents, bathymetry, and upwelling. Offshore water quality in the waters encompassing the offshore portion of the geographic analysis area is considered "good" and supportive of marine life based on regional monitoring data syntheses for offshore waters (USEPA 2015). Coastal waters near the shore, within New Jersey's jurisdictional limits and closer to recreation areas, population centers, and industrial uses, are monitored closely by federal and state authorities. Therefore, the water quality within the geographic analysis area, closer to shore, is monitored more frequently than the portion of the geographic analysis area further offshore (NJDEP 2019a).

The Barnegat Bay Partnership consists of federal, state, and local government agencies, academic institutions, nongovernmental organizations, and businesses working together to restore and protect Barnegat Bay. The Barnegat Bay Partnership revised its Comprehensive Conservation and Management Plan) for Barnegat Bay-Little Egg Harbor Estuary in January of 2021. One of the goals of the plan with regards to water quality is to protect and improve water quality throughout Barnegat Bay and its watershed by reducing the causes of water quality degradation to achieve swimmable, fishable, and drinkable water, and to support aquatic life. Though Barnegat Bay is within the geographic analysis area, the proposed Project would not cross the Barnegat Bay-Little Egg Harbor estuary and would not affect achievement of goals identified in the plan.

Existing Pollution Sources in the Offshore and Onshore Project Areas: The majority of contaminants in the coastal and marine environment are from both point and nonpoint sources from land-based and offshore anthropogenic activities. Several permitted surface water discharges are located along the New Jersey coast within the geographic analysis area. These include domestic (sewage), industrial or commercial facilities, and petroleum product cleanup site outfalls (NJDEP 2019d) (see Figure 3.4.2-2). Water quality concerns related to these sources are regulated by permit effluent standards, and any related water pollution impacts are mitigated by the dilution caused by mixing occurring in the receiving bays, rivers, and ocean (NJDEP 2015b).

Stormwater is considered a nonpoint source that transports sediment and/or pollutants from the land to an aquatic system such as wetlands or waterbodies. Most stormwater is not treated; as rainwater or snowmelt travels over surfaces mobilizing unstabilized soils and pollutants from human and animal activity (COP Volume II, Section 3.2.1.1, Atlantic Shore 2023; Mallin et al. 2008). Pollutants frequently found in stormwater runoff include fertilizers, insecticides, herbicides, oil, gas, sediment, and nutrients and bacteria from animals. These pollutants drive water quality degradation due to high levels of fecal coliform, turbidity, orthophosphates, biological oxygen demand, total phosphorus, TSS, surfactant compounds, and organic carbon (COP Volume II, Section 3.2.1.1, Atlantic Shores 2023). Acute and chronic nonpoint source pollution near ocean beaches, coastal bays, and other tidal systems can lead to harmful algal blooms, threats to human health and wildlife, and destruction of habitat in these sensitive areas (COP Volume II, Section 3.2.1.1, Atlantic Shores 2023; Mallin et al. 2008). However, in offshore waters, where depth and circulation drive the transport and dilution of water pollution, impacts from stormwater runoff are limited.

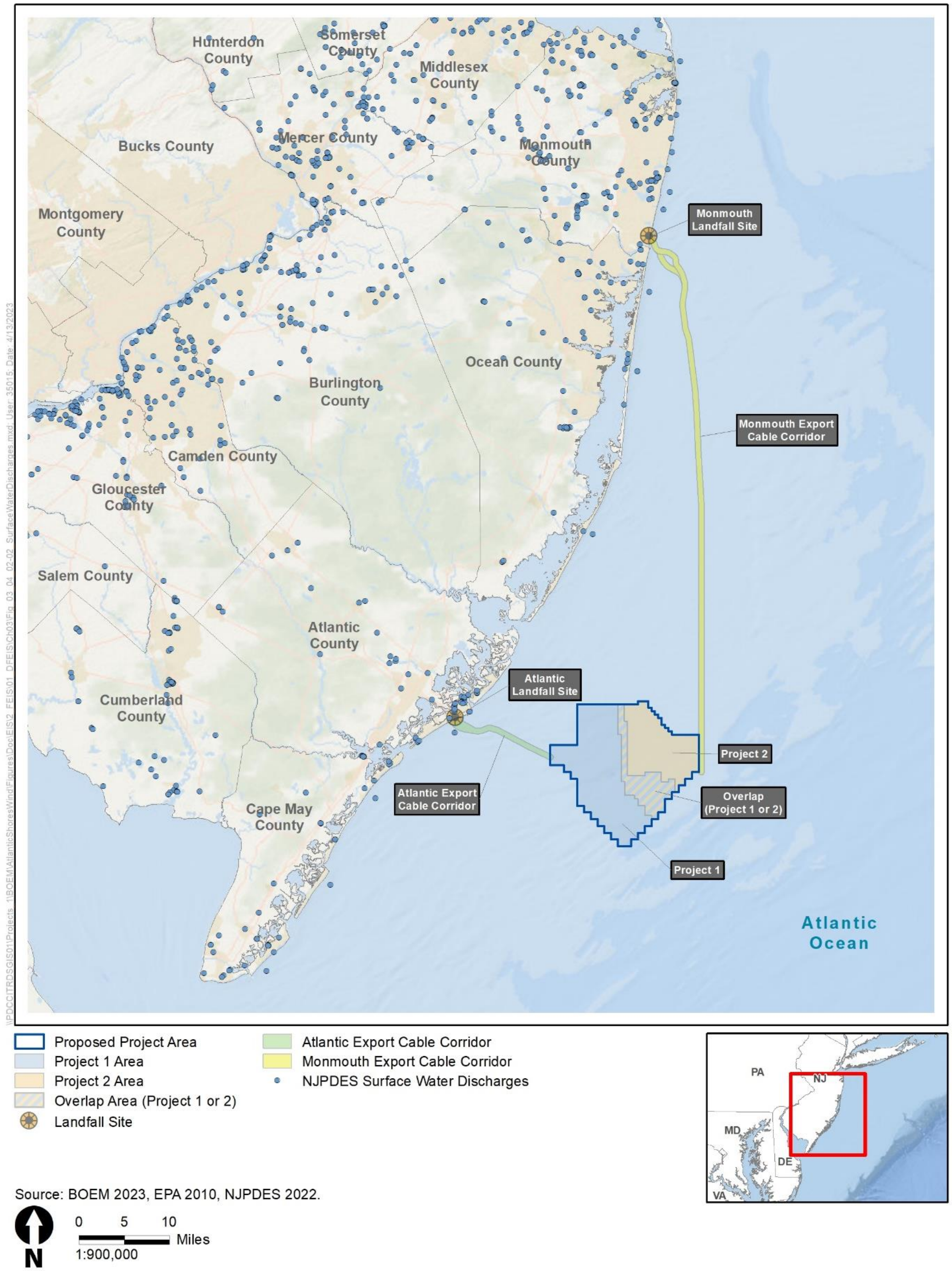


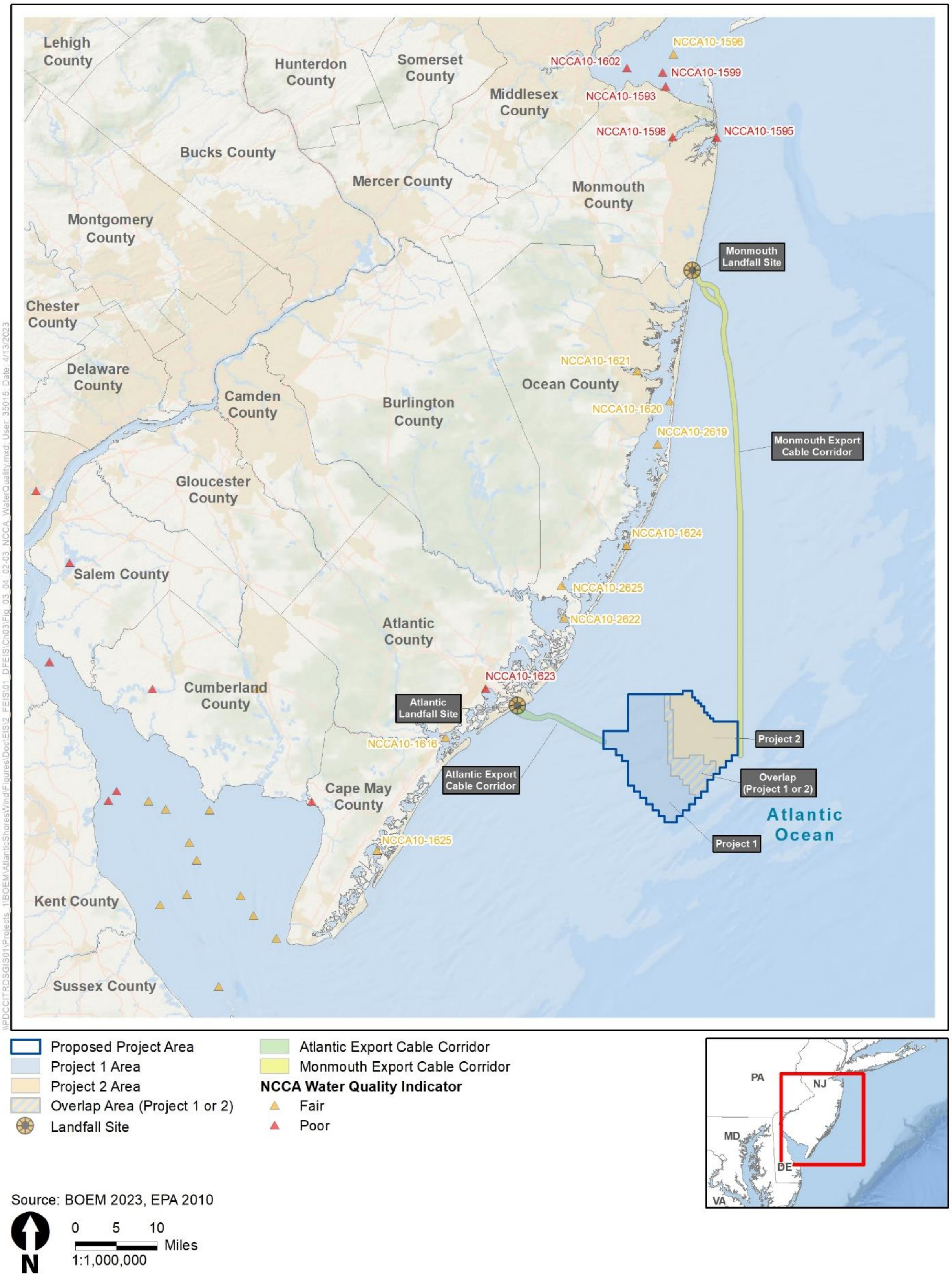
Figure 3.4.2-2 Permitted surface water discharges

Water Quality Assessments: USEPA publishes the National Coastal Condition Assessment (NCCA) report, which provides regional estimates of coastal water quality conditions for the east coast of the United States (USEPA 2015). Water quality was evaluated using quantities of DO, dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), light transmissivity, and turbidity to determine the water quality index at sampling sites. The results from the NCCA and relevant NJDEP water quality reports are summarized in Table 3.4.2-1. This data provides an overall water quality characterization for the marine waters associated with the Offshore Project area components. Twenty-three sampling sites located along New Jersey's coast extending from Sandy Hook Bay to Delaware Bay were assessed for water quality (Figure 3.4.2-3).

Table 3.4.2-1. Results summary of USEPA's National Coastal Condition Assessment

Water Quality Parameter	Value	USEPA NCCA Water Quality Indicator[1]
Dissolved oxygen (DO)*	2.6–9.1 mg/L	15 sites – "good" condition and 8 sites – "fair" condition
Chlorophyll α*	5.44–120.37 µg/L	15 sites – "fair" condition and 8 sites – "poor" condition
Dissolved inorganic nitrogen (DIN)*	0.02–9.7 µg/L	12 sites – "good" condition, 10 sites – "fair" condition, and 1 site – "poor" condition
Dissolved inorganic phosphorus (DIP)*	0.007–0.284 µg/L	2 sites – "good" condition, 13 sites – "fair" condition, and 8 sites – "poor" condition
Total Suspended Solids (TSS)^	17.2–35.7 mg/L	N/A
Turbidity^ (water clarity or Secchi disk reading)	3.2 feet (1 meter)– 9.8 feet (3 meters)	"medium" turbidity

Sources: COP Volume II, Section 3.2.11; Atlantic Shores 2023; * = USEPA 2015; ^ = NJDEP 2020e.
[1] See COP Volume II, Figure 3.2-2 and COP Volume II, Table 3.2-1.



Source: BOEM 2023, EPA 2010

Figure 3.4.2-3 National Coastal Condition Assessment water quality index

Algal blooms and excessive levels of bacteria are two water quality conditions that can affect the capacity of waterbodies to support both human and wildlife uses. A high level of nutrients such as nitrogen and phosphorus is a key factor contributing to algal blooms. NJDEP has created the Harmful Algal Bloom Interactive Mapping and Reporting System for monitoring and reporting algal blooms. According to this system, no algal blooms have been recorded between 2017 and 2020 within estuarine or coastal environments along the New Jersey coastline within the geographic analysis area (NJDEP 2019b, 2019c, 2020b, 2020c). Bacteria levels can also threaten public health, shellfish, and fish in coastal environments. Fecal coliform is a common bacterium observed in coastal waters along the east coast of the United States (NJDEP 2020d; VDH 2020). As part of the National Shellfish Sanitation Program (NSSP), fecal coliform levels are monitored by the NJDEP. According to this monitoring, the majority of the New Jersey coastline within the water quality geographic analysis area is open for shell fishing. Areas close to shore along the northern shore of New Jersey from Sandy Hook Bay to Point Pleasant Beach, south of Seaside Park, Surf City, Atlantic City, Ocean City, Avalon, Wildwood Crest, and around the U.S. Coast Guard Training Center have been classified as prohibited areas for shellfish harvesting (NJDEP 2022). The water quality geographic analysis area does contain prohibited areas for shellfish harvesting close to shore. See Figure 3.4.2-4 for an illustration of the Shellfish Classification in relation to the geographic analysis area based on the NJDEP's water quality monitoring program and fecal coliform levels.

The Integrated Water Quality Assessment Report (IWQAR) published in 2016 by NJDEP and in accordance with the CWA, New Jersey Water Quality Planning Act, and New Jersey Pollution Control Act assessed 958 units throughout New Jersey for water quality conditions of fresh, brackish, and marine environments (NJDEP 2019a). Acceptable water uses such as for public water supply and recreation were characterized by numerous physical, biological, and chemical parameters. Applicable IWQAR results for the nearshore and landfall portions of the geographic analysis area were evaluated to determine current water quality conditions in the vicinity of the Project. Results of this evaluation are presented in Table 3.4.2-2 and include categories of general aquatic life, recreational use, fish consumption, and shellfish harvesting.

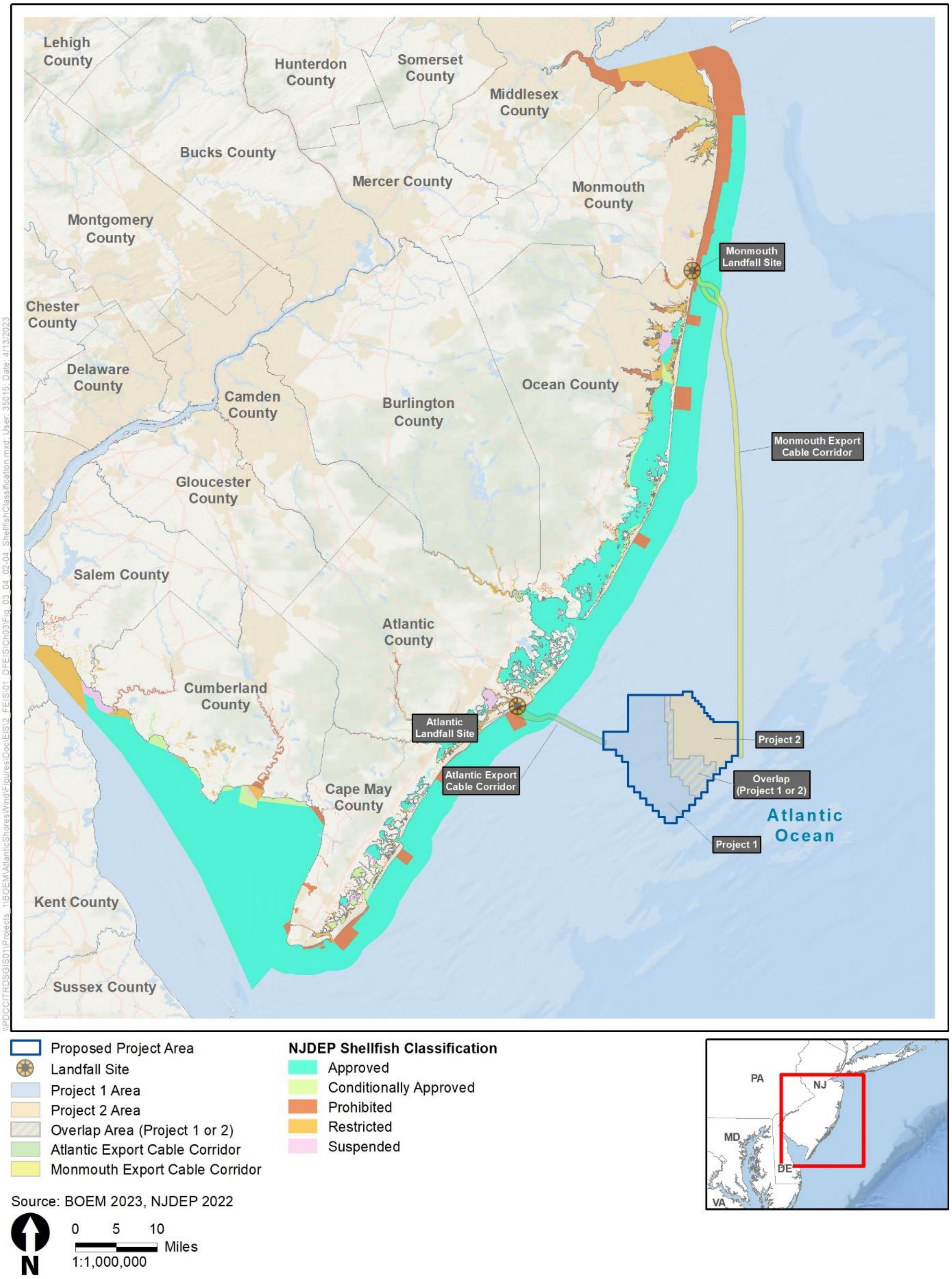


Figure 3.4.2-4 Shellfish classifications from NJDEP

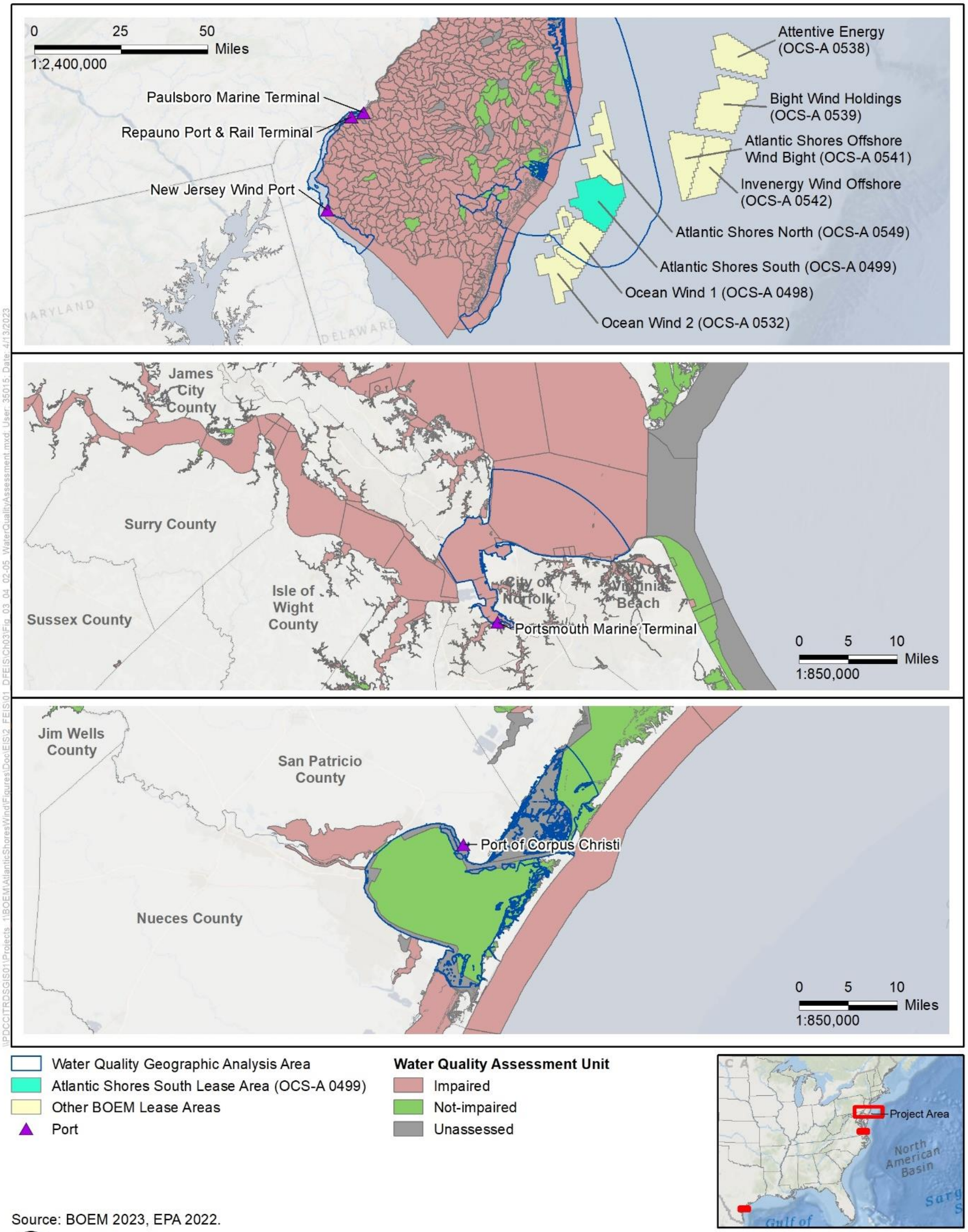
Table 3.4.2-2. Results summary of water quality use assessments from the 2016 Integrated Water Quality Assessment Report for marine waters within the water quality geographic analysis area

Site	Number of Applicable Assessment Units	Use Category and Assessment			
		General Aquatic Life	Recreational Use	Fish Consumption	Shellfish Harvesting
Monmouth Landfall Site	1	Unsupportive	Supportive	Undetermined	Unsupportive
Monmouth ECC	2	Unsupportive	Unsupportive	Undetermined	Supportive
Atlantic Landfall Site	1	Unsupportive	Supportive	Undetermined	Unsupportive
Atlantic ECC	1	Unsupportive	Supportive	Undetermined	Supportive

Source: COP Volume II, Section 3.2.1.1, Table 3.2-2; Atlantic Shores 2023.

Salinity and Temperature: The Offshore portion of the geographic analysis area is located within the Mid-Atlantic Bight region that extends from Cape Hatteras, North Carolina, to Cape Cod, Massachusetts. Three main water masses are present within this region. Relatively fresh shelf water contains less than 35 parts per thousand (PPT) of salt; the more saline slope water contains between 35 and 36 PPT; and the Gulf Stream contains more than 36 PPT (Miller et al. 2014). Data collected at the New Jersey WEA from 2003–2016 show that the median salinity of water within the offshore portion of the geographic analysis area is 32.2 PPT and ranges from 29.4 to 34.4 PPT. Water temperatures within the offshore portion of the geographic analysis area demonstrate seasonal temperature variations of up to 68°F (20°C) at the surface and 59°F (15°C) at the seabed (BOEM 2017). According to the World Ocean Atlas, longer-term data for the offshore portion of the geographic analysis area suggests surface water temperature varies from 41 to 73°F (5 to 23°C) with salinity ranging from 30.5 to 32.5 PPT (Zweng et al. 2018; Locarnini et al. 2018).

303(d) Listed Impaired Waters: Nearly all water quality assessment units of Barnegat Bay, Great Egg Harbor Bay, the Delaware River, and associated tidal tributaries within the geographic analysis area in New Jersey are listed as 303(d) impaired (USEPA 2020). These waters are non-attaining for fish consumption, ecological function, or recreation, with causes including pathogens, turbidity, oxygen depletion, pesticides, and PCBs. Waters along all the ocean-side barrier island shorelines in the geographic analysis area are non-attaining for ecological function due to oxygen depletions (USEPA 2020). Nearly all water quality assessment units of the Chesapeake Bay, James River, Elizabeth River, Nansemond River and associated tidal tributaries within the geographic analysis area in Virginia are listed as 303(d) impaired. These waters are non-attaining for fish consumption and ecological function with causes including noxious aquatic plants, unknown impaired biota, pathogens, pesticides, oxygen depletion, and PCBs (USEPA 2020). Assessment units of Nueces Bay, Corpus Christi Inner Bay, Oso Bay, Laguna Madre, the Gulf of Mexico, and associated tributaries within the geographic analysis area of the Corpus Christi Bay are non-attaining for ecological use, fish consumption or recreation. Causes include Mercury, metals other than Mercury, pathogens and oxygen depletion (USEPA 2020). See Figure 3.4.2-5 for a depiction of water quality assessment results within the geographic analysis area.



Source: BOEM 2023, EPA 2022.

N

Figure 3.4.2-5   Water quality assessments within the geographic analysis area

Water Quality Specific to Proposed Ports

Areas within the water quality analysis area of the Project generally include Silver Bay, Great Egg Harbor Bay, the Delaware River, Chesapeake Bay, James River, Nansemond River, Elizabeth River, and Corpus Christi Bay. Specifically, the existing ports of Repauno Port and Rail Terminal, Paulsboro Marine Terminal, Portsmouth Marine Terminal, and Port of Corpus Christi are to be used during construction and O&M of the Project; however, the Port of Corpus Christi would only be used during the construction phase. Additionally, a new port, the New Jersey Wind Port, is currently being constructed and is planned to be in operation by the start of construction of the Project (COP Volume II, Section 7.1.2.5, Table 7.1-17; Atlantic Shores 2023).

USEPA (2012) assessed water quality conditions along the coasts of the United States and developed a water quality index (good, fair, or poor) that evaluated five water quality parameters: nitrogen, phosphorus, chlorophyl *a*, water clarity (TSS or turbidity), and DO. The overall water quality condition of the Northeast Coast, which includes the water quality analysis area, is considered fair. Phosphorus, chlorophyll *a*, DO, and water clarity ratings are all considered fair, while nitrogen rating is considered good. The water quality index around Norfolk where the James River empties into Chesapeake Bay is generally considered fair for all five water quality parameters, with a few sample locations being considered poor, where two or more of the parameters did not meet standards. The overall water quality condition of the Gulf Coast, which includes the portion of the water quality geographic analysis area near the Port of Corpus Christi is rated as fair. Phosphorus, chlorophyll *a*, and water clarity ratings are all considered fair, while nitrogen and DO ratings are considered good along the Gulf Coast (USEPA 2012).

Water Quality Geographic Analysis Area: Coastal Onshore Waters

Groundwater reservoirs underlie some areas of the Onshore geographic analysis area (COP Volume II, Section 3.2.1.2; Atlantic Shores 2023). Many of these groundwater resources are designated and monitored because they supply water to communities. There are various types of water supplies within the onshore portion of the geographic analysis area, and New Jersey has different types of public water supplies. These include both community public systems such as municipalities and communities with at least 15 year-round service connections and noncommunity transient or non-transient public systems such as schools, factories, and motels. Noncommunity systems typically obtain water from groundwater resources (NJDEP 2020). A third type of water supply is a private system, such as an individual well serving a household (COP Volume II, Section 3.2.1.2; Atlantic Shores 2023).

Coastal onshore waters in the geographic analysis area include North Branch of the Metedeconk River, Manasquan River, Mingamahome River, Jumping Brook, Stephen Creek, Great Egg Harbor River, Mill Branch, Patcong Creek and associated tributaries to these waters. The majority of the assessment units within the water quality geographic analysis area are listed as impaired and 303(d) listed by NJDEP (USEPA 2020). The impaired assessment units are generally non-supporting for ecological use, fish consumption, and recreation use caused by factors including, but not limited to, oxygen depletion, pathogens, and PCBs.

Water Quality Geographic Analysis Area: Monmouth County/Larrabee Onshore Project Area

According to the New Jersey Department of Health, as of 2017, more than half of households within Monmouth County get their drinking water from private groundwater wells. Some of these private wells may be located at residences and businesses within the geographic analysis area. The municipalities within this area include the townships of Howell and Wall, and the boroughs of Manasquan and Sea Girt. Domestic water for these towns and boroughs is taken from groundwater or surface water reservoirs. Several wellhead protection areas are located within the geographic analysis area in Monmouth County (COP Volume II, Section 3.2.1.2; Atlantic Shores 2023). As shown on Figure 3.2-4 of the COP, no community wellhead protection areas or noncommunity water wellhead protection areas intersect the Onshore Project area (COP Volume II, Section 3.2.1.2; Atlantic Shores 2023).

The private New Jersey American Water company manages a public community water system that supplies Howell Township with drinkable water. Fourteen groundwater wells and one surface water source provide water for this system (New Jersey American Water 2020). Those groundwater wells and surface water are over 1 mile (1.6 kilometers) from the Onshore Project area and are not shown on COP Volume II, Figure 3.2-4, Section 3.2.1.2 (Atlantic Shores 2023).

Approximately 60 percent of the drinking water for the Monmouth County communities of Sea Girt Borough and Wall Township, as well as other communities, is sourced from the Manasquan Reservoir in Howell Township. This reservoir is managed by the New Jersey Water Supply Authority (New Jersey Water Supply Authority 2017) and is located over 1,000 feet (305 meters) to the northwest of the Onshore Project area at its nearest point (COP Volume II, Section 3.2.1.2; Atlantic Shores 2023).

Water Quality Geographic Analysis Area: Atlantic County/Cardiff Onshore Project Area

Both groundwater and surface water sources are used to supply Atlantic City with its public potable water (Atlantic City Municipal Utilities Authority 2020). The Atlantic City Reservoir, formed by damming Absecon Creek in two locations, is the surface water that supplies drinkable water to Atlantic City. Up to 13 community and noncommunity groundwater wells also supply public potable water to Atlantic City. These wells range from 200 to 675 feet (60 to 206 meters) in depth and draw from the Cohansey-Kirkwood Aquifer, which covers much of the New Jersey Coastal Plain (NJDEP 2009). Access to these wellhead locations is restricted to protect the water supply. Water from these wells is transported to and treated at Atlantic City's Water Treatment Plant (COP Volume II, Section 3.2.1.2; Atlantic Shores 2023).

As with Monmouth County, several wellhead protection areas are located within the geographic analysis area in Atlantic County (COP Volume II, Section 3.2.1.2, Figure 3.2-5; Atlantic Shores 2023). One public noncommunity wellhead protection area overlaps with an existing railroad ROW where the Cardiff onshore interconnection cable would be routed (COP Volume II, Section 3.2.1.2, Figure 3.2-5, Sheet 2; Atlantic Shores 2023). No community wellhead protection areas intersect with the proposed onshore substation site; however, the existing Cardiff Substation is located within the outermost Tier 3 (12-year source assessment) of a community wellhead protection area (COP Volume II, Section 3.2.1.2, Figure 3.2-5, Sheets 2–3; Atlantic Shores 2023).

3.4.2.2 Impact Level Definitions for Water Quality

This Draft EIS uses a four-level classification scheme to characterize potential impacts of the Proposed Action, as shown in Table 3.4.2-3. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions. There are no beneficial impacts on water quality.

Table 3.4.2-3. Impact level definitions for water quality

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

3.4.2.3 Impacts of Alternative A – No Action on Water Quality

When analyzing the impacts of the No Action Alternative on water quality, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for water quality. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for water quality described in Section 3.4.2.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on water quality are generally associated with onshore construction and include terrestrial runoff, ground disturbance (e.g., construction) and erosion, terrestrial point- and nonpoint-source discharges, atmospheric deposition, dredging and port operations and improvements, municipal waste discharges, marine transportation-related discharges, commercial fishing, submarine cable and pipeline maintenance, and climate change. Stormwater is an example of a nonpoint source that can transport sediment or pollutants from the land to aquatic systems such as streams, wetlands, and waterbodies. Pollutants such as fertilizers, insecticides, herbicides, oil, gas, sediment, and animal waste, which drive water quality degradation due to increased levels of fecal coliform, turbidity, orthophosphates, biological oxygen demand, total phosphorus, TSS, surfactant compounds, and organic carbon, are commonly found in stormwater runoff. Prolonged and intense nonpoint source pollution near coastal beaches, bays, and other tidal systems can lead to harmful algal blooms, human health and wildlife threats, and the destruction of habitat in these sensitive areas (Mallin et al. 2008). The deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). While water quality impacts may be short term and localized (e.g., construction) and state and federal statutes, regulations, and permitting requirements (e.g., CWA Section 402) avoid or minimize these impacts, issues with water quality can still persist.

See Appendix D, Table D.A1-23 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for water quality. There are no ongoing offshore wind activities within the geographic analysis area for water quality.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Other planned non-offshore wind activities that affect water quality include onshore development activities (including urbanization, forestry practices, municipal waste discharges, and agriculture); marine transportation-related discharges; dredging and port improvement projects; commercial fishing; military use; new submarine cables and pipelines; and climate change (see Section D.2 in Appendix D*,* for a description of planned activities). Water quality impacts from these activities, especially from dredging and harbor, port, and terminal operations, are expected to be localized and short term to permanent, depending on the nature of the activities and associated IPFs. Similar to under ongoing activities, the deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). State and federal water quality protection requirements and permitting would result in avoiding and minimizing these impacts. See Table D.A1-2 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for water quality.

The water quality geographic analysis area for the Proposed Action overlaps with most, but not all, of the Atlantic Shores North (OCS-A 0549), Ocean Wind 1 (OCS-A 0498) and Ocean Wind 2 (OCS-A 0532) Lease Areas. BOEM conservatively assumed in its analysis of water quality impacts that all 366 WTGs estimated for the Atlantic Shores North, Ocean Wind 1, and Ocean Wind 2 Lease Areas would be sited within the water quality geographic analysis area (Appendix D, Table D.A2-1). According to the construction schedules, Ocean Wind 1 would be constructed prior to the start of Ocean Wind 2 and Atlantic Shores North. Periods of construction overlap could occur between Ocean Wind 2 and Atlantic Shores North. There would be a risk of greater cumulative impacts on water quality during these periods due to an increased risk of accidental releases, resuspension and deposition of sediments from offshore construction activities, and land disturbance due to construction of onshore components and use of ports for construction.

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

Accidental releases: Planned offshore wind activities could expose surface waters to contaminants (such as fuel, solid waste, or chemicals, solvents, oils, or grease from equipment) in the event of a spill or release during routine vessel use. Planned offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with construction is expected to occur regularly in the New York and New Jersey lease areas beginning in 2023 and continuing through 2030 and then lessen to near-baseline levels during operational activities. Increased vessel traffic would be localized near affected ports and offshore construction areas. Increased vessel traffic in the region associated with offshore wind construction could increase the probability of collisions and allisions, which could result in oil or chemical spills.

Based on the estimated construction schedules (Appendix D, Table D.A2-1), offshore wind projects could occur with some overlapping construction schedules between 2023 and 2030.

Based on Appendix D, Table D.A2-3, up to about 1,030,582 gallons (3.9 million liters) of coolants, 2,092,564 gallons (7.9 million liters) of oils and lubricants, and 906,768 gallons (3.4 million liters) of diesel fuel would be contained in the structures for the wind energy projects within the water quality geographic analysis area. If accidental releases occur, they would most likely occur during construction but could occur during operations and decommissioning of offshore wind facilities.

Other chemicals, including grease, paints, and SF_6, would also be used at the offshore wind projects, and black and gray water may be stored in sump tanks on facilities. BOEM has assessed the toxicity of chemicals used at offshore wind facilities and conducted extensive modeling to determine the likelihood and effects of a chemical spill at offshore wind facilities at three locations along the Atlantic Coast, including an area near the proposed Project area (Maryland WEA) (Bejarano et al. 2013). Results of the model indicated a catastrophic, or maximum-case scenario, release of 129,000 gallons (488,318 liters) of oil mixture has a "Very Low" probability of occurring, meaning it could occur one time in 1,000 or more years. In other words, the likelihood of a given spill resulting in a release of the total container volume (such as from a WTG, OSS, or vessel) is low. The modeling effort also revealed the most likely type of spill (i.e., non-routine event) to occur is from the WTGs at a volume of 90 to 440 gallons (341 to 1,666 liters), at a rate of one time in 1 to 5 years, or a diesel fuel spill of up to 2,000 gallons (7,571 liters) at a rate of one time in 91 years. The likelihood of a spill occurring from multiple WTGs and OSSs at the same time is very low and, therefore, the potential impacts from a spill larger than 2,000 gallons (7,571 liters) are largely discountable. The modeling effort was conducted based on information collected from multiple companies and projects and would therefore apply to the other projects in the water quality geographic analysis area. For the purposes of this discussion, small-volume spills equate to the most likely spill volume between 90 and 440 gallons (341 to 1,666 liters) of oil mixture or up to 2,000 gallons (7,571 liters) of diesel fuel, while large-volume spills are defined as a catastrophic release of 129,000 gallons (488,318 liters) of material, based on modeling conducted by Bejarano et al. (2013). Small-volume spills could occur during maintenance or transfer of fluids, while low-probability small- or large-volume spills could occur due to vessel collisions, allisions with the WTGs/OSSs, or incidents such as toppling during a storm or earthquake.

All planned offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of accidental spills administered by USCG and BSEE. OSRPs are required for each project and would provide for rapid spill response, cleanup, and other measures that would help to minimize potential impacts on affected resources from spills. Vessels would also have their own onboard containment measures that would further reduce the impact of an allision. A release during construction or O&M would generally be localized and short term and result in little change to water quality. In the unlikely event an allision or collision involving Project vessels or components resulted in a large spill, impacts on water quality would be adverse and short term to long term, depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill.

Accidental releases of trash and debris would be infrequent and negligible because operators would comply with federal and international requirements for management of shipboard trash. All vessels would also need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162; allowed vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids.

In summary, there is potential for moderate water quality impacts due to a maximum-case scenario accidental release, but due to the very low likelihood of a maximum-case scenario release occurring and the expected size of the most likely spill to be small and of low frequency, the overall impact of accidental releases is anticipated to be short term and localized, resulting in minor change to water quality. As such, accidental releases from planned offshore wind development in the water quality geographic analysis area would not be expected to contribute appreciably to cumulative impacts on water quality.

Anchoring: Offshore wind activities would contribute to changes in offshore water quality from resuspension and deposition of sediments from anchoring during construction, installation, maintenance, and decommissioning of offshore components. BOEM estimates that approximately 41 acres (17 hectares) of seabed could be affected by anchoring within the water quality geographic analysis area. Disturbances to the seabed during anchoring would temporarily increase suspended sediment and turbidity levels in and immediately adjacent to the anchorage area. The intensity and extent of the additional sediment suspension effects would be less than that of new cable emplacement (see the *Cable emplacement and maintenance* IPF discussion below) and would therefore be unlikely to have an incremental impact beyond the immediate vicinity. If more than one project is being constructed during the same period, the impacts would be greater than for one project, and multiple areas would experience water quality impacts from anchoring, but, due to the localized area for sediment plumes, the impacts would likely not overlap each other geographically. The cumulative impact of increased sediment and turbidity from vessel anchoring is anticipated to be minor, localized, and short term, resulting in little change to ambient water quality. Anchoring would not be expected to appreciably contribute to overall impacts on water quality.

Cable emplacement and maintenance: Emplacement of submarine cables would result in increased suspended sediments and turbidity. Using the assumptions in Table D.A2-2 of Appendix D, planned offshore wind development in the water quality geographic analysis area would result in approximately 5,498 acres (2,225 hectares) of seabed impact. As described under the *Anchoring* IPF, these activities would contribute to changes in offshore water quality from the resuspension and deposition of sediment. The installation of interarray and offshore export cables, including site preparation activities, via jet plow, mechanical plow, or mechanical trenching, can cause temporary increases in turbidity and sediment resuspension. Due to the localized areas of disturbances and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance are anticipated to be localized, short term, and minor, resulting in little change to ambient water quality. Cable emplacement and maintenance activities would not be expected to appreciably contribute to cumulative impacts on water quality.

Discharges/intakes: Planned offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with offshore wind project construction is expected to occur regularly in the New Jersey lease areas beginning in 2023 and continuing through 2030, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. Planned offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be staggered over time and localized. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes such as treated deck drainage and sumps. BOEM assumes that all vessels operating in the same area will comply with federal and state regulations on effluent discharge. All offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of discharges and of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162. Furthermore, each project's vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151, and allowable vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids. Therefore, due to the minimal amount of allowable discharges from vessels associated with offshore wind projects, BOEM expects impacts on water quality resulting from vessel discharges to be minimal and to not exceed background levels over time.

The WTGs and OSSs are self-contained and do not generate discharges under normal operating conditions. In the event of a spill related to an allision or other unexpected or low-probability event, impacts on water quality from discharges from the WTGs or OSSs during operation would be short term. During decommissioning, all offshore wind structures would be drained of fluid chemicals via vessel, dismantled, and removed. BOEM anticipates decommissioning to have short-term impacts on water quality, with a return to baseline conditions.

Other offshore wind projects in the geographic analysis area may use HVDC substations that would convert AC to DC before transmission to onshore project components. As described in a recent white paper produced by BOEM (Middleton and Barnhart 2022), these HVDC systems are cooled by an open-loop system that intakes cool sea water and discharges warmer water back into the ocean. Chemicals such as bleach (sodium hypochlorite) would be used to prevent growth in the system and keep pipes clean. The warm water discharged is generally considered to have a minimal effect as it would be absorbed by the surrounding water and returned to ambient temperatures. Even though localized effects on water quality due to discharge of warmer water that may contain bleach could take place in the area immediately surrounding the outlet pipe, they are expected to be minimal due to the much larger mass of the surrounding ocean. Potential impacts on water quality to surrounding sea water would require permits through the USEPA National Pollutant Discharge Elimination System (NPDES) (Middleton and Barnhart 2022).

Due to the staggered increase in vessels from various projects; the current regulatory requirements administered by USEPA, USACE, USCG, and BSEE; and the restricted allowable discharges, the overall impact of discharges from vessels is anticipated to be localized and short term. Therefore, BOEM anticipates discharges/intakes to have a minor impact on water quality, as the level of impact in the water quality geographic analysis area from planned offshore wind development would be similar to existing conditions and would not be expected to appreciably contribute to cumulative impacts on water quality.

Land disturbance: Planned offshore wind development could include onshore components that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during the construction and installation of onshore components (e.g., equipment, including landfall and onshore cable construction and substation construction). Construction and installation of onshore components near waterbodies may involve ground disturbance, which could lead to unvegetated or otherwise unstable soils. Precipitation events could potentially erode the soils, resulting in sedimentation of nearby surface waters and subsequent increased turbidity. A Stormwater Pollution Prevention Plan (SWPPP) and erosion and sedimentation control BMPs would be implemented during the construction period to minimize impacts, resulting in infrequent and short-term erosion and sedimentation events.

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

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

Port utilization: Offshore wind development would use nearby ports and could also require port expansion or modification, resulting in increased vessel traffic or increased suspension and turbidity from any in-water work. These activities could also increase the risk of accidental spills or discharge. However, these actions would be localized, and port improvements would comply with all applicable permit requirements to minimize, reduce, or avoid impacts on water quality. As a result, port utilization impact would be minor and not expected to appreciably contribute to cumulative impacts on water quality.

Presence of structures: Using the assumptions in Table D.A2-1 of Appendix D, planned offshore wind projects are estimated to result in 377 WTG and OSS structures by 2030 within the water quality geographic analysis area. The construction of these structures could disturb up to 404 acres (164 hectares) of seabed within the water quality geographic analysis area from foundation and scour protection installation and disrupt bottom current patterns, leading to increased movement, suspension, and deposition of sediments (Appendix D, Table D.A2-2). Scouring, which could lead to impacts on water quality through the formation of sediment plumes (Harris et al. 2011), would generally occur in shallow areas with tidally dominated currents.

Offshore wind facilities have the potential to impact atmospheric and oceanographic processes through the presence of structures and the extraction of energy from the wind. There has been extensive research into characterizing and modeling atmospheric wakes created by wind turbines in order to design the layout of wind facilities and hydrodynamic wake/turbulence related to predicting seabed scour, but relatively few studies have analyzed the hydrodynamic wakes coupled with the interaction of atmospheric wakes with the sea surface. Further, even fewer studies have analyzed wakes and their impact on regional scale oceanographic processes and potential secondary changes to primary production and ecosystems. Studies thus far in this topic have focused on ocean modeling rather than field measurement campaigns.

The general understanding of offshore wind–related impacts on hydrodynamics is derived primarily from European based studies. A synthesis of European studies by Van Berkel et al. (2020) summarized the potential effects of wind turbines on hydrodynamics, the wind field, and fisheries. Local to a wind facility, the range of potential impacts include increased turbulence downstream, remobilization of sediments, reduced flow inside wind farms, downstream changes in stratification, redistribution of water temperature, and changes in nutrient upwelling and primary productivity. Human-made structures, especially tall vertical structures such as foundations, alter local water flow at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). When water flows around the structure, turbulence is introduced that influences local current speed and direction. Turbulent wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts on current speed and direction decrease rapidly around monopiles, there is a potential for hydrodynamic effects out to 0.6 mile (1 kilometer) from a monopile (Li et al. 2014). Direct observations of the influence of a monopile extended to at least 984 feet (300 meters); however, changes were indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to

3,281 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, and sensitivity of the analysis. In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing toward stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017; refer to Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, Section 3.5.6, *Marine Mammals*, and Section 3.5.7, *Sea Turtles*, regarding hydrodynamic and atmospheric wake effects on primary production).

Results from a recent BOEM (2021) hydrodynamic model of four different WTG build-out scenarios of the offshore Rhode Island and Massachusetts lease areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification), via their influence on currents from WTG foundations and by extracting energy from the wind. The results of the hydrodynamic model study show that introduction of the offshore wind structures into the offshore WEA modifies the oceanic responses of current magnitude, temperature, and wave heights by (1) reducing the current magnitude through added flow resistance, (2) influencing the temperature stratification by introducing additional mixing, and (3) reducing current magnitude and wave height by extracting of energy from the wind by the offshore wind turbines. BOEM conducted a similar model offshore Rhode Island and Massachusetts that evaluated ocean processes during two extreme weather events: the February 1978 Nor'easter storm (a 100-year storm) and the August 1991 Hurricane Bob (BOEM 2016). The results indicate that the wind turbine facility on the eastern shelf of Block Island, Rhode Island, can cause more significant local and regional impacts than offshore wind facilities over the outer shelves off Massachusetts and Rhode Island. Inside the wind turbine area, the maximum change during the nor'easter storm and hurricane cases can be 0.7 to 1.3 feet (0.2 to 0.4 meter) for surface elevation, 11.5 to 24 feet (3.5 to 7.3 meters) for significant wave height, 2.3 to 5.6 feet per second (0.7 to 1.7 meters per second) for vertically averaged, near-surface and near-bottom velocities, and 16.8 to 28.2 newtons per square meter for bottom stress (BOEM 2016). Alterations in currents and mixing would affect water quality parameters such as temperature, DO, and salinity, but would vary seasonally and regionally. WTGs and the OSSs associated with planned offshore wind projects would be placed in average water depths of 100 to 200 feet (30 to 60 meters) where current speeds are relatively low, and offshore cables would be buried where possible. Cable armoring would be used where burial is not possible, such as in hard-bottomed areas. BOEM will require that developers implement BMPs to minimize seabed disturbance from foundations, scour, and cable installation. As a result, adverse impacts on offshore water quality would be localized, short term, and minor. Presence of structures would not be expected to appreciably contribute to cumulative impacts on water quality.

The exposure of offshore wind structures, which are mainly made of steel, to the marine environment can result in corrosion without protective measures. Corrosion is a general problem for offshore infrastructures and corrosion protection systems are necessary to maintain structural integrity. Protective measures for corrosion (e.g., coatings, cathodic protection systems) are often in direct contact with seawater and have different potentials for emissions, e.g., galvanic anodes emitting metals, such as aluminum, zinc, and indium, and organic coatings releasing organic compounds due to weathering and leaching. The current understanding of chemical emissions for offshore wind structures is that emissions appear to be low, suggesting a low environmental impact, especially if compared to other offshore activities, but these emissions may become more relevant for the marine environment with increased numbers of offshore wind projects and a better understanding of the potential long-term effects of corrosion protection systems (Kirchgeorg et al. 2018). Based on the current understanding of offshore wind structure corrosion effects on water quality, BOEM anticipates the potential impact to be minor.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and water quality would continue to be affected by natural and human-caused IPFs. BOEM expects ongoing activities to have continuing localized temporary to permanent impacts on water quality, ranging from minor to moderate depending on the nature of the activities and associated IPFs. These impacts would result primarily through accidental releases and sediment suspension related to vessel traffic, port utilization, presence of structures, discharges, and runoff from land disturbance. Therefore, the No Action Alternative would result in **minor** to **moderate** impacts on water quality.

Cumulative Impacts Alternative A – No Action. BOEM anticipates the cumulative impacts on water quality under the No Action Alternative would range from minor to moderate. Water quality would continue to follow current regional trends and respond to current and future environmental and societal activities. BOEM expects ongoing and planned activities to have temporary impacts on water quality. BOEM anticipates these water quality impacts would be minor to moderate due to accidental releases and sediment suspension related to anchoring, cable emplacement and maintenance, discharges/intakes, land disturbance, port utilization, and presence of structures. A moderate impact could occur if there was a large-volume, catastrophic accidental release. However, the probability of catastrophic release occurring is very low; the expected size of the most likely spill would be very small, and such a spill would occur infrequently. BOEM anticipates that the impacts of ongoing activities, such as vessel traffic, military use and survey, commercial activities, recreational activities, and land disturbance, would be minor due to the staggered increase in vessels from various projects; the current regulatory requirements administered by USEPA, USACE, USCG, and BSEE; and the restricted allowable discharges. In addition to ongoing activities, planned activities other than offshore wind may also contribute to minor impacts on water quality. Planned activities other than offshore wind include increasing vessel traffic, new submarine cables and pipelines, increasing onshore development, marine surveys, port improvement, and the installation of new offshore structures. BOEM anticipates that the impacts of reasonably foreseeable activities other than offshore wind would be minor to moderate.

BOEM anticipates the cumulative impacts of the No Action Alternative on water quality would be **minor** to **moderate**, primarily driven by the unlikely event of a large-volume, catastrophic release.

3.4.2.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed Project design parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario,* Table C-1) would influence the magnitude of the impacts on water quality:

- The amount of vessel use during installation, operations, and decommissioning.
- The number of WTGs and OSSs and the amount of cable laid determines the area of seafloor and volume of sediment disturbed by installation. In the maximum-case scenario, there would be a maximum of 200 WTGs installed, up to 10 OSSs, 1 met tower, 4 temporary metocean buoys, 547 miles (880 kilometers) of interarray cable, and 37 miles (60 kilometers) of interlink cable. Approximately 342 miles (550 kilometers) of offshore export cable would be installed for the Monmouth ECC and approximately 99 miles (160 kilometers) for the Atlantic ECC (COP Volume I, Table E-1; Atlantic Shores 2023). These numbers represent Project 1 and Project 2 cumulatively.
- Installation methods chosen and the duration of installation.
- Proximity to sensitive water sources and mitigation measures used for onshore proposed Project activities.
- In the event of a non-routine event such as a spill, the quantity and type of oil, lubricants, or other chemicals contained in the WTGs, vessels, and other proposed Project equipment.

Variability of the proposed Project design as a result of the PDE includes the exact number of WTGs and OSSs (determining the total area of foundation footprints); the number of piled, suction bucket, and gravity foundations ; the total length of interarray cable; the total area of scour protection needed; and the number, type, and frequency of vessels used in each phase of the proposed Project. Changes in the design may affect the magnitude (number of structures and vessels), location (WTG and other Project element layouts), and mechanism (installation method, non-routine event) of water quality impacts.

Atlantic Shores has committed to measures to minimize impacts on water quality (Appendix G, *Mitigation and Monitoring*, Table G-1). Anchor midline buoys on anchored construction vessels would be used, where feasible, to minimize disturbance to the seafloor (GEO-03) and dynamically positioned vessels, and jet plow embedment would be utilized to the maximum extent practicable to minimize sediment disturbance and alteration during cable laying process (WAT-01). Accidental spill or release of oils or other hazardous materials are to be managed through the OSRP that meets USCG and the BSEE requirements (WAT-02). HDD would be used to install the export cable to the landfall sites, and activities would be managed by an HDD Contingency Plan (WAT-03). Vessels would be operated in a way that complies with regulatory requirements related to the prevention and control of discharged and accidental spills (WAT-04). Project facilities would be routed/sited in previously disturbed areas and along existing ROWs (WAT-05) and would avoid public water supplies and wellhead protection areas to the maximum extent possible (WAT-06). Trenchless cable installation methods would be used to avoid impacts on wetlands or waterbodies during onsite construction (WAT-07), and BMPs would be implemented to properly contain excavated soils and stabilize disturbed land areas, to avoid erosion and sediment runoff into waterbodies and impacts on water quality (WAT-08). The Project would also implement an approved New Jersey Division of Land Resource Protection Stormwater Management Control Plan to avoid and minimize Project-related water quality impacts on nearby aquatic habitats (WAT-08, WAT-10). Any temporarily disturbed areas would be stabilized in accordance with the approved Soil Erosion and Sediment Control Plan (WAT-19). Additionally, Environmental/Construction Monitor(s) would be assigned to ensure compliance with applicable permit conditions and to ensure BMPs are functional (WET-11).

3.4.2.5 Impacts of Alternative B – Proposed Action on Water Quality

The Proposed Action would contribute to impacts through all of the identified IPFs in Section 3.4.2.3, *Impacts of Alternative A – No Action on Water Quality*. The most impactful IPFs would likely include cable emplacement and maintenance that could cause noticeable short-term impacts during construction through increased suspended sediments and turbidity, the presence of structures that could result in alteration of local water currents and lead to the formation of sediment plumes, and discharges that could result in localized turbidity increases during discharges or bottom disturbance during dredged material disposal.

Accidental releases: Similar to other offshore wind projects, chemicals (e.g., coolants, oils, diesel fuel) would be used and stored in facilities, and black and gray water may be stored in sump tanks on facilities. Chemicals such as coolants, oils, and diesel fuels used during construction activities could have negative impacts on offshore water quality. The Proposed Action would have a maximum of 830,300 gallons (3,143,027 liters) of coolants, 976,250 gallons (3,695,508 liters) of oils and lubricants, and 155,000 gallons (586,739 liters) of diesel stored within WTG foundations and OSSs within the water quality geographic analysis area (Appendix D, Table D.A2-3). As discussed previously, the risk of a spill from any single offshore structure would be low, and any effects would likely be localized. Modeling conducted for an area near the Project (Maryland WEA) indicates that the most likely type of spill (i.e., non-routine event) to occur during the life of a project is 90 to 440 gallons (341 to 1,666 liters) at a rate of one time in 5 years, which would have brief, localized impacts on water quality (Bejarano et al. 2013). One difference between the Proposed Action and the Maryland WEA is that there would be more WTGs under the Proposed Action (up to 200 instead of 125), which could lead to an increased likelihood of spill events compared to the Bejarano et al. (2013) model. Overall, the probability of an oil or chemical spill occurring that is large enough to affect water quality is extremely low and the degree of impact on water quality would depend on the spill volume. The impacts of the Proposed Action alone on water quality from accidental releases would be localized, short term, and minor.

The use of HDD during installation of the export cables at the landfall locations will require HDD drilling fluid, usually made up of a water and bentonite mixture. The mixture is not anticipated to considerably affect water quality if released. Atlantic Shores would implement BMPs during construction to minimize potential release of the fluid. These methods may include returning the drilling fluid to surface pits and collecting it for reuse. The HDD also creates a potential for frac-out during drilling activities. A frac-out occurs when the drilling fluids migrate unpredictably to the surface through factures, fissures, or other conduits in the underlying rock or unconsolidated sediments. In the unlikely event of a frac-out, the inadvertent release of bentonite into the water column could result in short-term and localized impacts on water quality in the nearshore marine environment. However, design considerations, operational controls, and contingency planning would greatly diminish the likelihood of accidental releases. Furthermore, HDD activities would be managed by an HDD Contingency Plan for the Inadvertent Release of Drilling Fluid to ensure the protection of marine and inland surface waters from an accidental release of drilling fluid. All drilling fluids would be collected and recycled upon HDD completion (Appendix G, *Mitigation and Monitoring,* Table G-1). Therefore, with implementation of BMPs and the development and implementation of the contingency plan, potential impacts from chemical release would be localized, short term, and minor.

Increased vessel traffic in the region associated with the Proposed Action could increase the probability of collisions and allisions, which could possibly result in oil or chemical spills. However, collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Project: USCG requirement for lighting on vessels, NOAA vessel speed restrictions, the proposed spacing of WTGs and OSSs, the lighting and marking plan that would be implemented, and the inclusion of proposed Project components on navigation charts. Atlantic Shores would implement its Oil Spill Response Plan that meets USCG and the BSEE requirements (COP Volume I, Appendix I-D; Atlantic Shores 2023), which would provide for rapid spill response, cleanup, and other measures to minimize any potential impact on affected resources from spills and accidental releases, including spills resulting from catastrophic events (Appendix G, Table G-1). In the unlikely event an allision or collision involving vessels or components associated with the Proposed Action resulted in a large spill, impacts from the Proposed Action alone on water quality would be short term to long term and minor to moderate depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill.

Onshore construction activities would require heavy equipment use or HDD activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. The Proposed Action would store onshore a maximum of 2,550 gallons (9,653 liters) of coolants, 545,020 gallons (2,063,125 liters) of oils and lubricants, and 3,000 gallons (11,356 liters) of diesel fuel for the two onshore substations or converter stations (one per POI) within the water quality geographic analysis area (Table 3.4.2-4). Atlantic Shores would develop and implement an SPCC Plan and OSRP to minimize impacts on water quality (prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). In addition, all wastes generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the U.S. Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates the Proposed Action alone would result in negligible, short-term, and long-term impacts on water quality as a result of releases from heavy equipment during construction and other cable installation activities.

Table 3.4.2-4. List of potential chemical products used for onshore substations and converter stations

Component	Description	Approximate Quantity per Onshore Substation or Converter Station	
		Gallons	Liters
Diesel fuel storage	Diesel fuel	1,500	5,678
Diesel engines	Internal motor lubrication	10	38
Main power transformers, earthing transformers	Biodegradable dielectric insulating fluid, mineral oil, or synthetic ester oil	162,500	615,129
Reactors	Biodegradable dielectric insulating fluid, mineral oil, or synthetic ester oil	110,000	416,395
UPS batteries	Electrolyte inside lead/acid batteries or valve-regulated lead acid battery	400	1,514
Diesel engine cooling	Water/glycol	25	95
Equipment cooling system	Water/glycol	1,250	4,732

Atlantic Shores would use a new onshore O&M facility in Atlantic City, New Jersey, sited on a parcel that was previously used for vessel docking and other port activities. The O&M facility would include offices, control rooms, warehouses, and workshop space. Construction and operation of the O&M facility could result in accidental fuel spills or sedimentation that could cause impacts on water quality. Construction would be separately reviewed and authorized by USACE and local authorities, as needed. BOEM anticipates negligible impacts on water quality in the event of a potential release at the facility because the terms and conditions of permits for construction and any in-water work would require measures to avoid and minimize sedimentation, turbidity, and accidental release impacts on surface waters.

Anchoring: There would be increased vessel anchoring during the construction and installation, O&M, and decommissioning of offshore components of the Proposed Action. Anchoring would cause increased turbidity levels from the positioning of anchors and anchor chain contact with the seafloor. Impacts on water quality from the Proposed Action alone due to anchoring would be localized, short term, and minor during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in reduced impacts. Atlantic Shores has not yet selected the specific vessels that would carry out construction activities. Because the number of vessels and the number of vessel trips depend on the specific vessels used, estimates were generated using sample vessels and preliminary Project plans. Currently, maximum estimates for the total number of vessels required for any single offshore construction activity range from 2 vessels for scour protection installation to up to 16 vessels for OSS installation. For export cable installation, it is estimated that up to 6 vessels could be operating at once. In the unlikely event that all Project 1 and Project 2 construction activities were to occur simultaneously, a total of 51 vessels could be present at any one time (COP Volume II, Section 7.6.2.1; Atlantic Shores 2023). The number of vessels is anticipated to result in 714 acres (289 hectares) of impact from anchoring(Appendix D, Table D.A2-2). Atlantic Shores has proposed to use anchor midline buoys on anchored construction vessels, where feasible, to minimize disturbance to the seafloor and sediments (Appendix G, Table G-1).

Cable emplacement and maintenance: The installation of interarray cables and offshore export cables would include site preparation activities (e.g., sandwave clearance, boulder removal) and cable installation via jet plow, mechanical plow, or mechanical trenching, which can cause temporary increases in turbidity and sediment resuspension. Other projects using similar installation methods (e.g., jet plowing, pile driving) have been characterized as having minor impacts on water quality due to the short-term and localized nature of the disturbance (Latham et al. 2017). Additionally, Atlantic Shores proposes to use dynamically positioned vessels and jet plow embedment to the maximum extent practicable to minimize sediment disturbance and alteration during cable laying process (Appendix G, Table G-1).

Based on the Sediment Transport Modeling results, suspended sediment concentrations resulting from cable installation, HDD activities, and sandwave clearing are predicted to remain close to the route centerline or HDD pit, be constrained to the bottom of the water column, and occur for durations of less than 24 hours (COP Volume II, Appendix II-J3; Atlantic Shores 2023). Simulations of possible interarray cable or offshore export cable installation methods using jet trenching installation or mechanical trenching installation predicted above-ambient TSS of ≥10 mg/L stayed relatively close to the route centerline. According to Balthis et al. (2009), 10 mg/L is considered within the range of ambient TSS concentrations in the Mid-Atlantic Bight. TSS concentrations of ≥10 mg/L traveled a maximum distance of approximately 1.8 miles (2.9 kilometers), 1.6 miles (2.6 kilometers), and 1.1 miles (1.7 kilometers) for installation of interarray cables, Monmouth ECC cables, and Atlantic ECC cables, respectively. The use of an excavator without a cofferdam was assumed and sediment was assumed to be introduced at the surface for the landfall approaches. Results showed a maximum distance for the predicted above-ambient TSS concentrations ≥10 mg/L to be approximately 2.1 miles (3.3 kilometers) and 1.2 miles (1.9 kilometers) for the Monmouth and Atlantic HDD pits, respectively (COP Volume II, Section 3.2.2.1; Atlantic Shores 2023). The Atlantic ECC and interarray cable model scenarios showed above-ambient TSS concentrations significantly dissipated within 2 to 4 hours and fully dissipated in 6 or less hours. Above-ambient TSS concentrations substantially dissipated within 2 to 6 hours but required up to 13 hours to fully dissipate for the Monmouth ECC model scenarios. The landfall approach scenarios results showed that tails of sediment plumes, with concentrations of ≥10 mg/L, were transported away from the source and were brief, while concentrations around the HDD pits dissipated within 11 hours for the Atlantic HDD pit and 12 hours for the Monmouth HDD pit (COP Volume II, Section 3.2.2.1; Atlantic Shores 2023). Above-ambient TSS concentrations stemming from sandwave clearance activities were also predicted to be short lived and remain relatively close to the route centerline. The maximum distances for the predicted above-ambient TSS concentrations of ≥10 mg/L and 100 mg/L were approximately 2.0 miles (3.2 kilometers) and 1.3 miles (2.1 kilometers), respectively. The models showed that above-ambient TSS concentrations were projected to considerably dissipate within 4 to 6 hours and fully dissipate in less than 12 hours for most areas (COP Volume II, Section 3.2.2.1; Atlantic Shores 2023). These modeling results are similar to modeling predictions conducted for similar projects in similar conditions (COP Volume II, Section 3.2.2.1; Atlantic Shores 2023). Based on Elliot et al. (2017), actual suspended sediment concentrations and transport during installation may be even lower. Environmental monitoring surveys conducted during installation of the Block Island Wind Farm submarine cable found that suspended sediment levels during jet plow installation were measured to be up to 100 times lower than those predicted by the modeling (COP Volume II, Section 3.2.2.1; Atlantic Shores 2023).

Atlantic Shores would select cable installation techniques (e.g., jet plow embedment) that minimize sediment suspension to the maximum extent practicable (WAT-02; Appendix G, Table G-1). Atlantic Shores would also use anchor midline buoys (WAT-01) and dynamically positioned vessels to the extent practicable (WAT-02) to minimize seafloor disturbance (Appendix G, Table G-1). Sediments disturbed during construction activities are not expected to contain contaminants considering sediments are predominantly sandy and known sources of anthropogenic contaminants such as ocean disposal sites would be avoided.

Discharges/intakes: Contaminants in the coastal and marine environments are generally from point and nonpoint sources from both onshore and offshore human activities. Numerous permitted point source surface water discharges are located along the coast in the geographic analysis area. These discharges include petroleum product cleanup site, sewage, and industrial or commercial facilities outfalls (NJDEP 2019d). None of these discharges are located within either of the proposed ECCs or the WTA, These discharges are regulated by effluent standards, and related water pollution is mitigated through the dilution and mixing that takes place in the receiving streams, bays, and ocean (NJDEP 2015b).

During construction of the Proposed Action, vessel traffic would increase in and around the WTA, leading to potential discharges of uncontaminated water and treated liquid wastes. Tables 7.0-1 through 7.0-3 in COP Volume I list the types of wastes that could potentially be produced by the Proposed Action (Atlantic Shores 2023). The Project's solid and liquid wastes would be treated, released, stored, or disposed of in accordance with applicable federal, state, and local regulations. Vessels may discharge some liquid wastes such as domestic wastewater, uncontaminated bilge water and ballast water, treated deck drainage and sumps, and uncontaminated fresh or seawater from vessel air conditioning. Waste—such as sewage, solid waste, or chemicals, solvents, oils, and greases from equipment, vessels, or facilities—would be stored and properly disposed of onshore or incinerated offshore. All vessels for the Project would comply with USCG waste and ballast water management regulations and oil and hazardous material pollution prevention regulations, in addition to other regulations. Project vessels covered under the NPDES Vessel General Permit (VGP) are also subject to effluent limits contained in Section 2 of the VGP. Atlantic Shores would also require offshore contractors to participate in a marine trash and debris prevention training program. With implementation of these mitigation measures and the regulatory requirements described herein, the short-term impact of routine vessel discharge is expected to be minor.

The WTGs and OSSs are generally self-contained and do not generate discharges under normal operating conditions. In the event of a spill related to an allision or other unexpected or low-probability event, impacts on water quality from discharges from the WTGs or OSSs during operation would be short term.

Any onshore waste that could likely cause environmental harm would be stored in containers situated in designated, secure, and bermed locations away from depressions and drainage lines that carry surface water until collected by the selected waste contractor. Spill kits would be provided at all locations where hazardous materials are held to control foreseeable spills, and protocols would be in place to minimize the chance of such spills (see COP, Volume I, Section 1.5.3.2; Atlantic Shores 2023). Waste required to be removed for use away from storage areas would be kept in portable bunds (temporary spill berms), and waste oils would be recycled where appropriate. BMPs would be utilized to adequately contain excavated soils and sediments during onshore construction. Disturbed soil areas would be stabilized to avoid potential sedimentation and runoff into waterbodies or wetlands. See Appendix G, for proposed environmental protection measures that would be adhered to during construction of onshore components.

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

Land disturbance: Construction and installation of onshore components (e.g., substations, cable installation) would disturb ground and lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity. Two onshore interconnection cables (one per POI) would be installed underground primarily along existing roadways, bike paths, and utility ROWs from both the Monmouth and Atlantic Landfall Site(s) to their respective onshore substations. The Cardiff Onshore Interconnection Cable Route would be approximately 12.4 to 22.6 miles (20 to 36.4 kilometers), and the Larrabee Onshore Interconnection Cable Route would be approximately 9.8 to 23 miles (15.8 to 37 kilometers) in length. Utilizing existing roads, paths, and ROWs would minimize potential disturbance to onshore waterbodies and impacts on water quality. Atlantic Shores has also proposed to use trenchless technologies to install onshore cables in certain areas to avoid impacts on wetlands and water quality (Appendix G, Table G-1). These trenchless techniques would be used to install onshore cables under wetlands and waterbodies, minimizing soil disturbance in these sensitive areas. Atlantic Shores would implement appropriate BMPs such as silt fence, filter socks, inlet protection, dust abatement, and other approved BMPs in accordance with the approved Soil Erosion and Sediment Control Plan to properly contain excavated soils and sediments and stabilize disturbed land areas, to avoid erosion and sediment runoff into waterbodies and impacts on water quality. Additionally, the Project would be constructed in accordance with an approved New Jersey Division of Land Resource Protection Stormwater Management Control Plan (NJPDES and SWPPP) and County Soil Conservation District BMPs to avoid and minimize Project-related water quality impacts on nearby aquatic habitats (WAT-09, Appendix G, Table G-1). Temporarily disturbed areas would be restored (i.e., reseeding or repaving) in accordance with an approved Soil Erosion and Sediment Control Plan and SWPPP within the Onshore Project area. Construction would lead to an increased potential for water quality impacts resulting from accidental fuel spills or sedimentation in waterbodies. The incremental increases in land disturbance from the Proposed Action would be small, and mitigation measures, such as the use of an SPCC Plan, Erosion and Sedimentation Control Plan, and SWPPP, would be implemented. As such, impacts from the Proposed Action alone on water quality from land disturbance would be short term and negligible to minor.

Port utilization: During construction the port facilities of Paulsboro Marine Terminal and the Repauno Port and Rail Terminal in New Jersey, the Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas would be used for construction staging of activities associated with the Project. The State of New Jersey is building a new offshore wind port in Salem County, approximately 7.5 miles

(12.1 kilometers) southwest of Salem. The port is expected to be complete in late 2023 (New Jersey Wind Port 2021). The Virginia Department of Mines Minerals and Energy commissioned a study that was published in 2015 that evaluated ports in Virginia based on their readiness to supply offshore wind construction activities. The Portsmouth Marine Terminal was identified as having a high level of readiness to support offshore wind activities; however, the State of Virginia plans to upgrade this port to make it even more suitable for offshore wind manufacturing, handling, and transportation (Appendix D, Table D-8). The impacts on water quality could include accidental fuel spills or sedimentation during port use. The incremental increases in vessel traffic at the ports would be small; multiple authorities regulate water quality impacts from these operations (BOEM 2019). Therefore, the impacts of the Proposed Action alone on water quality from port utilization would be localized, short term, and negligible.

Presence of structures: Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area. Dock facilities and other structures are concentrated along the coastline. The Proposed Action would add up to 200 WTGs, 10 OSSs, 1 permanent met tower, 4 temporary metocean buoys and related Project elements, which would increase seabed disturbance and potential water quality impacts. As described in Section 3.4.2.3*,* results from a recent BOEM (2021) hydrodynamic model of four different WTG build-out scenarios of the offshore Rhode Island and Massachusetts lease areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification) via their influence on currents from WTG foundations and by extracting energy from the wind.

Two onshore substations or converter stations (one per POI) and one O&M facility are proposed for the Project. Onshore facilities locations would be in previously disturbed and developed areas away from surface waters and water supplies to minimize soil disturbance and risk of sediment deposition in nearby water resources. Atlantic Shores also proposes to use specialized cable installation technologies (e.g., trenchless technologies) in some areas to minimize environmental impacts. For example, HDD would be used to complete export cable landfall (i.e., offshore-to-onshore transition), which would minimize the amount of sediment and soil disturbance at the landfall sites, both offshore and onshore (WAT-04; Appendix G, Table G-1). Atlantic Shores would also use trenchless techniques (e.g., pipe jacking, jack-and-bore, and HDD) to install the onshore interconnection cables under wetlands, waterbodies, or roadways, which would minimize soil disturbances at these locations (WAT-08; Appendix G, Table G-1). See Figures 3.2-4 and 3.2-5 in Section 3.2.1.2 of COP Volume II for a depiction of the proposed routes of the onshore interconnection cables (Atlantic Shores 2023).

Impacts on water quality could result primarily from sedimentation due to ground disturbance and contamination due to accidental releases from heavy equipment during construction. Atlantic Shores would implement erosion and sedimentation BMPs and an SPCC Plan during the construction period in order to minimize potential impacts on onshore water resources. The proposed Project’s contribution to impacts on water quality due to the presence of onshore structures would be additive with the impacts of all structures, including those of offshore wind activities, that occur within the water quality geographic analysis area and that would remain in place during the life of the proposed Project. The impacts from the Proposed Action alone on water quality due to the presence of onshore structures would be negligible during construction, decommissioning, and operations.

The proposed Project's contribution to impacts on water quality due to the presence of structures would be additive with the impacts of all structures, including those of offshore wind activities, that occur within the water quality geographic analysis area and that would remain in place during the life of the proposed Project. These disturbances would be localized but, depending on the hydrologic conditions, have the potential to affect water quality through altering mixing patterns and the formation of sediment plumes. Scour protection may be necessary at the base of constructed OSS foundations to protect them from sediment transport or erosion caused by water currents. The addition of scour protection would further minimize effects on local sediment transport. The impacts from the Proposed Action alone on water quality due to the presence of structures would be negligible during construction, decommissioning, and operations. In addition, as described in Section 3.4.2.3, the exposure of offshore wind structures to the marine environment can result in emissions of metals and organic compounds from corrosion protection systems. However, the current understanding of chemical emissions for offshore wind structures is that emissions appear to be low, suggesting a low environmental impact (Kirchgeorg et al. 2018). The contributions of the Proposed Action to the cumulative structure placement impacts on water quality from ongoing and planned activities would likely be constant over the lifespans of the reasonably foreseeable activities.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* this EIS analyzes a planned bulkhead repair and/or replacement and maintenance dredging activities as a connected action under NEPA. The existing bulkhead consists of multiple sections that are made from steel sheet piles, timbers, and concrete. It is missing sections, making it unstable and increasing the potential for erosion. Repair and/or replacement of the existing bulkhead would take place in order to stabilize the shoreline and prevent additional erosion. This activity would be necessary regardless of whether the Proposed Action is implemented. Independently of the Proposed Action, Atlantic Shores is pursuing a USACE Nationwide Permit 3/Nationwide Permit 13 to install a new bulkhead composed of steel or composite vinyl sheet piles. Additionally, the City of Atlantic City obtained a USACE approval (CENAP-OPR-2021-00573-95) and a NJDEP Dredge Permit (No. 0102.20.0001.1 LUP 210001) to perform 10-year maintenance dredging of 13 city waterways, including the area associated with the proposed O&M facility. Dredging would reestablish a water depth of 15 feet (4.6 meters) below the plane of MLW plus 1.0 foot (0.3 meter) of allowable overdredge and 4:1 slide slopes within the site. Maintenance dredging activities would serve to maintain safe navigational depths for transiting vessels by re-establishing in-water depths consistent with depths historically maintained in collaboration with dredging activities of adjacent harbors and waterways. These activities would be implemented independently from the Proposed Action.

BOEM expects the connected action to affect water quality through the accidental releases, discharges/intakes, and land disturbance IPFs.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during staging and construction of the new bulkhead and during dredging activities. NJDEP would develop and implement a SWPPP or SPCC Plan to manage accidental spills or releases of oil, fuel, or hazardous materials during construction of the new bulkhead and dredging activities, which would include measures related to the potential release of materials to Clam Creek. As previously mentioned, the City of Atlantic City obtained approval of a USACE Individual Permit and a NJDEP Dredge Permit to perform maintenance dredging, inclusive of the area associated with the proposed O&M facility. BOEM anticipates the connected action would result in negligible, short-term impacts on water quality as a result of releases from heavy equipment, dredging, and other in-water work during construction.

Discharges/intakes: Sediment resuspension during dredging and installation of the bulkhead and piles would also result in release of sediment contaminants to the water column. The release of contaminants would be minimized by BMPs during dredging to minimize sediment resuspension. The dredged material would be removed and disposed of at Dredged Hole #86, a subaqueous borrow pit restoration site, in Beach Thorofare in Atlantic City, New Jersey, and in accordance with Department of the Army Permit Number NAP-2020-00059-95. The total suspended sediments and associated contaminant concentrations generated by the in-water activities would be temporary and would result in minor short-term impacts on water quality.

Localized increases in TSS resulting in localized turbidity would be expected during dredging and during installation of the bulkhead and piles. Dredging would be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. The hydraulic cutterhead dredge would be the primary dredge method, with the mechanical dredge utilized to access small marina, canal, or lagoon areas. Pile driving typically results in minimal increases in TSS and would not result in significant impacts on water quality. Turbidity associated with these activities would be minimal and temporary in nature and would result in localized, short-term, and minor impacts on water quality, as resuspended sediments would dissipate relatively quickly with the tidal currents.

Land disturbance: Connected action–related construction would disturb the ground, which can lead to unstable soils and sedimentation that could reach nearby surface waters, causing turbidity. However, the area where the connected action would take place is already heavily disturbed with concrete debris and impervious surfaces, and little actual soil disturbance is anticipated. A SWPPP would be developed and implemented and the appropriate NPDES permit obtained to avoid and minimize water quality impacts during construction. Any impact on water quality from land disturbance is anticipated to be temporary, lasting only the duration of construction. Therefore, due to the nature of the location and conditions of the site where the connected action activities would occur, BOEM anticipates negligible impacts on water quality.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities and the connected action. Ongoing and planned non-offshore wind activities related to onshore development, terrestrial runoff and discharges, marine transportation-related discharges, dredging and port improvement projects, commercial fishing, military use, submarine cables and pipelines, atmospheric deposition, and climate change would contribute to impacts on water quality through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, port utilization, discharges, and land disturbance. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities in the geographic analysis area would also contribute to the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, port utilization, discharges, presence of structures, and land disturbance. However, given the low probability of accidental releases, the temporary impacts of suspended sediment, and the regulatory and permitting requirements to avoid and minimize impacts on water quality (e.g., NPDES permits; Vessel General Permit; Oil Spill Response Plan; Spill Prevention, Control, and Countermeasure Plan), adverse impacts on water quality would be minimized. Construction and operations related to the connected action would include accidental releases, discharges, and runoff impacts related to land disturbance.

Accidental releases: The contribution of the Proposed Action to the cumulative accidental release impacts on water quality would likely be short term but noticeable due to the low risk and localized nature of the most likely spills, and the use of an OSRP for the Project. These impacts would occur primarily during construction but also during operation and decommissioning, to a lesser degree. In the unlikely event that an allision or collision involving Project vessels or components resulted in an oil or chemical spill, it would be expected that a small spill would have minor, short-term impacts, while a larger spill would have potentially increased impacts for a longer duration. Given the low probability of these spills occurring, BOEM does not expect ongoing and planned activities, including the Proposed Action, to appreciably contribute to impacts on water quality resulting from oil and chemical spills.

Anchoring: The contribution of the Proposed Action to the cumulative anchoring impacts on water quality from ongoing and planned activities is anticipated to be localized, short term, and noticeable, primarily during construction and decommissioning.

Cable emplacement and maintenance: The contribution from the Proposed Action to increased sediment concentration and turbidity would be additive with the impact(s) of all other cable installation activities, including offshore wind activities, that occur within the water quality geographic analysis area and that would have overlapping timeframes during which sediment is suspended.

Discharges/intakes: Impacts on water quality from the Proposed Action due to discharges would be additive with the impact(s) of any and all discharges, including those of offshore wind activities, that occur within the water quality geographic analysis area during the same timeframe. Vessel traffic (e.g., fisheries use, recreational use, shipping activities, military uses) in the region would overlap with vessel routes and port cities expected to be used for the Proposed Action, and vessel traffic would increase under the Proposed Action. Discharge events would mostly be staggered over time and localized, and all vessels would be required to comply with regulatory requirements related to prevention and control of discharges, accidental spills, and nonindigenous species administered by USEPA, USACE, USCG, and BSEE. Therefore, BOEM expects that the contribution of the Proposed Action to the cumulative discharge impacts on water quality would likely be short term, localized, and noticeable, primarily during construction and to a lesser extent during O&M and decommissioning.

Land disturbance: The contribution of the Proposed Action to the cumulative land disturbance impacts on water quality would likely be localized, short term, and negligible due to the low likelihood that construction of onshore components would overlap in time or space, and the minimal amount of expected erosion into nearby waterbodies.

Overall, the Proposed Action could contribute a detectable increment to the cumulative accidental release (in the event of a large-volume catastrophic release) and cable emplacement impacts (turbidity) on water quality.

Port utilization: In context of reasonably foreseeable environmental trends and due to the need for minimal port modifications or expansions (except for construction of the New Jersey Wind Port) and the small increase in ship traffic, the contribution of the Proposed Action to the cumulative port utilization impact on water quality from ongoing and planned activities during the construction and installation of onshore components would likely be localized, short term, and noticeable.

Presence of structures: The proposed Project's contribution to impacts on water quality due to the presence of structures would be additive with the impacts of all structures, including those of offshore wind activities, that occur within the water quality geographic analysis area and that would remain in place during the life of the proposed Project. In the water quality geographic analysis area, planned offshore wind activities including the Proposed Action would result in 693 acres (281 hectares) of impact from installation of foundations and scour protection and 1,484 acres (601 hectares) of impact from hard protection for offshore cables and interarray cables (Appendix D, Table D.A2-2). These disturbances would be localized but, depending on the hydrologic conditions, have the potential to affect water quality through altering mixing patterns and the formation of sediment plumes. Scour protection may be necessary at the base of constructed OSS foundations to protect them from sediment transport or erosion caused by water currents. The addition of scour protection would further minimize effects on local sediment transport. The impacts from the Proposed Action alone on water quality due to the presence of structures would be negligible to minor during construction, decommissioning, and operations. In addition, as described in Section 3.4.2.3, the exposure of offshore wind structures to the marine environment can result in emissions of metals and organic compounds from corrosion protection systems. However, the current understanding of chemical emissions for offshore wind structures is that emissions appear to be low, suggesting a low environmental impact (Kirchgeorg et al. 2018).

Conclusions

Impacts of Alternative B – Proposed Action. BOEM anticipates the impacts on water quality resulting from the Proposed Action would be **minor**. Impacts from routine activities including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; dredging; vessel discharges; sediment contamination; discharges from the WTGs or OSSs during operation; sediment plumes due to scour; and erosion and sedimentation from onshore construction, would be negligible to minor. Impacts from non-routine activities, such as accidental releases, would be minor from small spills. While a larger spill could have moderate impacts on water quality, the likelihood of a spill this size is very low. The impacts associated with the Proposed Action are likely to be temporary or small in proportion to the geographic analysis area and the resource would recover completely after decommissioning.

BOEM anticipates **negligible** to **minor** water quality impacts for the connected action due to the nature of the location and conditions of the site, and the required dredging, water quality permits, and regulatory requirements for protection of water quality.

Cumulative Impacts of Alternative B – Proposed Action. The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action at the Inlet Marina in Atlantic City, New Jersey. BOEM anticipates that the cumulative impacts on water quality in the geographic analysis area would be moderate. The incremental impacts contributed by the Proposed Action to the cumulative impacts on water quality would be detectable should a large-volume, catastrophic release occur. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to these impacts from ongoing and planned activities would be minor. The main drivers for this impact rating are the temporary, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures. BOEM has considered the possibility of a moderate impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic release. While it is an impact that should be considered, it is unlikely to occur. The Proposed Action would contribute to the overall **minor** to **moderate** impact rating primarily through the increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures.

3.4.2.6 Impacts of Alternatives C, D, E, and F on Water Quality

Impacts of Alternatives C, D, E, and F. The impacts resulting from individual IPFs under all of the action alternatives would be either the same or less than those described under the Proposed Action due to the same (Alternative F [Foundation Structures]) or potentially reduced (Alternatives C [Habitat Impact Minimization/Fisheries Habitat Impact Minimization], D [No Surface Occupancy at Select Locations to Reduce Visual Impacts], and E [Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1]) number of WTGs, OSSs, and interarray/export cables in the WTA. While the reduced number of structures may slightly reduce localized water quality impacts during construction and installation, operations, and decommissioning, the difference in impacts compared to the Proposed Action would not be substantially different. Therefore, BOEM does not anticipate that impacts from any of the action alternatives would be substantially different from those described under the Proposed Action.

Cumulative Impacts of Alternatives C, D, E, and F. The cumulative impacts on water quality would be the same or less than those described under the Proposed Action. The incremental impacts contributed by Alternatives C, D, E, and F to the cumulative impacts on water quality would not be significantly different from those described under the Proposed Action. As described for the Proposed Action, Atlantic Shore’s existing commitments to mitigation measures and BOEM’s potential additional mitigation measures could further reduce impacts from the action alternatives but would not change the impact ratings.

Conclusions

Impacts of Alternatives C, D, E, and F. As discussed in the above sections, the expected **minor** impacts associated with the Proposed Action alone would not change substantially under Alternatives C, D, E, and F. The same construction, O&M, and decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives C, D, and E may result in slightly less, but not materially different, **minor** impacts on water quality due to a reduced number of offshore structures that would need to be constructed and maintained. Alternative F would have similar **minor** impacts on water quality due to the same number of proposed structures as the Proposed Action. Therefore, the overall **minor** impacts would be the same across all action alternatives due to the same or fewer structures that would be constructed and maintained.

Cumulative Impacts of Alternatives C, D, E, and F. The incremental impacts contributed by Alternatives C, D, E, and F to the cumulative impacts on water quality would be similar to the Proposed Action because the majority of the water quality impacts within the geographic analysis area would come from other planned offshore wind development, which does not change between alternatives. However, the differences in impacts among action alternatives would still apply when considered alongside the impacts of other ongoing and future activities. Therefore, cumulative impacts on water quality would be about the same or less under Alternative F, and slightly lower but not materially different under Alternatives C, D, and E. The cumulative impacts resulting from individual IPFs associated with any action alternative would range from **minor** to **moderate** due to the same or fewer structures that would be constructed and maintained during the Project.

3.4.2.7 Proposed Mitigation Measures

No measures to mitigate impacts on water quality have been proposed for analysis.

3.4.2.8 Comparison of Alternatives

Construction of any of the action alternatives would have the same minor impacts on water quality as described under the Proposed Action. Alternative C would result in slightly less effects on water quality due to the potential removal of up to 29 WTGs, 1 OSS, and associated interarray cables to avoid and minimize impacts on sensitive habitats. Alternative D would include an alteration in the layout and number of WTGs to reduce visual impacts. Alternative D1 would remove up to 21 WTGs sited within 12 miles (19.3 kilometers) of the shore, Alternative D2 would remove up to 31 WTGs sited within 12.75 miles (20.5 kilometers) of the shore, and Alternative D3 would remove up to 6 WTGs sited within 10.8 miles (17.4 kilometers) of the shore. These subalternatives would all result in slightly less impacts on water quality than the Proposed Action. Alternative E would result in slightly less impacts on water quality due to the potential exclusion or micrositing of up to 5 WTGs. The Alternative F options would result in the same or less impacts on water quality due to potentially minimizing the amount of seabed disturbance during construction of offshore structures.

3.5 Biological Resources

3.5.1 Bats

This section discusses potential impacts on bats from the proposed Project, alternatives, and ongoing and planned activities in the bat geographic analysis area. The bat geographic analysis area, as shown on Figure 3.5.1-1, includes the United States coastline from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland. The geographic analysis area for bats was established to capture most of the movement range for migratory species. The offshore limit was established to capture the migratory movements of most species in this group, while the onshore limits cover onshore habitats used by species that may be affected by onshore and offshore components of the proposed Project.

3.5.1.1 Description of the Affected Environment and Future Baseline Conditions

The number of bat species in the geographic analysis area varies by state, ranging from 8 species in Rhode Island, New Hampshire, and Maine to 17 species in Virginia and North Carolina (Rhode Island Department of Environmental Management n.d.; Maine Department of Inland Fisheries and Wildlife 2021; New Hampshire Fish and Game n.d.; Virginia Department of Wildlife Resources 2021; North Carolina Wildlife Resources Commission 2017). New Jersey has 8 bat species whose ranges overlap with the onshore or offshore components of the Proposed Action (or both), as shown in Table 3.5.1-1. They include the big brown bat (*Eptesicus fuscus*), eastern small-footed bat (*Myotis leibeii*), little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), tri-colored bat (*Perimyotis subflavus*), eastern red bat (*Lasiurus borealis*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*). The federally endangered Indiana bat (*M. sodalis*) also occurs in New Jersey, but only in northern portions of the state (USFWS 2007). Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, and tri-colored bat are short-distance migrants that hibernate in the region during winter (“cave-hibernating bats”) whereas eastern red bat, silver-haired bat, and hoary bat are long-distance migrants that overwinter mainly in the southeastern U.S. (“migratory tree bats”). Both groups are nocturnal insectivores that use a variety of forested and open habitats for foraging during the summer (CWFNJ 2008).

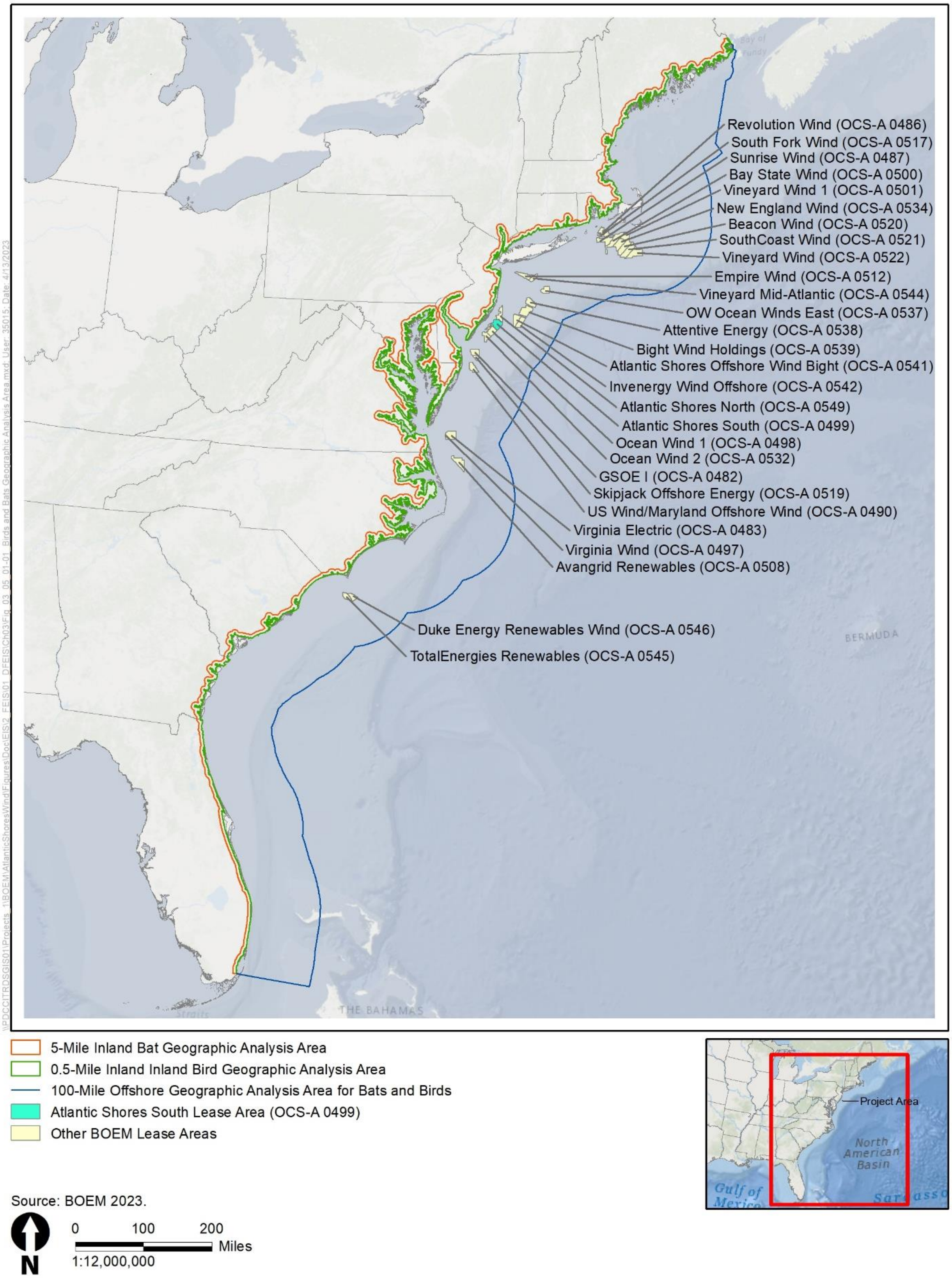


Figure 3.5.1-1. Bats geographic analysis area

Table 3.5.1-1. Bats present in New Jersey and their conservation status

Common Name	Scientific Name	State Status	Federal Status
Cave-Hibernating Bats			
Eastern small-footed bat	*Myotis leibii*	SC	--
Little brown bat	*Myotis lucifugus*	SGCN	Under Review[1]
Northern long-eared bat	*Myotis septentrionalis*	T	T[2]
Indiana bat	*Myotis sodalis*	E	E
Tri-colored bat	*Perimyotis subflavus*	SGCN	PE[3]
Big brown bat	*Eptesicus fuscus*	--	--
Migratory Tree Bats			
Eastern red bat	*Lasiurus borealis*	--	--
Hoary bat	*Lasiurus cinereus*	--	--
Silver-haired bat	*Lasionycteris noctivagans*	--	--

Source: CWFNJ 2008.
[1] Currently under a USFWS discretionary status review. Results of the review may be to propose listing, make a species a candidate for listing, provide notice of a not warranted candidate assessment, or other action as appropriate. USFWS anticipates a decision in Fiscal Year 2022.
[2] USFWS elevated to endangered status, effective March 31, 2023.
[3] USFWS proposed to classify the tri-colored bat as endangered on September 14, 2022. The proposal is currently open to public comments, and USFWS will evaluate all information received during the comment period and announce a final decision within 12 months.
E = Endangered; PE = Proposed Endangered; SC = Special Concern; SGCN = Species of Greatest Conservation Need; T = Threatened.

Bats are terrestrial species that spend the majority of their lives on or over land. Occasionally, tree bats may occur offshore during spring and fall migration and under very specific conditions, such as high temperatures and low wind; however, 80 percent or more of acoustic detections occur in August and September (Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Stantec 2016; Normandeau 2022). In contrast to tree bats, the likelihood of detecting a *Myotis* species or other cave bats is considerably less in offshore environments (Pelletier et al. 2013).

The occurrence of bats has been recorded in the offshore marine environment in the United States (Cryan and Brown 2007; Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013). Bats have been documented temporarily roosting on structures, such as lighthouses, on nearshore islands, and there is evidence of eastern red bats migrating offshore in the Atlantic. During the spring and fall of 2009 and 2010, a mid-Atlantic bat acoustic study conducted for a total of 86 nights, found the maximum distance bats were detected from shore was 13.6 miles (21.9 kilometers) and the mean distance was 5.2 miles (8.4 kilometers) (Sjollema et al. 2014). Bats were detected on Maine islands up to 25.8 miles (41.6 kilometers) from the mainland (Peterson et al. 2014). In the mid-Atlantic acoustic study, eastern red bat represented 78 percent of all bat findings offshore, and bat activity decreased as wind increased (Sjollema et al. 2014). Additionally, eastern red bats were detected in the mid-Atlantic up to 27.3 miles (44 kilometers) offshore by high-definition video aerial surveys (Hatch et al. 2013). During post-construction bat monitoring at the Coastal Virginia Offshore Wind Pilot Project (CVOW), approximately 27 miles (44 kilometers) offshore, nearly all bat detections occurred in the fall and were limited to eastern red bat, hoary bat, and silver-haired bat (Normandeau 2022). Bat activity was negatively related to wind speed, significantly declining when winds were above 6 meters per second, and no collisions of bats with the WTGs were observed on thermal or visible-light video cameras (Normandeau 2022). While some uncertainty regarding the level of bat use of the OCS still remains, all available data indicate that bat activity levels are substantially lower offshore compared to onshore. For example, a study in the North Sea off Belgium found that bat detections were 24 times higher at onshore locations than offshore sites (Brabant et al. 2021). During shipboard acoustic surveys conducted at the operational BIWF in Rhode Island, 911 bat passes were detected offshore. Bats were detected during 41 of 125 (33 percent) surveyed nights (Stantec 2018). The average bat detection rate (passes/detector night) was 7.3. This is a small fraction of the average bat detection rates typically observed onshore (e.g., Johnson et al. 2011; Haddaway and McGuire 2022).

Cave-hibernating bats overwinter in regional caves, mines, and other structures (e.g., buildings) and feed mostly on insects in terrestrial and freshwater habitats. These species generally display lower activity in the offshore environment than the migratory tree bats (Sjollema et al. 2014), with movements mainly during the fall months. The maximum distance *Myotis* bats were detected offshore in the mid-Atlantic was 7.2 miles (11.5 kilometers) (Sjollema et al. 2014). A recent nano-tracking investigation on Martha's Vineyard documented little brown bat movements off the island in late August and early September, with one individual traveling from Martha's Vineyard to Cape Cod (Dowling et al. 2017). Big brown bats were also recorded migrating from the island as late as October through November (Dowling et al. 2017). These findings are supported by an acoustic study conducted on islands and buoys off the Gulf of Maine that demonstrated the highest percentage of activity occurs during the months of July–October (Peterson et al. 2014). Given the use of coastlines as migratory routes by cave-hibernating bats is likely limited to their fall migration period, that acoustic studies indicate lower use of the offshore environment, and that cave-hibernating bats do not habitually feed on insects over the ocean, exposure to the proposed Project is not likely for cave-hibernating bats.

Tree bats migrate south to winter and have been recorded in the offshore environment (Hatch et al. 2013). Eastern red bats have been detected migrating from Martha's Vineyard in late fall, with one individual tracked as far south as Maryland. These outcomes are supported by past observations of eastern red bats offshore and recent acoustic and survey results (Hatch et al. 2013, Peterson et al. 2014, Sjollema et al. 2014, Normandeau 2022). Offshore acoustic bat surveys were conducted in the Lease Area (OCS-A 0499) in 2020 and 2021 (Table 3.5.1-2). Eastern red bat represented the most detections (495), followed by big brown/silver-haired bat group (478), silver-haired bat (80), hoary bat (37), big brown bat (26), tri-colored bat (5), and *Myotis* spp. (3). Detections occurred from July to October, with peak activity in August and September, and the latest detection occurring on November 1. These results suggest that tree bats, particularly eastern red and silver-haired bats, are more likely to pass through the Lease Area than cave-hibernating bats, and mostly during the fall migration period (late summer/early fall) (COP Volume II, Appendix II-F4; Atlantic Shores 2023). Overall, there were 1,124 total bat detections identified to species or species group across the 180 survey nights in the Lease Area. This averages to 6.2 bat detections per detector-night, which is a small fraction of bat passage rates typically found onshore during migration in eastern North America. For a nearby onshore comparison, Johnson et al. (2011) found bat activity along the coast of Maryland to average 25 passes per detector-night over the span of an entire year. During fall migration, the number of bat passes there commonly exceeded

500 per detector-night and peaked around 1,000 (Johnson et al. 2011), compared to an average of only 6.2 bat passes per night in the Lease Area during a similar time of year. As another comparison, a recent study farther inland, along Lake Erie, reported an average of 155 bat passes per detector-night during the fall migration period of 2020 (Haddaway and McGuire 2022). As such, while some individuals may take offshore routes during migration and can be present in the Lease Area, they appear to represent a very small percentage of their species' total population onshore.

Table 3.5.1-2. Total number of bat detections in the Lease Area (OCS-A 0499) in 2020 and 2021

Species	Year		Total
	2020	2021	
Hoary bat	13	24	37
Big brown bat	17	9	26
Silvered-hair bat	26	54	80
Big brown/Silver-haired bat	163	315	478
Eastern red bat	148	347	495
Evening bat	0	0	0
Tri-colored bat	3	2	5
Little brown bat	0	0	0
Eastern small-footed bat	0	0	0
Indiana bat	0	0	0
Northern long-eared bat	0	0	0
Myotis species	1	2	3
Total	**371**	**753**	**1,124**

Source: COP Volume II, Appendix F4, Table 3 (Atlantic Shores, 2023).
Note: Results show the number of files vetted for each category that were recorded in the study area.

Onshore coastal areas throughout the geographic analysis area provide an assortment of habitats that support a variety of bat species, including coastal wetlands, forested wetlands, forested uplands, forested lowlands, barrier beaches, and bay island habitats. This includes the urbanized and residential landscape in which the existing Cardiff and Larrabee onshore substations and proposed new substation and/or converter station sites are located. The woodland fragments in these areas are potential non-hibernating habitat for big brown bat, little brown bat, northern long-eared bat, eastern red bat, silver-haired bat, and hoary bat. Big brown bat, little brown bat, eastern red bat, and hoary bat are the most urban-adapted and disturbance-tolerant of these species, and therefore are the most likely to occur in the area. The disturbed and fragmented habitat around the existing Cardiff and Larrabee onshore substations and proposed new substation and/or converter station sites does not represent high-quality, critical, or limited habitat for any bat species, and bat abundance and diversity there are expected to be low. Moreover, occurrences of bats in this area would be limited to the April through October active period, as there are no known hibernacula for cave bats nearby and the area is well north of the wintering grounds of migratory tree bats.

The northern long-eared bat is the only currently ESA-listed bat species with the potential to occur in the Onshore or Offshore Project areas. The tri-colored bat, which was proposed by the USFWS for listing as endangered under the ESA on September 13, 2022, also has potential to occur in the Onshore and Offshore Project areas.

There are acoustic records of northern long-eared bats in surrounding townships around the existing Cardiff and Larrabee substations and proposed new onshore substation and/or converter station sites (COP Volume II, Section 4.4.1.2; Atlantic Shores 2023). There are no known records of northern long-eared bat hibernacula, roost trees, or maternity colonies in Absecon, Pleasantville City, or Wall; however, records of roost trees, including maternity colonies, exist in Howell Township, but they are all within the grounds of the Earle Naval Weapon Station or farther north (COP Volume II, Section 4.4.1.2; Atlantic Shores 2023). There are no known hibernacula within the designated buffer of the Onshore Project area and no known maternity roost trees within 150 feet (45 meters) of any planned onshore activities (COP Volume II, Section 4.4.1.2; Atlantic Shores 2023). The nearest maternity colony to Onshore Project structures associated with the Atlantic City Landfall to Cardiff POI route is approximately 2.88 miles (4.64 kilometers) from the Cardiff Onshore Interconnection Cable Route. The nearest maternity colonies to Onshore Project structures associated with the Monmouth Landfall to Larrabee POI route are approximately 6 miles (9.66 kilometers) from the Larrabee Onshore Interconnection Cable Route, approximately 8 miles (12.87 kilometers) from the existing Larrabee substation (POI), and approximately 7 miles (11.27 kilometers) from the three substation and/or converter station options. As such, northern long-eared bats are expected to be potentially present in wooded areas near the proposed Cardiff and Larrabee onshore substation and/or converter station sites. Occupancy modeling has suggested the occurrence of northern long-eared bats in coastal New Jersey and coastal areas of other mid-Atlantic and northeastern states is low relative to inland areas (USGS 2019). However, there is increasing recognition that northern long-eared bat occurrence in low-lying coastal areas may be much greater than previously expected and that coastal areas may be providing an important refuge from white-nose syndrome (WNS) because of their milder winter climate (e.g., Grider et al. 2016; Dowling and O'Dell 2018; Jordan 2020; Gorman et al. 2021). Because northern long-eared bats in coastal areas have been found to be overwintering there (Grider et al. 2016; Dowling and O'Dell 2018; Jordan 2020; Gorman et al. 2021), their potential to occur in the vicinity of the Cardiff and Larrabee onshore substation and/or converter station sites is year-round. Under the programmatic Biological Opinion that assists with Section 7 consultation for this ESA-listed species, the USFWS has determined that activities away from known roost trees and hibernacula are not likely to impact the species (USFWS 2018). Therefore, if the Project can avoid removing trees 0.5 mile (0.8 kilometer) from known hibernacula, or 150 feet (46 meters) around a known roost tree from June 1 to July 31, formal Section 7 consultation may be unnecessary (USFWS 2018). It should be noted, however, that USFWS elevated the listing of northern long-eared bat from threatened to endangered, effective March 31, 2023, and current regulations and mitigation requirements for the species may therefore be subject to change in the near future.

Northern long-eared bats are not likely to occur in the Offshore Project area given that none were detected there during acoustic surveys in 2020 and 2021 (COP Volume II, Appendix II-F4; Atlantic Shores 2023) and offshore records of northern long-eared bats elsewhere in the geographic analysis area are extremely rare (e.g., Dowling et al. 2017; Tetra Tech 2021a, b). For example, post-construction acoustic and video monitoring of bats at the CVOW pilot project from the spring of 2021 through winter of 2022 found no northern long-eared bats (or other *Myotis* species) among the 519 bats detected (Normandeau 2022). If northern long-eared bats were to migrate over water, movements would likely be close to the mainland. The related little brown bat has been documented to migrate from Martha's Vineyard to Cape Cod, and northern long-eared bats may likewise migrate to mainland hibernacula from these islands in August through September (Dowling et al. 2017). In addition, while in a different area, the Vineyard Wind 1 BA concluded that "it is extremely unlikely northern long-eared bats would traverse offshore portions" of that project (BOEM 2019). Additional, stationary acoustic detectors positioned on two WTGs within the operational BIWF in Rhode Island did not detect any northern long-eared bat calls over a 3-year period (Stantec 2020); similarly, acoustic detectors on WTGs in a CVOW-pilot off Virginia did not detect northern long-eared bat during a 1–year survey period (Tetra Tech 2021b, Normandeau 2022). Given that there is little evidence of use of the offshore environment by northern long-eared bat, exposure to the offshore components of the Proposed Action is anticipated to be minimal. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing, and results of the consultation will be presented in the Final EIS.

Tri-colored bat habitat is very similar to habitats used by the northern long-eared bat. The occurrence of tri-colored bat in the vicinity of the Onshore Project area is predicted to be relatively low (USGS 2019). The USFWS' Species Status Assessment Report for the tri-colored bat indicates that prior to WNS in 2000 there were several occupied hibernacula in northern New Jersey, but the estimated number of current (2019) occupied hibernacula in New Jersey is one (USFWS 2021). None of the hibernacula are close to the Onshore Project area.

Although there were five detections of this species during offshore acoustic surveys conducted as part of the proposed Project in 2020 and 2021 (COP Volume II, Appendix II-F4; Atlantic Shores 2023), other available survey data and the ecology of the species suggest there is little evidence of use of the offshore environment. Offshore surveys recorded several observations of migratory tree bats in the nearshore portion of the New Jersey Coast, but none were identified as tri-colored bat (Geo-Marine Inc. 2010). There are records of tri-colored bat in Nantucket, Massachusetts (Dowling and O'Dell 2018), indicating that some individuals traveled over open water to the islands, but their occurrence over the ocean is rare. During the offshore construction of the BIWF, bats were monitored with acoustic detectors on boats; no tri-colored bats were detected among the 1,546 bat passes (Stantec 2018). Preliminary results of the first year of post-construction monitoring at BIWF indicated low numbers of tri-colored bat calls (33 out of 1,086 calls) (Stantec 2018). In addition, recent data from 3 years of post-construction monitoring around BIWF found relatively low numbers of bats present only during the fall (Stantec 2020); although 80 passes were labeled as tri-colored bats, none had characteristics that were diagnostic of the species, and these were more likely to be eastern red bats (Stantec 2020). Post-construction acoustic and video monitoring of bats at the Coastal Virginia Offshore Wind Pilot Project from the spring of 2021 through winter of 2022 similarly found no tri-colored bats among the 519 bats detected (Normandeau 2022).

Collectively, this information indicates that tri-colored bat could occur in the terrestrial components of the Project area during non-hibernation periods, although presence would be very limited and in very small numbers. Any occurrence of tri-colored bat in the offshore component of the Project area would be very rare and in very small numbers.

The northern long-eared bat, tri-colored bat, and other cave bats are experiencing drastic declines due to WNS, which occurs in New Jersey and every other state in the geographic analysis area besides Florida. Impacts associated with the Project have the potential to affect cave bat populations already affected by WNS. The unprecedented mortality of more than 5.5 million bats in northeastern North America as of 2015 reduces the likelihood of many individuals being present within the onshore portions of the Project area (USFWS 2015). However, given the drastic reduction in cave bat populations in the region, the biological significance of mortality resulting from the Project, if any, may be increased.

3.5.1.2 Impact Level Definitions for Bats

As described in Section 3.3, *Definitions of Impact Levels,* this Draft EIS uses a four-level classification scheme to characterize potential adverse impacts of alternatives, including the Proposed Action. The definitions of potential adverse impact levels for bats are provided in Table 3.5.1-3. There are no beneficial impacts on bats.

Table 3.5.1-3. Impact level definitions for bats

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

3.5.1.3 Impacts of Alternative A – No Action on Bats

This section explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on bats, BOEM considered the impacts of past and ongoing trends and activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for bats. BOEM separately analyzes how resource conditions will be affected over time as reasonably foreseeable activities are implemented. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for bats described in Section 3.5.1.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities.

Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on bats are generally associated with onshore construction and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bat species through temporary and permanent habitat removal and temporary noise impacts, which could cause avoidance behavior and displacement. Mortality of individual bats could occur, but population-level effects would not be anticipated. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on bats include:

- Continued O&M of the BIWF (five WTGs) installed in Massachusetts state waters;
- Continued O&M of the CVOW pilot project (two WTGs) installed in OCS-A 0497 approximately 27 miles (44 kilometers) off the coast of Virginia Beach, Virginia; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 approximately 14 miles (23 kilometers) offshore of Nantucket, Massachusetts, and approximately 14 miles (23 kilometers) offshore Martha's Vineyard, Massachusetts, and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517 approximately 19 miles (31 kilometers) southeast of Block Island, Rhode Island, and 35 miles east of Montauk Point, New York.

The effects of approved projects have been evaluated through previous NEPA review and are incorporated by reference. Ongoing O&M of the BIWF and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect bats through the primary IPFs of noise, presence of structures, and land disturbance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and land disturbance described in detail in the *Cumulative Impacts of Alternative A –No Action* section for planned offshore wind activities, but the impacts would be of lower intensity.

The northern long-eared bat and tri-colored bat are the only ESA-listed or proposed threatened or endangered bat species that may occur within the proposed Project area. Planned onshore and offshore activities without the Proposed Action are not expected to significantly impact populations of the northern long-eared bat or tri-colored bat. WNS remains the primary threat to these species, and summer habitat availability is not considered to be a factor regulating the species' population sizes (USFWS 2015, 2021). As such, coastal development and other onshore activities without the Proposed Action would not be expected to impact northern long-eared bat or tri-colored bat populations. Future offshore wind development without the Proposed Action also would not be expected to impact northern long-eared bat or tri-colored bat populations because offshore records of these species are rare and exposure to WTGs would be minimal (Dowling et al. 2017; BOEM 2019; Tetra Tech 2021a, b; Normandeau 2022; COP Volume II, Appendix II-F4; Atlantic Shores 2023).

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that could affect bats include new submarine cables and pipelines, oil and gas activities, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Section D.2 in Appendix D for a description of planned activities). These activities could result in short-term and permanent onshore habitat impacts and short-term or permanent displacement and injury of or mortality to individual bats, but population-level effects would not be expected.

The sections below summarize the potential impacts of planned offshore wind activities on bats during construction, O&M, and decommissioning of the projects. The federally listed northern long-eared bat is the only bat species listed under the ESA that may be affected by other offshore wind activities. Impacts on the northern long-eared bat would most likely be limited to onshore impacts, and generally during onshore facility construction.

In addition to the four ongoing offshore wind projects, 31 additional offshore wind projects are planned to be constructed in the geographic analysis area for bats. These 31 planned projects, along with the ongoing offshore wind projects, would result in an additional 2,974 WTGs and 41 OSSs/ESPs in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). The impacts of planned offshore wind projects are discussed in this section.

BOEM expects other offshore wind activities to affect bats through the following primary IPFs:

Land disturbance: A small amount of infrequent construction impacts associated with onshore power infrastructure would be required over the next 8 years to connect future offshore wind energy projects to the electrical grid. Typically, this would require only small amounts of habitat removal, if any, and would generally occur in previously disturbed areas. Short-term and long-term impacts associated with habitat loss or avoidance during construction may occur, but no injury or mortality of individuals would be expected. As such, onshore construction activities associated with future offshore wind development would not be expected to appreciably contribute to overall impacts on bats.

In addition to electrical infrastructure, some amount of habitat conversion may result from port expansion activities required to meet the demands for fabrication, construction, transportation, and installation of wind energy structures. The overall trend along the coastal region from Virginia to Maine is that port activity will increase modestly and require some conversion of undeveloped land to meet port demand. This conversion will result in permanent habitat loss for local bat populations. However, the incremental increase from future offshore wind development would be a minimal contribution in the port expansion required to meet increased commercial, industrial, and recreational demand (BOEM 2019).

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

In the planned activities scenario (Appendix D), the construction of 2,974 offshore WTGs and up to 41 OSSs or ESPs would create noise and may temporarily affect some migrating tree bats, if conducted at night during spring or fall migration. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 7 to 9 hours per monopile and 2 monopiles per day, and 3 to 4 hours per pin pile and up to 4 pin piles per day over an 8-year period. Construction activity would be temporary and highly localized. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to temporary threshold shifts (TTS) than other terrestrial mammals (Simmons et al. 2016). Habitat-related impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior by individual migrating tree bats (Schaub et al. 2008). These impacts would likely be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). However, these impacts are highly unlikely to occur, as little use of the OCS is expected, and only during spring and fall migration.

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

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

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

Presence of structures: Offshore wind-related activities would add up to 2,974 WTGs and up to 41 OSSs on the OCS (Appendix D, Tables D.A2-1 and D.A2-2), and the presence of these structures could result in potential long-term effects on bats. Cave bats (including the federally endangered northern long-eared bat and proposed endangered tri-colored bat) do not tend to fly offshore (even during fall migration), and, therefore, exposure to construction vessels during construction or maintenance activities, or the RSZ of operating WTGs in the offshore wind lease areas, is expected to be negligible, if exposure occurs at all (BOEM 2015; Pelletier et al. 2013).

However, tree bats may pass through the offshore wind lease areas during fall migration, with limited potential to encounter vessels during construction and decommissioning of WTGs, OSSs, and offshore export cable corridors, even though structure and vessel lights may attract bats due to increased prey availability. As previously discussed, while bats have been documented at offshore islands, relatively little bat activity has been documented in open water habitat. The frequency of bat passes recorded offshore has been found to be a minor fraction of that which is commonly observed over shorelines and inland.

At onshore wind farms, bats have sometimes been observed to be attracted to WTGs, and several authors (e.g., Cryan and Barclay 2009, Cryan et al. 2014, and Kunz et al. 2007) have proposed hypotheses of why this may occur. Many, including the creation of linear corridors, altered habitat conditions, or thermal inversions, do not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009; Cryan et al. 2014; Kunz et al. 2007). Other hypotheses regarding bat attraction to WTGs include bats perceiving the WTGs as potential roosts, potentially increased prey base, visual attraction, disorientation due to EMFs or decompression, or attraction due to mating strategies (Arnett et al. 2008; Cryan 2007; Kunz et al. 2007). However, no definitive answer as to why, if at all, bats are attracted to WTGs has been postulated, despite intensive studies at onshore wind facilities. As such, it is possible that some bats may encounter, or perhaps be attracted to, OSSs and non-operational WTG towers to opportunistically roost or forage. However, bats' echolocation abilities and agility make it unlikely that these stationary objects (OSSs and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the bases of onshore turbine towers (Choi et al. 2020).

Tree bat species that may encounter the operating WTGs in the offshore wind lease areas include the eastern red bat, hoary bat, and silver-haired bat. Offshore O&M would present a seasonal risk factor to migratory tree bats that may utilize the offshore habitats during fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during fall migration, the overall occurrence of bats on the OCS is very low (Stantec 2016). Acoustic surveys in the Lease Area found bat activity there to average only a small fraction of that which occurs onshore. Furthermore, unlike with terrestrial migration routes, there are no landscape features that would concentrate bats and thereby increase exposure to the offshore wind lease areas. Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would be expected to encounter operating WTGs or other structures associated with future offshore wind development. With the proposed up to 1-nautical-mile (1.9-kilometer) spacing between structures associated with future offshore wind development and the distribution of anticipated projects, individual bats migrating over the OCS within the RSZ of WTGs would likely pass through with only slight course corrections, if any, to avoid operating WTGs because, unlike with terrestrial migration routes, there are no landscape features that would concentrate migrating tree bats and increase exposure to offshore wind lease areas on the OCS (Baerwald and Barclay 2009; Cryan and Barclay 2009; Fiedler 2004; Hamilton 2012; Smith and McWilliams 2016). As seen with some birds (Masden et al. 2012, Peschko et al. 2021), wide spacing between WTG rows is expected to reduce barrier effects by providing bats ample space to fly through wind farms while staying far away from the nearest WTG. Additionally, the potential collision risk to migrating tree bats varies with climatic conditions; for example, bat activity both onshore and offshore is known to be associated with relatively low wind speeds and warm temperatures (COP Volume II, Appendix II-F4; Atlantic Shores 2023; Arnett et al. 2008; Brabant et al. 2021; Cryan and Brown 2007; Fiedler 2004; Kerns et al. 2005; Sjollema et al. 2014; Normandeau 2022). Post-construction acoustic and video monitoring of bats at the Coastal Virginia Offshore Wind Pilot Project from the spring of 2021 through winter of 2022 found bat activity to decline with increasing wind speed and no video evidence of collisions with the WTGs (Normandeau 2022). Given the relatively low numbers of tree bats in the offshore environment, the wide spacing of the WTGs, and the patchiness of projects, the likelihood of collisions is expected to be low; therefore, impacts on bats would be expected to be negligible. Additionally, the likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bats onshore and offshore have been shown to suppress activity during periods of strong winds, low temperatures, and rain (COP Volume II, Appendix II-F4; Atlantic Shores 2023; Arnett et al. 2008; Brabant et al. 2021; Erickson et al. 2002; Sjollema et al. 2014; Normandeau 2022).

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, bats would continue to be affected by existing environmental trends and ongoing activities. See Appendix D, Table D.A1-2 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for bats. BOEM expects ongoing activities to have continuing temporary, long-term, and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on bats primarily through the onshore construction impacts, the presence of structures, and climate change. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, ongoing offshore wind activities would not appreciably contribute to impacts on bats. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. The No Action Alternative would result in **negligible** impacts on bats.

Cumulative Impacts of Alternative A – No Action. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and bats would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on bats due to habitat loss from increased onshore construction. BOEM anticipates cumulative impacts of the No Action Alternative would likely be **negligible** because bat presence on the OCS is anticipated to be limited and onshore bat habitat impacts are expected to be minimal.

3.5.1.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on bats:

- The onshore export cable routes, including routing variants, and extent of ground disturbance for the proposed new onshore substations or converter stations, which could require the removal of trees suitable for roosting and foraging;
- The number, size, and location of WTGs;
- The number, size, and location of the planned met tower and metocean buoys; and
- The time of year during which construction occurs.

Variability of the proposed Project design exists as outlined in Appendix C. Below is a summary of potential variances in impacts:

- WTG number, size, and location: The level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to bats.
- Met tower and metocean buoy number, size, and location: The level of hazard related to met towers and metocean buoys is proportional to the number of met towers and metocean buoys installed; fewer met towers and metocean buoys would present less hazard to bats.
- Onshore export cable routes and substation footprints: The route chosen (including variants within the general route) and substation footprints would determine the amount of habitat affected.
- Season of construction: The active season for bats in this area is from April through October. Construction outside of this window would have lesser potential impact on bats than construction during the active season.

3.5.1.5 Impacts of Alternative B – Proposed Action on Bats

The following sections summarize the potential impacts of the Proposed Action on bats during the various phases of the Project, onshore and offshore. Routine activities would include construction and installation, O&M, and decommissioning of the Project, as described in Chapter 2, *Alternatives*.

Onshore Activities and Facilities

Land disturbance: Land disturbance impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities took place during the active season of bats (generally April through October), and may result in injury or mortality of individuals, particularly juveniles who are unable to flush from a roost, if occupied by bats at the time of removal. The primary potential effect on bats from the Onshore Project components is localized and involves minor habitat modification. The majority of the proposed onshore export and interconnection cable routes are in disturbed areas (e.g., roadways) where there is no vegetated habitat suitable for bats, and anthropogenic sources of noise already exist (GEO-12). Tree clearing and other land disturbance for two of the proposed substations and/or converter stations would occur in an urbanized, fragmented landscape, have a small footprint, and would not eliminate high-quality roosting or foraging habitat for bats. This long-term but negligible effect on bat habitat would occur for the duration of the Project's operational lifetime. Approximately 18 acres (7.3 hectares) of permanent tree clearing could occur at the Fire Road Onshore Substation/Converter Station site. No more than 14~~2.4~~ acres (~~0.97~~ 5.7 hectares) of permanent tree clearing could occur at either the Lanes Pond Road Substation/Converter Station site or the Randolph Road Substation/Converter Station site. Tree clearing at the potential Brook Road parcel would be performed by MAOD (or the designated lead state or federal agency, as appropriate) as part of the development under the SAA and is thereby not included as part of the Proposed Action. Because tree clearing would be anticipated to occur during the winter period when bats are not active and present in the area (BAT-08), there would be no potential for direct impacts on bats that could result from the removal of an active roost tree. Other minimization measures include siting Onshore Project components in disturbed areas as much as practicable and minimizing tree clearing (BAT-07). With these measures in place and given the small area of marginal-quality bat habitat that would be affected, the fragmented and disturbed conditions in the surrounding landscape, and existing sources of anthropogenic activity in the area, BOEM anticipates that disturbance to bats from construction and installation of the Onshore Project facilities would not result in individual fitness or population-level effects.

O&M of the onshore facilities and interconnection cable routes is not expected to affect bats, as it would entail highly localized, temporary, and small-scale activities. No tree clearing or other major habitat disturbance is anticipated to result from O&M. Overall, O&M of onshore facilities for the Proposed Action is not expected to have measurable impacts on bats at the individual or population level. Potential impacts on bats during decommissioning would be similar to those discussed above for construction and installation, but without additional removal of trees or other habitat expected. Decommissioning would be temporary and have only negligible potential effects on bats at the individual and population level.

Noise: Noise associated with the construction, O&M, and decommissioning of onshore elements of the Proposed Action is expected to result in short-term and highly localized impacts. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). Additionally, Atlantic Shores would implement BMPs to minimize onshore construction noise (BAT-11). Noise from O&M operations at onshore facilities is not anticipated to have any adverse impacts on bats.

Presence of structures: There are no anticipated impacts associated with bats interacting with onshore structures such as substations during construction, O&M, and decommissioning. Atlantic Shores will employ the following applicant-proposed measures to further minimize disturbances to bats related to onshore structures: minimization of night-time activities (BAT-12), the use of down-shielding and downlighting on onshore structures to the maximum extent practicable (BAT-04), the limiting of light during onshore O&M to the minimum required by regulation and for safety (BAT-02) and ensuring that onshore construction lighting is temporary and localized to the work area (BAT-09). These measures will minimize the potential for any light-driven attraction of bats or their insect prey and therefore reduce the effects of light on potential collisions of bats at night.

Offshore Activities and Facilities

Noise: Construction and installation and decommissioning of the offshore facilities of the Proposed Action would generate potential noise disturbances during pile driving and other loud construction activities. This would be expected to result in short-term and highly localized potential impacts on bats, which are not abundant offshore and are primarily limited in occurrence to the fall migration period. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to temporary behavioral avoidance of pile-driving or construction activity, with no temporary or permanent hearing damage (Simmons et al. 2016). Noise associated with offshore O&M activities is not anticipated to have negative effects on bats.

Construction and decommissioning of the offshore facilities would involve increased vessel activity and noise. The increased activity and noise associated with the construction and decommissioning of offshore facilities would be highly localized and short term and would not be expected to affect the low number of bats potentially in the airspace above. Effects, if any, would likely be limited to temporary avoidance of the areas of decommissioning activity, which would be expected to have only negligible impacts on individual bats. Decommissioning of the offshore facilities would not be expected to have impacts on bats at the population level.

Presence of structures: The various types of impacts on bats that could result from the presence of structures during the life of the Proposed Action, such as migration disturbance and turbine strikes, are described in detail under Section 3.5.1.3, *Impacts of Alternative A – No Acton on Bats*. The up-to 200 WTG structures, along with one permanent met tower and up to four temporary metocean buoys, associated with the Proposed Action would remain at least until decommissioning of the Project is complete and could pose long-term effects on bats. At this time, there is some uncertainty regarding the level of bat use of the OCS and the consequences to bats, if any, from operating offshore WTGs and associated offshore structures on the OCS. Migratory tree bats have the potential to pass through the Lease Area, but in low numbers because of its distance from shore (BOEM 2014). While there is evidence of bats visiting WTGs and other associated offshore wind structures close to shore (2.5–4.3 miles [4–7 kilometers]) in the Baltic Sea (enclosed by land) (Ahlén et al. 2009; Rydell and Wickman 2015), the individual bats would be expected to enter the Lease Area in low numbers during late summer/fall migration. As discussed above, acoustic surveys in the Lease Area found bat activity levels to be only a small fraction of those typically found onshore. In addition, recent data from 3 years of post-construction monitoring around BIWF found relatively low numbers of bats and only during the fall, and none of the bats were the ESA-listed northern long-eared bat (Stantec 2020). Atlantic Shores would implement measures to avoid and minimize bat impacts, including implementing a monitoring program (COP Volume II, Section 4.4.2.5; Atlantic Shores 2023) and reporting dead and injured bats to NJDEP and USFWS to further understand the long-term effects of structures. Additional measures include the use of red flashing FAA lights and yellow flashing marine navigation lights on WTGs rather than constant white lights to reduce eastern red bat fatality rates (BAT-03), the use of an ADLS system to reduce the number of hours that FAA lighting will be illuminated (BAT-03), limiting lighting during offshore O&M activities to minimize the potential for any light-driven attraction of bats and their insect prey (BAT-02), and the use of down-shielding and down-lighting (BAT-04) to the maximum extent practicable. Therefore, population-level impacts are unlikely given the small numbers of bats offshore relative to onshore and the measures that would be implemented to avoid and minimize bat impacts.

Impacts of Alternative B – Proposed Action on ESA-Listed Bats

As discussed in Section 3.5.1.1, northern long-eared bats and tri-colored bats are not likely to occur in the Offshore Project area given that, respectively, zero and five were detected there during acoustic surveys in 2020 and 2021 (COP Appendix II-F4; Atlantic Shores 2023) and offshore records of these species elsewhere in the geographic analysis area are rare (e.g., Dowling et al. 2017;, Tetra Tech 2021a, 2021b; Normandeau 2022). If northern long-eared bats or tri-colored bats were to migrate over water, movements would likely be in proximity to the mainland. Northern long-eared bats have the potential to occur in the vicinity of the Onshore Project facilities, but there are no known hibernacula nearby and tree removal during construction would be limited to outside of the species' active season to avoid potential for direct impacts that could result from the removal of an active roost tree. BOEM is preparing a BA for the potential effects on USFWS federally listed species. A preliminary draft found that the Proposed Action *may affect, but is not likely to adversely affect* ESA-listed bat species. There is no critical habitat designated for this species. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing, and results of the consultation will be presented in the Final EIS.

Impacts of the Connected Action

As described in Chapter 2, bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). The bulkhead site and dredging activities are in-water activities that would be conducted within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area, with a majority of that area consisting of maintenance dredging. BOEM expects the connected action to affect bats through the noise IPF. Because there is no bat habitat in the vicinity of the Inlet Marina area, land disturbance and presence of structures IPFs would not pose a risk to bats.

Noise: As stated for the Proposed Action, pile-driving noise and onshore construction noise alone are expected to be temporary and highly localized. However, because there is no bat habitat in the Inlet Marina area due to the highly developed nature of the area, noise impacts on bats are not anticipated. Even if a bat were flying close to the Inlet Marina area where construction noise could be detected above ambient urban noise conditions, auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities related to submarine cables and pipelines, oil and gas activities, marine minerals extraction, onshore development, and port expansions would contribute to impacts on bats through the primary IPFs of noise, presence of structures, and land disturbance. Construction related to the connected action would generate temporary and localized noise impacts on bats. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of noise, presence of structures, and land disturbance. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration and given that cave bats do not typically occur on the OCS, offshore wind activities would not appreciably contribute to impacts on bats. Temporary disturbance and permanent loss of onshore habitat may occur as a result of constructing onshore infrastructure such as onshore substations and onshore export cables for offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. Ongoing and planned offshore wind activities in combination with the Proposed Action would result in an estimated 3,031 WTGs, of which the Proposed Action would contribute 200, or about 6.5 percent.

The cumulative impacts on bats would likely be negligible because the occurrence of bats offshore is low and onshore habitat loss is expected to be minimal. The Proposed Action would contribute an undetectable increment to the cumulative noise, presence of structures, and land disturbance impacts on bats.

Conclusions

Impacts of Alternative B – Proposed Action. Construction and installation, O&M, and decommissioning of the Proposed Action alone would be expected to have **negligible** impacts on bats, especially if conducted outside the active season. The main significant risk would be from operation of the offshore WTGs and potential onshore removal of habitat, which could lead to negligible long-term impacts in the form of mortality, although BOEM anticipates this to be rare. Noise effects from construction are expected to be limited to temporary and localized behavioral avoidance that would cease once construction is complete. Similarly, the connected action is anticipated to have **negligible** impacts on bats with the potential for temporary and localized noise impacts during construction.

Cumulative Impacts of Alternative B - Proposed Action. The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action at the Inlet Marina in Atlantic City, New Jersey. The contribution of the Proposed Action to the cumulative impacts of individual IPFs resulting from ongoing and planned activities would be expected to be **negligible**. The primary IPFs are noise, presence of structures, and land disturbance. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Proposed Action, would result in **negligible** impacts on bats in the geographic analysis area. Because the occurrence of bats offshore is low, the Proposed Action would contribute to the cumulative impact rating primarily through the long-term impacts from minor habitat loss associated with the onshore facilities.

3.5.1.6 Impacts of Alternatives C, D, E, and F on Bats

Impacts of Alternatives C, D, E, and F. Impacts on bats resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would be the same as those described for the Proposed Action. Under Alternatives C, D, and E potential impacts on bats from the presence of structures could be reduced if the number of WTGs was reduced, but any such difference compared to the Proposed Action would likely be immeasurable. None of the differences between these other alternatives and the Proposed Action would have the potential to significantly reduce or increase impacts on bats from the analyzed IPFs. All conclusions reached for the Proposed Action with regard to impacts on bats would also apply to Alternatives C, D, E, and F.

Cumulative Impacts of Alternatives C, D, E, and F. The contribution of Alternatives C, D, E, and F to the cumulative impacts of the individual IPFs resulting from ongoing and planned activities would be similar to those described under the Proposed Action, which would be undetectable.

Impacts of Alternatives C, D, E, and F on ESA-listed Bats

Impacts on the ESA-listed northern long-eared bat or proposed endangered tri-colored bat resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives C, D, E, and F would be the same as those described for the Proposed Action. Under Alternatives C, D, and E potential impacts on northern long-eared bats and tri-colored bats from the presence of structures could be reduced if the number of WTGs was reduced, but any such difference compared to the Proposed Action would likely be immeasurable. None of the differences between these other alternatives and the Proposed Action would have the potential to significantly reduce or increase impacts on northern long-eared bats or tri-colored bats from the analyzed IPFs. All conclusions reached for the Proposed Action with regard to impacts on northern long-eared bats and tri-colored bats would also apply to Alternatives C, D, E, and F.

Conclusions

Impacts of Alternatives C, D, E, and F. The impacts on bats resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives C, D, E, and F would be the same or substantially similar to those described under the Proposed Action. None of the differences between these alternatives and the Proposed Action would have the potential to significantly reduce or increase overall impacts on bats from the analyzed IPFs. As with the Proposed Action, the main significant risks would be from operation of the offshore WTGs and potential onshore removal of habitat, which could lead to negligible long-term impacts in the form of mortality, although BOEM anticipates this to be rare. All conclusions reached for the Proposed Action also apply to Alternatives C through F, with impacts on bats expected to be **negligible** for each IPF, Project stage, and location (onshore, offshore).

Cumulative Impacts of Alternatives C, D, E, and F. The incremental impacts contributed by Alternative C, D, E, or F to the cumulative impacts on bats would be undetectable. Because the impacts of the Proposed Action would not change under Alternatives C, D, E, and F, BOEM anticipates that the cumulative impacts of Alternatives C, D, E, and F would be the same as described for the Proposed Action: **negligible**.

3.5.1.7 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed in Table 3.5.1-4 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.5.1-4. Proposed mitigation measures – bats

Mitigation Measure	Description	Effect
Tree clearing restrictions	Because many wildlife species overwinter in cavities and nests, any mature trees slated for removal should be checked (including for vacant raptor nests) and avoided if possible. If the tree must be taken down, this should occur between October 1 and February 28 or 29.	While this mitigation measure would reduce impacts on roosting bats located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs.

3.5.1.8 Comparison of Alternatives

Potential impacts on bats from the other action alternatives would be the same or substantially similar to each other and to the Proposed Action. Therefore, none of the differences among the different alternatives and the Proposed Action would have the potential to significantly increase or decrease impacts on bats onshore or offshore.

3.5.2 Benthic Resources

This section discusses potential impacts on benthic resources, other than fishes and commercially important benthic invertebrates, from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The benthic geographic analysis area, as shown on Figure 3.5.2-1, includes the WTA plus a 10-mile (16.1-kilometer) buffer area and a 330-foot-wide (100-meter-wide) buffer around the ECCs. The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. Some species have ranges that extend beyond the geographic analysis area; however, this analysis focuses on impacts within the geographic analysis area. Although sediment transport beyond 10 miles (16.1 kilometers) is possible, sediment transport related to proposed Project activities would likely be on a smaller spatial scale than 10 miles (16.1 kilometers). Finfish, commercially important invertebrates, and essential fish habitat (EFH) are addressed in Section 3.5.5.

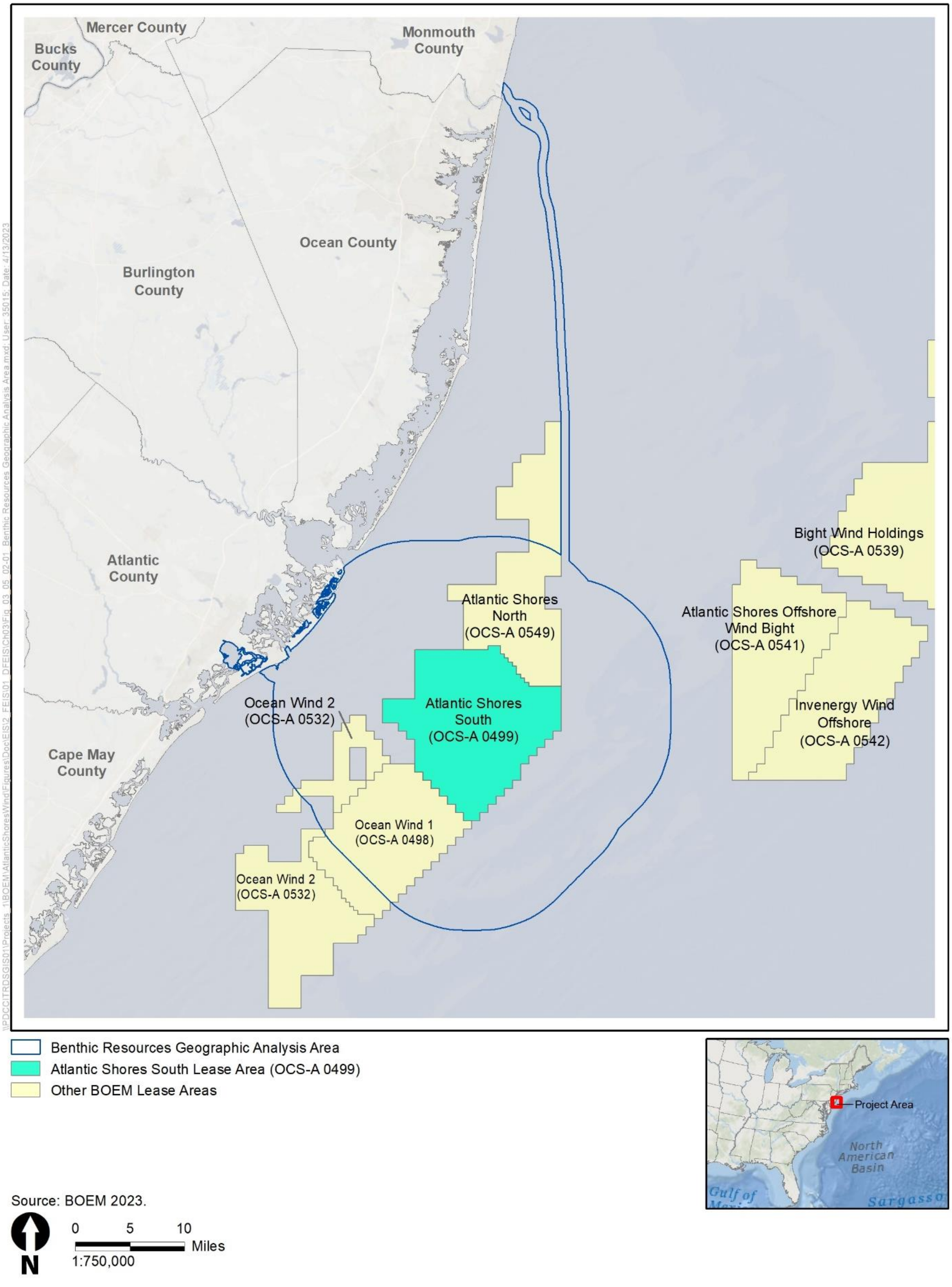


Figure 3.5.2-1. Benthic resources geographic analysis area

3.5.2.1 Description of the Affected Environment and Future Baseline Conditions

Regional Setting

The geographic analysis area for benthic resources includes the WTA plus a 10-mile (16.1-kilometer) buffer area and a 330-foot-wide (100-meter-wide) buffer around the ECCs. The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. Although sediment transport beyond 10 miles (16.1 kilometers) is possible, sediment transport related to proposed Project activities would likely be on a smaller spatial scale than 10 miles (16.1 kilometers). Detailed baseline descriptions of the affected environment within the Project area are provided in COP Volume II, Appendix II-G and Section 4.5 (Atlantic Shores 2023) and summarized in this section.

The WTA is located a minimum of 8.7 miles (14 kilometers) east of the New Jersey coast, on the submerged shallow portion of the OCS of the Western Atlantic continental margin in the Mid-Atlantic Bight. The Mid-Atlantic Bight is described as the area between Cape Hatteras, North Carolina, and Martha’s Vineyard, Massachusetts, extending westward into the Atlantic Ocean to the 100-meter isobath.

The WTA is located on the New York Bight (Guida et al. 2017), with the export cable routes extending from the WTA to coastal and back-bay areas. The WTA is relatively flat and composed mainly of soft sediments, with low-degree seaward slopes and depth contours generally paralleling the shoreline. Predominant bottom features include a series of ridges and troughs that are closely oriented in a northeast-southwest direction, although side slopes are typically less than 1 degree (Guida et al. 2017). Troughs are characterized by finer sediments and higher organic matter, while ridges are characterized by relatively coarser sediments. Differences in benthic invertebrate assemblages, likely driven by differences in sediment characteristics, have been observed that include increased diversity and biomass within troughs (Rutecki at al. 2014). This may subsequently influence distribution of fish and shellfish. Ridge and trough habitat features are common in the mid-Atlantic OCS and are not unique to the Project area. Surface sediments of the New York/New Jersey shelf region are dominated by medium to coarse sands, with sediment grain sizes generally diminishing with distance from shore (Williams et al. 2007). As indicated by side scan sonar, the seabed across the WTA and ECCs is largely level and consistent, with sand bedforms of varying sizes and swales (COP Volume II, Section 2.1.1.2.2; Atlantic Shores 2023). According to regional surficial sediment mapping, surface sediments are predominantly sandy to the south across the Lease Area, with increased gravel and gravelly deposits present in the north and western parts (MARCO 2020). Hard, structured, elevated relief (i.e., reef habitat) is scattered among the relatively flat, sandy, shelf seafloor of the Mid-Atlantic Bight and Southern New England but is scarce (Steimle and Zetlin 2000).

The Project area is affected by the circulation features of the Mid-Atlantic Bight coastal area, as well as the Gulf Stream current and eddies. The currents near the Project area in the coastal Mid-Atlantic Bight are separated and flow in opposite directions at a point that varies over a distance of 54 nautical miles (100 kilometers) along the New Jersey coastline (Ashley et al. 1986). The currents near the bifurcation point show spatial variation, especially regarding the short-term regional scale current pattern (Buteux 1982 as cited by Ashley et al. 1986); however, variability is less pronounced over the long term (Bumpus 1965). In combination with this regional scale pattern, small-scale circulation patterns caused by wave refraction and rip current circulation are also present near the coast. These smaller scale current reversals do not show significant spatial variation and can cause erosion in the Offshore Project area. Based on data collected at the New Jersey WEA for 2003–2016, the median salinity of the water in the Project area is 32.2 ppt and ranges from 29.4 to 34.4 ppt. Temperature in the Offshore Project area shows higher seasonal variability (Guida et al. 2017), with variation of temperature as high as 68°F (20°C) at the surface and 59°F (15°C) at the seabed (Guida et al. 2017).

Benthic resources include the seafloor, substrate, and communities of bottom-dwelling organisms that live in (infauna), on (epifauna), or are closely associated with (demersal) the substrate. Invertebrate communities associated with soft-bottom habitats of the Northeast U.S. WEAs include infaunal (i.e., burrowing) or surficial (i.e., on the seabed) organisms such as annelid worms (Oligochaeta and Polychaeta), flatworms (Platyhelminthes), and nematodes (Nematoda) (BOEM 2021a). Common soft-bottom crustaceans (Crustacea) include amphipods (Amphipoda), mysids (Mysida), copepods (Copepoda), and crabs (Brachyura) (BOEM 2021a). Echinoderms are another abundant soft-bottom group in the geographic analysis area that includes sand dollars (Clypeasteroida), starfishes (Asteroidea), and sea urchins (Echinoidea). Other soft-bottom invertebrates include commercially important shellfishes such as Atlantic surfclam (*Spisula solidissima*), ocean quahog (*Arctica islandica*), bay scallop (*Argopecten irradians*), and horseshoe crab (*Limulus polyphemus*) (BOEM 2021a; Cargnelli et al. 1999). Within the New Jersey WEA, the soft-bottom infaunal community is dominated by polychaetes; the surficial faunal community is dominated by sand shrimp, sea slugs, and sand dollars (Guida et al. 2017). Atlantic surfclam are present within the New Jersey WEA and the Offshore Project area (Guida et al. 2017).

Common invertebrate taxa found in hard-bottom habitats of the geographic analysis area include corals and anemones (Cnidaria), barnacles (Crustacea), sponges (Porifera), hydroids (Hydrozoa), bryozoans (Bryozoa), and bivalve mussels and oysters (Bivalvia) (BOEM 2021a). These organisms affix to hard substrate and have limited movement (BOEM 2021a). This group of invertebrates also includes free-living organisms such as American lobster (*Homarus americanus*), crabs, shrimps, amphipods, starfishes, and sea urchins (BOEM 2021a). Hard-bottom habitat is not common in the geographic analysis area, which likely limits abundance of these species and influences connectivity among local communities.

Burrowing infaunal organisms such as amphipods, polychaetes, and bivalves perform important ecosystem functions at the sediment-water interface such as: water filtration; sediment oxygenation, mixing, and redistribution; and nutrient cycling (Rutecki et al. 2014). Benthic invertebrate species are an important link in marine trophic interactions and serve as a major food source for epifaunal, demersal, and nektonic fish and invertebrates (e.g., Rutecki et al. 2014; Able et al. 2018).Additionally, many benthic species are commercially or recreationally important (see Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*).

Offshore Project Area

The Project area is in the southern New England ecoregion, with its southern border close to the Mid-Atlantic Bight ecoregion. There is considerable overlap among the dominant species in the two ecoregions, with dominant species from both ecoregions either resident in, or transient through, the Project area. Descriptions of benthic resources in the Project area are based on site-specific high resolution geophysical (HRG), geophysical, and benthic surveys conducted by Atlantic Shores in 2019 and 2020 within the Project area including side-scan sonar, backscatter, and bathymetry surveys, benthic grabs and drop-down video (COP Volume II, Appendix II-G1 and Appendix II-G2; Atlantic Shores 2023), sediment profile and plan view surveys conducted in 2020 (COP Volume II, Appendix II-G4; Atlantic Shores 2023), and towed video surveys conducted in 2021 (COP Volume II, Appendix II-G3; Atlantic Shores 2023).

Sediment grab samples taken during 2019 and 2020 surveys in the Lease Area and ECCs indicated predominately medium-grained sands (0.01–0.02 inch [0.25–0.5 millimeter]), with grain sizes ranging from very fine (0.002– 0.005 inch [0.06– 0.125 millimeter]) to very coarse sands (0.04–0.08 inch [1.0–2.0 millimeters]). Medium-grained sands are predominant in the WTA, with some gravelly sands along the northern and western portions (Table 3.5.2-1, Figure 3.5.2-2). Gravelly sands are predominant along the Monmouth ECC, and fine/very fine sands and medium sands to gravelly sands are predominant along the Atlantic ECC (Table 3.5.2-2, Figure 3.5.2-2). Towed video surveys conducted in 2021 confirmed that the dominant Coastal and Marine Ecological Classification Standard (CMECS) Sediment Group within the WTA and ECCs was Sand/Mud, with some sampling stations in the Monmouth ECC having higher percentages of gravelly sand (COP Volume II, Appendix IIG3, Figures 4-7 and 4-17; Atlantic Shores 2023). The only complex hard bottom habitat in the Project area is provided by multiple shipwrecks that are located in and along its borders, and three artificial reefs (the Atlantic City reef located near the southwest corner of the WTA, and the Manasquan Inlet and Axel Carlson reefs located along the outer borders of the Monmouth ECC) (COP Volume II, Appendix II-G2; Atlantic Shores 2023).

Although most of the Offshore Project area is considered to be flat, smaller soft-bottom topographic features such as sand waves, ripples, mega ripples, depressional areas, sand bedforms, textured seafloor, and sand ridges are present in the WTA and ECCs (Steimle and Zetlin 2000; Stevenson et al. 2004; BOEM 2021; COP Volume II, Atlantic Shores 2023). Two NMFS Areas of Concern (AOCs) are located within the WTA. The “Lobster Hole” designated recreational fishing area (AOC 1) is a broad swale/depression that extends roughly from the middle of the eastern edge of the WTA towards its center. AOC 2 is part of a larger sand ridge and trough complex and is located at the southern tip of the WTA. Both NMFS AOCs have pronounced bottom features and produce habitat value. Swale, trough, and ridge habitats provide complex physical structures, which are often associated with greater species diversity, abundance, overall function, and productivity. In the mid-Atlantic, sand ridges and troughs are areas of biological significance for migration and spawning of mid-Atlantic fish species, many of which are recreationally targeted in those specific areas.

Table 3.5.2-1. Grab sample site locations and NMFS CMECS substrate classification within the WTA

Sample Location	NMFS CMECS Substrate Category	Sample Location	NMFS CMECS Substrate Category	Sample Location	NMFS CMECS Substrate Category
OCS-20-038	Medium Sand	OCS-20-091	Medium Sand	OCS-20-139	Gravelly Sand
OCS-20-039	Very Coarse/ Coarse Sand	OCS-20-092	Medium Sand	OCS-20-141	Medium Sand
OCS-20-041	Gravelly Sand	OCS-20-093	Medium Sand	OCS-20-143	Gravelly Sand
OCS-20-043	Medium Sand	OCS-20-095	Medium Sand	OCS-20-145	Gravelly Sand
OCS-20-046	Medium Sand	OCS-20-097	Gravelly Muddy Sand	OCS-20-147	Medium Sand
OCS-20-047	Medium Sand	OCS-20-099	Medium Sand	OCS-20-148	Medium Sand
OCS-20-048	Medium Sand	OCS-20-101	Medium Sand	OCS-20-149	Gravelly Sand
OCS-20-049	Gravelly Sand	OCS-20-103	Medium Sand	OCS-20-151	Gravelly Sand
OCS-20-051	Gravelly Sand	OCS-20-105	Gravelly Sand	OCS-20-153	Medium Sand
OCS-20-053	Medium Sand	OCS-20-107	Medium Sand	OCS-20-155	Gravelly Sand
OCS-20-055	Medium Sand	OCS-20-109	Medium Sand	OCS-20-157	Medium Sand
OCS-20-057	Medium Sand	OCS-20-110	Gravelly Sand	OCS-20-159	Medium Sand
OCS-20-059	Medium Sand	OCS-20-112	Medium Sand	OCS-20-160	Medium Sand
OCS-20-061	Very Coarse/ Coarse Sand	OCS-20-113	Medium Sand	OCS-20-161	Medium Sand
OCS-20-063	Medium Sand	OCS-20-114	Gravelly Sand	OCS-20-163	Fine/Very Fine Sand
OCS-20-064	Gravelly Sand	OCS-20-116	Medium Sand	OCS-20-165	Medium Sand
OCS-20-065	Gravelly Sand	OCS-20-117	Gravelly Sand	OCS-20-167	Medium Sand
OCS-20-067	Gravelly Sand	OCS-20-118	Gravelly Sand	OCS-20-169	Gravelly Sand
OCS-20-069	Medium Sand	OCS-20-121	Gravelly Sand	OCS-20-171	Medium Sand
OCS-20-071	Medium Sand	OCS-20-122	Gravelly Sand	OCS-20-172	Muddy Sand
OCS-20-073	Medium Sand	OCS-20-123	Gravelly Sand	OCS-20-173	Medium Sand
OCS-20-075	Gravelly Sand	OCS-20-125	Medium Sand	OCS-20-175	Medium Sand
OCS-20-077	Medium Sand	OCS-20-127	Gravelly Sand	OCS-20-177	Medium Sand
OCS-20-079	Medium Sand	OCS-20-128	Gravelly Sand	OCS-20-179	Medium Sand
OCS-20-081	Medium Sand	OCS-20-129	Medium Sand	OCS-20-180	Medium Sand
OCS-20-083	Gravelly Sand	OCS-20-131	Very Coarse/ Coarse Sand	OCS-20-181	Fine/Very Fine Sand
OCS-20-085	Medium Sand	OCS-20-133	Medium Sand	OCS-20-183	Gravelly Sand
OCS-20-086	Very Coarse/ Coarse Sand	OCS-20-135	Gravelly Sand	OCS-20-185	Sandy Gravel
OCS-20-087	Medium Sand	OCS-20-136	Medium Sand	OCS-20-191	Medium Sand
OCS-20-089	Medium Sand	OCS-20-137	Gravelly Sand	OCS-20-500	Gravelly Sand

Source: COP Volume II, Appendix A to Appendix G-2, Table A-1; Atlantic Shores 2023.

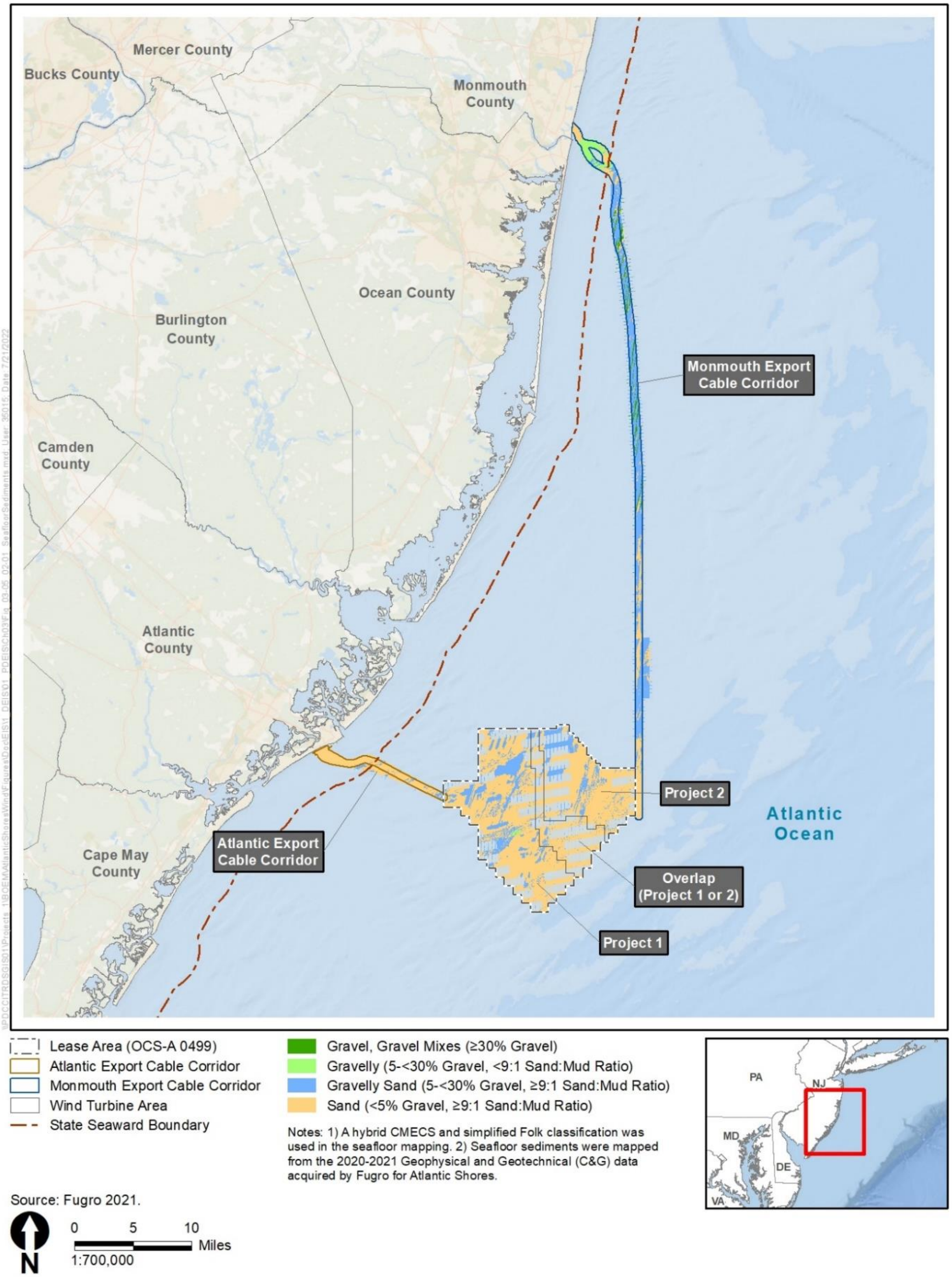


Figure 3.5.2-2. Seafloor sediments in the Offshore Project area

Table 3.5.2-2. Grab sample site locations and NMFS CMECS substrate classification within the Monmouth ECC and the Atlantic ECC

Sample Location	NMFS CMECS Substrate Category	Sample Location	NMFS CMECS Substrate Category
Monmouth ECC		Atlantic ECC	
LAR-20-002	Gravelly Muddy Sand	CAR-20-201	Fine/Very Fine Sand
LAR-20-004	Gravelly Sand	CAR-20-202	Fine/Very Fine Sand
LAR-20-005	Fine/Very Fine Sand	CAR-20-203	Fine/Very Fine Sand
LAR-20-006	Very Coarse/ Coarse Sand	CAR-20-204	Gravelly Sand
LAR-20-008	Gravelly Muddy Sand	CAR-20-206	Medium Sand
LAR-20-010	Gravelly Sand	CAR-20-208	Very Coarse/Coarse Sand
LAR-20-011	Medium Sand	CAR-20-210	Medium Sand
LAR-20-012	Medium Sand	CAR-20-211	Fine/Very Fine Sand
LAR-20-014	Gravelly Sand	CAR-20-212	Muddy Sand
LAR-20-016	Medium Sand	CAR-20-217	Medium Sand
LAR-20-018	Gravelly Sand		
LAR-20-020	Gravelly Sand		
LAR-20-021	Very Coarse/ Coarse Sand		
LAR-20-022	Gravelly Sand		
LAR-20-024	Sandy Gravel		
LAR-20-026	Gravelly Sand		
LAR-20-028	Sandy Gravel		
LAR-20-030	Gravelly Sand		
LAR-20-031	Gravelly Sand		
LAR-20-032	Gravelly Sand		
LAR-20-037	Muddy Sandy Gravel		

Source: COP Volume II, Appendix A to Appendix G-2; Table A-1; Atlantic Shores 2023.

Data obtained from video surveys conducted from 2003 to 2012 by the University of Dartmouth School of Marine Sciences and Technology and mapped by the Northeast Regional Ocean Council showed low to moderate average presence of bryozoans, hydrozoans, and sponges, and moderate to high average presence of sand dollars in the WTA and Monmouth ECC (NROC 2009; SMAST 2016). Moon snails, hermit crabs, and sea stars had low abundance in the WTA and Monmouth ECC (NROC 2009). These datasets did not include data from the Atlantic ECC. Site-specific benthic grab surveys were conducted by Atlantic Shores in 2019 and 2020 throughout the WTA and ECCs, and the survey data were used to analyze species diversity, richness, and evenness across the WTA, Atlantic ECC, and Monmouth ECC. Overall, the site-specific benthic surveys showed that nematodes and arthropods were the most common organisms collected and were present in the highest densities across the survey area compared to other collected phyla, although nematodes were present in lesser quantities during the 2019 surveys. The highest average species diversity and evenness occurred in the Atlantic ECC, and the highest average species richness occurred in the WTA. The most commonly collected species in NEFSC and NJDEP federal and state trawl and dredge surveys conducted in the Offshore Project area between 2009 and 2019 (NEFSC Multi-Species Bottom Trawl [2009–2019]; NJDEP Ocean Stock Assessment Program [OSAP] [2009–2019];NEFSC Atlantic Surfclam and Ocean Quahog dredge survey [2011–2015]) included sand dollars (Echinoidae spp.), lady crab (*Ovalipes ocellatus*), gulf shrimp *(Penaeus* spp.), Atlantic rock crab (*Cancer irroratus*), and Atlantic surfclam (*Spisula solidissima*) (COP Volume II, Appendix II-G2; Atlantic Shores 2023). In the 2021 towed video transect survey contracted by Atlantic Shores (COP Volume II, Appendix II-G3; Atlantic Shores 2023), Sand Dollar Bed was the most common CMECS biotic component classification in the WTA and the Monmouth ECC. *Diopatra* Bed, and the broader biotic group, Larger Tube-building Fauna were the most common CMECS classification observed in the towed video transect surveys in the Atlantic ECC (COP Volume II, Appendix II-G3; Atlantic Shores 2023).

No coral or sponge species were observed in any of the site-specific surveys in the Project area, including inshore areas of the ECCs (COP Volume II, Appendices II-G2 and II-G3; Atlantic Shores 2023). Additionally, no observations of coral or sponge species have been made within the Project area (NOAA 2017). In addition to lacking observational data, coral habitat suitability is low throughout the Project area according to NOAA's Deep Sea Coral Research and Technology modeling (Kinlan et al. 2016). The Monmouth ECC is the only portion of the Project area that could provide some habitat for non-gorgonian coral species; however, habitat suitability in this area is classified as low to medium (Kinlan et al. 2016). Image analysis showed the presence of "seaweed," or algae, at four stations in the Offshore Project area (one station in the WTA and three stations along the Monmouth ECC). At one of these stations, the algae was noted as only being present on the shell of a single bivalve. No seagrass was observed during site-specific surveys in the Offshore Project area (COP Volume II, Appendices II-G2 and II-G3; Atlantic Shores 2023).

Inshore Project Area

The Atlantic Landfall Site for the Atlantic ECC is located in Atlantic City, New Jersey, on a parcel of land that is currently used as a public parking lot and located at the eastern terminus of South California Avenue adjacent to the Atlantic City Boardwalk. The site is bounded by Pacific, South Belmont, and South California Avenues, as seen on Figure 2.1-2 in Chapter 2, Section 2.1.2, *Alternative B – Proposed Action*. The landfall would be connected to the approximately 12.4- to 22.6-mile (20.0- to 36.4-kilometer) Cardiff Onshore Interconnection Cable Route, which continues northwest under urban residential, commercial, and industrial areas to the potential site for the Cardiff Substation and/or Converter Station and terminates at the Cardiff Substation POI owned by ACE. The potential substation and/or converter station site, as shown on Figure 2.1-2, is a vacant lot located in Egg Harbor Township, covering approximately 20 acres (8 hectares) and bordered by Fire Road (County Road 651) to the north and Hingston Avenue to the south. On this route, the Atlantic ECC passes through portions of Chelsea Harbor and Great Thoroughfares located inshore of the Atlantic Landfall Site near the former Atlantic City Municipal Airport (Bader Field). Although resources in this area have not been recently surveyed, a 1979 NJDEP map of seagrass resources near Atlantic City shows the presence of seagrass (NJDEP 2022a) and a 1963 NJDEP survey of shellfish resources shows this area mapped as "Hard Clam – High Value Commercial" (NJDEP 2022b).

The Monmouth Landfall Site for the Monmouth ECC is located in Sea Girt, New Jersey, at the U.S. Army NGTC. The landfall is connected to the approximately 9.8- to 23.0-mile (15.8- to 37.0-kilometer) Larrabee Onshore Interconnection Cable Route, which continues west to one of three potential sites for the Larrabee Substation and/or Converter Station and terminates at the Larrabee Substation POI. Interbedded surficial sediments, which are characterized by terraced seafloor with steep slopes, and scarps were identified in nearshore areas of the Monmouth ECC near the Monmouth Landfall Site (COP Volume II; Atlantic Shores 2023) and add complexity to the seafloor habitat in this area.

Both the Monmouth and Atlantic ECC landfall sites occur on sandy ocean beaches. Impacts on the coastal and upland portions of the landfall sites are analyzed in Section 3.5.4, *Coastal Habitat and Fauna*. Wetlands and streams do not occur at the Monmouth or Atlantic ECC landfall sites, and all delineated wetlands and waterbodies present along the onshore cable routes are located adjacent to roadways, railroads, electric utility lines, and other developed areas (COP Volume II, Appendices II-D1, II-D2, II-E1, and II-E2; Atlantic Shores 2023). For a more detailed description of impacts on wetlands and freshwater waterbodies, please see Section 3.5.8, *Wetlands and Other Waters of the United States*.

3.5.2.2 Impact Level Definitions for Benthic Resources

This Draft EIS uses a four-level classification scheme to characterize both negative (i.e., adverse) and beneficial potential impacts of alternatives, including the Proposed Action (see Table 3.3-1 and Table 3.3-2 in Chapter 3, Section 3.3, *Definition of Impact Levels*).

Table 3.5.2-3 Impact level definitions for benthic resources

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on species or habitat would be adverse but so small as to be unmeasurable.
	Beneficial	Impacts on species or habitat would be beneficial but so small as to be unmeasurable.
Minor	Adverse	Most adverse impacts on species would be avoided. Adverse impacts on sensitive habitats would be avoided; adverse impacts that do occur would be temporary or short term in nature.
	Beneficial	If beneficial impacts occur, they may result in a benefit to some individuals and would be temporary to short term in nature.
Moderate	Adverse	Adverse impacts on species would be unavoidable but would not result in population-level effects. Adverse impacts on habitat may be short term, long term, or permanent and may include impacts on sensitive habitats, but would not result in population-level effects on species that rely on them.
	Beneficial	Beneficial impacts on species would not result in population-level effects. Beneficial impacts on habitat may be short term, long term, or permanent but would not result in population-level benefits to species that rely on them.
Major	Adverse	Adverse impacts would affect the viability of the population and would not be fully recoverable. Adverse impacts on habitats would result in population-level impacts on species that rely on them.
	Beneficial	Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them.

3.5.2.3 Impacts of Alternative A – No Action on Benthic Resources

When analyzing the impacts of the No Action Alternative on benthic resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for benthic resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*. This analysis is limited to impacts within the geographic analysis area for benthic resources as shown on Figure 3.5.2-1, which includes the WTA plus a 10-mile (16.1-kilometer) buffer area and a 330-foot-wide buffer around the ECCs. Benthic resources include the seafloor surface, the substrate, and the communities of bottom-dwelling organisms that live within these habitats. Benthic habitats include soft-bottom (i.e., unconsolidated sediments) and hard-bottom (e.g., cobble, rock, and ledge) habitats, as well as biogenic habitats (e.g., eelgrass, mussel beds, and worm tubes) created by structure-forming species.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for benthic resources identified in Section 3.5.2.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on benthic resources are generally associated with coastal and offshore development, marine transport, fisheries use, and climate change. Coastal and offshore development, marine transport, and fisheries use and associated impacts are expected to continue at current trends and have the potential to affect benthic resources through accidental releases, habitat disturbance and conversion, temporary noise, and EMF. Mortality of some benthic organisms would occur, but population-level effects would not be anticipated. Climate change, driven in part by ongoing GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, ocean acidification, and changes to ocean circulation patterns. Impacts associated with climate change have the potential to alter benthic community structure.

See Appendix D, Table D.A1-3 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for benthic resources. There are no ongoing offshore wind activities within the geographic analysis area for benthic resources.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities within the geographic analysis area that may contribute to impacts on benthic resources include development activities for undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects;; dredging and port improvement projects; marine transportation; fisheries use and management; military use; oil and gas activities; onshore development activities; marine minerals use and ocean-dredged material disposal; and climate change. BOEM expects planned activities other than offshore wind to affect benthic resources through several primary IPFs (see Table D.A1-3 in Appendix D for a summary of benthic resource impacts associated with planned activities other than offshore wind). The sections below summarize the potential impacts of the other planned offshore wind activities on benthic resources during construction, O&M, and decommissioning of the projects. Other planned offshore wind activities in the geographic analysis area for benthic resources are limited to the construction, O&M, and decommissioning of the following offshore wind projects:

- Ocean Wind 1 in Lease Area OCS-A 0498;
- Ocean Wind 2 in Lease Area OCS-A 0532; and
- Atlantic Shores North in Lease Area OCS-A 0549.

BOEM expects planned offshore wind development activities to affect benthic resources through the following primary IPFs.

Accidental releases: Planned offshore wind activities may increase accidental releases of fuels, fluids, and hazardous material contaminants, trash and debris, and invasive species due to increased vessel traffic and installation of WTGs and other offshore structures. The risk of accidental releases is expected to be highest during construction, but accidental releases could also occur during operation and decommissioning.

Planned offshore wind activities, not including the Proposed Action, are expected to gradually increase vessel traffic over the next 34 years, increasing the risk of accidental releases of fuels/fluids/hazardous materials. There would also be a low risk of fuel/fluid/hazardous material leaks from any of the up to 366 WTGs and up to 11 OSSs/ESPs and met towers (Appendix D, Tables D.A2-1 and D.A2-2) anticipated from planned offshore wind activities in the geographic analysis area other than the Proposed Action. The total volume of WTG fuels, fluids and hazardous materials (including oils and lubricants, coolant, and diesel fuel) from planned offshore wind activities other than the Proposed Action in the geographic analysis area is estimated at 2,309,697 gallons (8,743,154 liters) (Appendix D, Table D.A2-3). OSSs are expected to hold an additional 1,720,217 gallons (6,511,730 liters) of fuels, fluids and hazardous materials (Appendix D, Table D.A2-3). BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons (484,533 liters) is likely to occur no more frequently than once every 1,000 years and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). Diesel floats on the water's surface briefly before volatilizing; it does not sink to the bottom and would not affect benthic habitat or species. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to nontoxic levels before they reach benthic resources (BOEM 2021a). In most cases, the corresponding impacts on benthic resources are unlikely to be detectable unless there is a catastrophic spill (e.g., an accident involving a tanker ship). Large-scale spills may be accompanied by the use of chemical dispersants during post-spill response. Crude oil treated with dispersants (specifically Corexit 9500A) has been shown to have higher toxicity to marine zooplankton and meroplankton than either the crude oil or dispersant alone (Rico-Martinez et al. 2012; Almeda et al. 2014a, 2014b). Benthic resources with planktonic larval stages may be susceptible to this toxicity, which may affect subsequent recruitment. Given the volumes of fuels, fluids, and hazardous materials potentially involved and the low likelihood of release occurrence, the increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

A wide variety of marine vessels utilize anti-fouling and anti-corrosion paints to protect hulls from biofouling and corrosive processes induced by the marine environment in order to improve vessel longevity. Moreover, subsurface components of WTGs and OSSs may also utilize anti-fouling and anti-corrosion coatings to prevent degradation of project components. Potential chemical leaching from anti-fouling and anti-corrosion coatings may cause toxic effects on benthic organisms. Increased offshore wind development could increase the potential toxic effect of anti-fouling and anti-corrosion coatings on marine organisms.

Epoxied resins and polyurethane-based coatings are a state-of-the-art technique for corrosion protection in a wide range of marine applications and are an artificial barrier to separate the steel from the corrosive environment (Lyon et al. 2017; Price and Figueira 2017). Organic compounds and Bisphenol A, common components of epoxied resins used in marine applications, were documented leaching from epoxy coatings in a laboratory setting (Bruchet et al. 2014; Rajasärkkä et al. 2016). Copper-based anti-fouling paints are also used in many marine applications and have replaced previous anti-fouling paints such as Tributyltin paints, which were found to have toxic effects on marine organisms (Alzieu et al. 1986; Michel and Averty 1999). Katranitsas et al. (2003) found copper-based anti-fouling paint to be substantially toxic to Artemia nauplii. Although the extent of emissions from anti-fouling and anti-corrosion coatings are currently unknown at scales such as the WTA and greater WEA, increased usage of such coatings due to future wind generation activities may be a point source of toxic chemicals potentially affecting benthic organisms.

The overall impacts of anti-fouling and anti-corrosion paints on benthic resources at the scale of the WTA and greater WEA require further evaluation and are difficult to adequately quantify; however, impacts are likely to be negligible, resulting in little change to these resources. As such, anti-fouling and anti-corrosion paints used during offshore wind development processes would not be expected to appreciably contribute to population-level impacts on these resources.

The release of nontoxic drilling mud during HDD at the export cable landfall sites for offshore wind facilities would be unlikely, but possible. Given the unlikely occurrence of a release and precautions outlined in construction and operations contingency plans, impacts of drilling muds on benthic habitat would be indirect and short term, which is consistent with BOEM's analysis of the HDD installation at the Virginia Offshore Wind Technology Advancement Project (BOEM 2015).

Increased accidental releases of trash and debris may occur from vessels primarily during construction but also during operations and decommissioning of planned offshore wind facilities. There is a higher likelihood of releases from nearshore project activities (e.g., transmission cable installation, transport of equipment and personnel from ports). BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of projects and therefore project-related marine debris would only have an indirect, short-term effect on benthic resources.

Planned offshore wind activities may increase accidental releases of invasive species due to increased vessel traffic and installation of WTGs and other offshore structures. Invasive species are periodically released accidentally during nearshore and offshore activities, including from the discharge of ballast and bilge water from marine vessels. Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction when the number of project-related vessels would be greatest. This includes invasive species that could compete with, prey on, or introduce pathogens that negatively affect benthic species. Offshore wind farms have been reported to host nonindigenous invasive species, particularly through their provision of hard substrate and intertidal habitat (on foundation piles) where none previously existed (Adams et al. 2014; Kerckhof et al. 2010; Lindeboom et al. 2011). Although sub-tidal invasive species found in offshore wind farms have, in general, been noted elsewhere in their respective regions, invasive intertidal hard-substrate organisms have been previously absent from offshore waters (De Mesel et al. 2015; Kerckhof et al. 2011, 2016). It is possible that offshore wind farms could serve as “stepping-stones” and facilitate the spread and establishment of invasive species new to the region, as well as native species, in the offshore environment (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2018). Invasive species releases may or may not lead to the establishment and persistence of invasive species. Although the likelihood of invasive species becoming established as a result of offshore wind activities is very low, their impacts on benthic resources could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna; however, such an outcome is considered highly unlikely. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities (e.g., trans-oceanic shipping).

The cumulative impacts of accidental releases on benthic resources are relative to their magnitude and range from minor, localized, and short term (for fuels/fluids/hazardous material contaminants, trash and debris, and HDD drilling muds) to strongly adverse, widespread, and permanent (for invasive species); however, the likelihood of invasive species becoming established is low. Smaller releases of fuels/fluids/hazardous material contaminants and trash and debris are expected to occur at a higher frequency and to be less severe, while major releases are expected to be rare but have more impacts. The impacts of accidental releases on benthic resources are likely to be negligible because large-scale releases are unlikely and impacts from small-scale releases would be localized and short term, resulting in little change to benthic resources. As such, accidental releases would not be expected to appreciably contribute to cumulative impacts on benthic resources.

Anchoring: Vessel anchoring from planned wind-related activities would predominantly occur outside of the benthic resource geographic analysis area for the Project; however, biological monitoring efforts related to other wind-related projects may increase anchoring within or near the geographic analysis area. Vessel anchoring from these activities may be minimized by the use of dynamic positioning systems. Anchor/chain contact with the seafloor may cause injury to and mortality of benthic resources, as well as physical damage to their habitats. Direct impacts on seafloor habitat and benthic organisms from anchor contact from offshore wind activities other than the Proposed Action in the geographic analysis area would be limited to an approximate area of 771 acres (312 hectares) (Appendix D, Table D.A2-2). Mortality of organisms may occur due to anchor contact but affected areas are expected to be recolonized in the short term; however, impacts on seafloor habitats may be permanent if they occur in sensitive or limited habitats such as eelgrass beds or hard-bottom areas. Indirect impacts from anchoring include resuspension of sediments and burial from sediment deposition. Dispersal of resuspended sediments is dependent on bottom currents, and burial of hard-bottom habitat and organisms is possible. Mobile organisms may avoid burial by repositioning in the sediments or moving away. Recovery from non-permanent impacts is expected to occur rapidly.

Overall impacts from anchoring within the geographic analysis area are expected to be localized and range from minor and short term (for soft-bottom habitats) to moderate and permanent (for sensitive or hard-bottom habitats). Anchoring related to planned wind-related activities would mainly occur outside the geographic analysis area and would be limited, as the use of vessel dynamic positioning systems is likely and construction/decommissioning phases generally occur over a relatively short window.

Cable emplacement and maintenance: Planned offshore wind activities other than the Proposed Action would install buried or armored export and interarray cables, some of which may traverse the geographic analysis area. The width of the disturbed bottom along cable routes, however, would likely be less than 58 feet (17.7 meters). More than 6,162 acres (2,294 hectares) of seafloor habitat would be disturbed by export and interarray cable installation in planned offshore wind development other than the Proposed Action in the geographic analysis area between 2024 and 2030 (Appendix D, Tables D.A2-1, D.A2-2). Cable installation would require trenching, laying, then burial. Trenching can be done using a cutting wheel in hard-bottom habitat or ploughing or water jetting in soft-bottom habitat (Taormina et al. 2018). Ploughing is designed to minimize resuspension of sediments by trenching, laying, and burying all in successive steps. Dredging and mechanical trenching used during cable installation activities can cause localized, short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through sediment deposition. Additionally, water jetting would entrain and possibly injure or kill larvae of some benthic organisms. The level of impact may vary seasonally, particularly in nearshore locations, and spatially with the greatest impact occurring if the activities overlap spatially and temporally with areas of high benthic organism abundance. Locations, amounts, and timing of dredging for planned offshore wind projects are not known at this time. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and recover fairly quickly from disturbance, although recovery time varies by region, species, and type of disturbance. The mechanical trenching process, which is used in sediments with larger grain size (e.g., gravel, cobble), causes immediate seabed profile alterations; however, the seabed profile is usually restored to its original condition after cable installation in the trench. Therefore, seabed profile alterations, while locally intense, have little impact on benthic resources in the greater geographic analysis area.

Cables may also be armored with hard material for protection. Atlantic Shores is considering the use of one or more of five types of cable protection: (1) rock placement, (2) concrete mattresses, (3) rock bags, (4) grout-filled bags, and (5) half-shell pipes (COP Volume I, Section 4.5.7; Atlantic Shores 2023). Each of these forms of protective cable armor would create hard-bottom habitat up to 16 feet (5 meters) wide along cable corridors. The continuous hard-bottom habitat may fragment soft-bottom habitat communities, especially benthic infaunal communities, while presenting habitat opportunities for complex-bottom communities (e.g., biofouling communities that include anemones and barnacles). Although Atlantic Shores will work to minimize the amount of cable protection required, it is conservatively assumed that up to 10 percent of the export cables, interarray cables, and interlink cables may require cable protection in areas where sufficient burial depth is not achieved. Cable armoring impacts are likely permanent, but some re-sedimentation may occur.

Following cable installation and armoring activities associated with the construction of offshore wind facilities, suspended sediments would settle in and adjacent to the submarine cable routes. The height of the suspended sediment above the bottom would be influenced by particle size and bottom currents. Adult and juvenile individuals, demersal eggs, and larvae could be buried by deposited sediments during construction; however, measurable sediment deposition would be limited to the installation trench and the areas immediately adjacent. Currents, storms, and other oceanographic processes frequently disturb soft-bottom habitats, and native invertebrates are adapted to respond to such disturbances (Guida et al. 2017). Evidence of recovery following sand mining in the United States Atlantic and Gulf of Mexico indicates that soft-bottom benthic habitat in the geographic analysis area would fully recover within 3 months to 2.5 years (Brooks et al. 2006; BOEM 2015; Kraus and Carter 2018; Normandeau 2014). NMFS estimated that recovery of the soft-bottom benthic community at Block Island Wind Farm occurred within 3 years (NMFS 2015). Although estimates of recovery time following disturbance vary by region, species, and type of disturbance, a one-time disturbance associated with the construction of offshore wind facilities would not prevent natural recovery of benthic communities. Therefore, such impacts, while locally intense, would have little impact on benthic resources in the greater geographic analysis area.

Cumulative impacts from cable emplacement and maintenance activities within the geographic analysis area related to sediment resuspension and deposition, seabed profile disturbance, and entrainment of organisms would be localized, short term, and minor due to the relatively quick recovery time associated with soft-bottom communities in the area. Impacts due to cable armoring activities would be localized, permanent, and range from moderate adverse to moderate beneficial due to the conversion of soft-bottom substrate to hard-bottom substrate.

Discharges/intakes: There would be increased potential for discharges from vessels during construction, O&M, and decommissioning of planned offshore wind facilities. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, particularly during construction and decommissioning, and the discharges would be staggered over time and localized. Additionally, components of anti-fouling paints and anti-corrosives may leach into surface waters. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. There does not appear to be evidence that the volumes and extents anticipated would have any impact on benthic resources.

The cumulative impacts of discharges on benthic resources are likely to be localized, short term, and have negligible impacts on benthic resources. As such, discharges from planned offshore wind activities would not be expected to appreciably contribute to overall impacts on benthic resources.

Electric and magnetic fields and cable heat: The marine environment continuously generates a variable ambient EMF. Export and interarray cables from planned offshore wind development, not including the Proposed Action, would add an estimated 1,616 miles (2,601 kilometers) of buried cable to the geographic analysis area, producing EMFs in the immediate vicinity of each cable during operation (Appendix D, Table D.A2-1). BOEM would require these planned submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation; however, these measures would not eliminate EMF (Hutchinson et al. 2021). EMF effects from these planned projects on benthic habitats would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). EMF strength diminishes rapidly with distance, and EMFs that could elicit a behavioral response in an organism would likely extend less than 50 feet (15.2 meters) from each cable. The strength of the EMFs generated by power cables is a factor of cable voltage, current, and type of cable. HVDC cables generate static EMFs, which have greater intensities than the variable EMFs generated by HVAC cables, and thus can have a more prominent influence on local geomagnetic fields than HVAC cables (Bilinski 2021; Waterproof Marine Consultancy & Services and Bureau Waardenburg 2021). In general, HVAC cables are used for interarray cables, but either HVAC or HVDC can be used for export cables. Although HVAC export cables do not necessitate the need for converter stations and thus have lower initial costs, HVDC export cables are usually used for projects with longer distances (I.e., greater than 62.14 miles [100 kilometers]) between the WTA and the onshore substations because of greater voltage stability and more efficient transmission of power (Waterproof Marine Consultancy & Services and Bureau Waardenburg 2021). The intensity of the magnetic fields generated by export cables can be reduced through cable bundling (e.g., bundled AC three-phase cables) and thoughtful positioning of multiple export cables (e.g., close placement of direct current (DC) cables with equal currents) (Waterproof Marine Consultancy & Services and Bureau Waardenburg 2021).

Impacts of EMF on benthic habitats is an emerging field of study; as a result, there is a high degree of uncertainty regarding the nature and magnitude of effects on all potential receptors (Gill and Desender 2020). Recent reviews by Bilinski (2021), Gill and Desender (2020), Albert et al. (2020), and Snyder et al. (2019) of the effects of EMF on marine invertebrates in field and laboratory studies concluded that measurable, though minimal, effects could occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. Behavioral impacts from EMF, though observed at higher levels than are representative of offshore wind projects, were documented for lobsters near a direct current cable (Hutchison et al. 2018) and a domestic electrical power cable (Hutchison et al. 2020), including subtle changes in activity (e.g., broader search areas, subtle effects on positioning, and a tendency to cluster near the EMF source). There was no evidence of the cable acting as a barrier to lobster movement, and no effects were observed for lobster movement speed or distance traveled. Additionally, faunal responses to EMFs by marine invertebrates, including crustaceans and mollusks, include interfering with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Bilinski 2021; Jakubowska et al. 2019; Hutchinson et al. 2018; Taormina et al. 2018; Normandeau at al. 2011). Burrowing infauna may be exposed to stronger EMFs, but little information is available regarding the potential consequences. Any effects on burrowing infauna, however, would be local and would not have population-level impacts due to the small spatial scale of the impact relative to the available benthic habitat in the geographic analysis area. Non-mobile infauna would be unable to move to avoid EMF. Any effects on non-mobile infauna, however, would be local and would not have population-level impacts due to the small spatial scale of the impact relative to the available benthic habitat in the geographic analysis area.

Other studies have found that EMFs do not affect behavior for other invertebrate species. For example, Schultz et al. (2010) and Woodruff et al. (2012, 2013) conducted laboratory experiments exposing American lobster (*Homarus americanus*) and Dungeness crab (*Metacarcinus magister*) to EMFs ranging from 3,000 to 10,000 milligauss and found that EMFs do not affect their behavior. Assuming the other wind projects with HVAC cables in the geographic analysis area have similar array and export cable voltages as the Proposed Action, the induced magnetic field levels expected for the offshore wind projects are two to three orders of magnitude lower than those tested by Schultz et al. (2010) and Woodruff et al. (2012, 2013). Similarly, a field experiment in Southern California and Puget Sound, Washington, found no evidence that the catchability of two crab species was influenced by the animals crossing an energized low-frequency submarine alternating current power cable (35 and 69 kV, respectively) to enter a baited trap. Whether the cables were unburied or lightly buried did not influence the crab responses (Love et al. 2017). While these voltages are between two and eight times lower than those expected for the offshore wind projects, the array and export cables would be shielded and buried at depth to reduce potential EMFs from cable operation.

Although studies of the effects of EMF have often focused on behavioral effects, EMF generated by subsea cables could have adverse effects on early life history stages of benthic invertebrates. A study by Harsanyi and others (2022) found that exposing gravid European lobster (*Homarus gammarus*) and edible crab (*Cancer pagurus*) to static DC EMFs (2.8 mT intensity) in an experimental arena throughout the duration of embryonic development resulted in an increased occurrence of larval deformities and reduced swimming test success rates in lobster larvae. Decreases in stage-specific egg volume in maximum were also observed, resulting in decreased eye diameter, carapace height, and total length in stage I lobster and zoea I crab larvae (Harsanyi et al. 2022). An early study by Levin and Ernst (1997) found that fertilized eggs of the echinoderms *Lytechinus pictus* and *Strongylocentrotus purpuratus* exhibited delayed mitosis when exposed to static DC EMFs (10 mT to 0.1 T). Additionally, exposure to 30 mT DC EMF fields caused an 8-fold increase in a developmental abnormality known as exogastrulation in *Lytechinus pictus* (Levin and Ernst 1997).

EMF levels would be highest at the seabed near cable segments that cannot be fully buried and are laid on the bed surface under protective rock or concrete blankets. Invertebrates in proximity to these areas could experience detectable EMF levels and minimal associated behavioral and physiological effects. These unburied cable segments would be short and widely dispersed. CSA Ocean Sciences, Inc. and Exponent (2019) found that offshore wind energy development as currently proposed would have negligible effects, if any, on bottom-dwelling species.

Offshore cables would emit heat along cable routes. Impacts on most epibenthic organisms would be negligible considering that most cables from offshore wind development are expected to be buried, and heat from above-sediment cables would be cooled by water, limiting the heated area at short distances from cables (Taormina et al. 2018). Infaunal fishes (e.g., sand lances) and invertebrates, however, may be impacted by cable heat. Based on controlled experiments, Emeana and others (2016) measured > 10°C increases in sediment temperature at distances ranging from 40 centimeters to over a meter from cable source that varied depending on sediment substrate and source temperature. Alternating current cables generate higher heat than direct current cables (Taormina et al. 2018). Cable burial depth, sheathing, and armoring could mitigate impacts of heat emission from cables.

Further research in this field is needed to better determine the effects of EMF and heat on benthic fauna. The information presented herein indicates that cumulative EMF and cable heat impacts on benthic fauna would be biologically insignificant, highly localized, and limited to the immediate vicinity of cables, and would be undetectable beyond a short distance; however, localized impacts would persist as long as cables are in operation. The affected area would represent an insignificant portion of the available benthic habitat; therefore, based on currently available information, impacts from planned activities on benthic resources would be minor.

Gear utilization: Benthic and fisheries monitoring surveys are usually conducted pre-, during, and post-construction of offshore wind projects as part of their Benthic and Fisheries Monitoring Plans. These surveys can have direct impacts on benthic habitats. Bottom-disturbing trawls can alter the composition and complexity of soft-bottom benthic habitats. For example, when trawl gear contacts the seabed it can flatten sand ripples, remove epifaunal organisms and biogenic structures like worm tubes, and expose anaerobic sediments (BOEM 2022). The multi-method surveys for structure-associated fish would also be conducted concurrently with the trawl survey. Methods employed in the multi-method survey include chevron traps, rod-and-reel fishing, and baited remote underwater video. The equipment used for baited remote underwater video would include a weighted line attached to surface and subsurface buoys that would hold a stereo-camera system in the water column and a system at the seafloor. Fishing activity used in some fish surveys can damage benthic invertebrates on hard-bottom benthic habitat, resulting in long-term effects on community composition and complexity (Tamsett et al. 2010). The towed sampling dredges often used for clam surveys would cause localized and direct impacts on both hard- and soft-bottom habitat, resulting in potentially long-term effects on community composition. Soft-bottom impacts would be short term and expected to recover quickly. Because the affected area would represent a small area of the available benthic habitat in the geographic analysis area, cumulative impacts from gear utilization on benthic resources would be negligible to minor.

Noise: Sources of anthropogenic noise that may affect benthic resources in the geographic analysis area include vessels, G&G surveys, operational WTGs, cable laying/trenching, pile driving, and O&M activities associated with offshore wind facilities. Benthic habitat is composed of various types of sediment, structural features that are formed by that sediment (e.g., interstitial spaces between boulders, sand waves), and organisms that reside in and on the sediment. Substrates and associated structural features are unaffected by underwater noise. Benthic invertebrates are sensitive only to the particle motion component of noise. Many invertebrates have structures called statocysts which, similar to fish ears, act like accelerometers: a dense statolith sits within a body of hair cells, and when the animal is moved by particle motion, it results in a shearing force on the hair cells (Budelmann 1992; Mooney et al. 2010). Some invertebrates also have sensory hairs on the exterior of their bodies, allowing them to sense changes in the particle motion field around them (Budelmann 1992). The research thus far shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper et al. 2022a). Invertebrates may experience a range of impacts from underwater sound depending on physical qualities of the sound source and the environment, as well as the physiological characteristics and the behavioral context of the species of interest. Damage to invertebrate statocysts has been observed as a result of sound exposure, but it is unclear whether the hair cells can regenerate, like they do in fishes (Solé et al. 2013, 2017). As with marine mammals, continuous, lower-level sources (e.g., vessel noise) are unlikely to result in auditory injury but could induce changes in behavior or acoustic masking. Detectable particle motion effects (e.g., startle responses, valve closure, changes to respiration or oxygen consumption rates) on invertebrates are typically limited to within 7 feet (2 meters) of the source or less (Carroll et al. 2017; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007).

Vessel noise includes non-impulsive sounds that arise from a vessel's engines, propellers, and thrusters. Sound levels emitted from vessels depend on the vessel's operational state (e.g., idling, in-transit) and are strongly weather dependent. Zykov et al. (2013) and McPherson et al. (2019) report a maximum broadband source level of 192 decibel (dB) re 1 micropascal (µPa) for numerous vessels with varying propulsion power. The limited research on invertebrates' response to vessel noise has yielded inconsistent findings thus far. Some crustaceans seem to increase oxygen consumption (crabs: Wale et al. 2013) or show increases in some hemolymph (an invertebrate analog to blood) biomarkers like glucose and heat-shock proteins, which are indicators of stress (spiny lobsters: Filiciotto et al. 2014). Other species (American lobsters and blue crabs) showed no difference in hemolymph parameters but spent less time handling food, defending food, and initiating fights with competitors (Hudson et al. 2022). While there does seem to be some evidence that certain behaviors and stress biomarkers in invertebrates could be negatively affected by vessel noise, it is difficult to draw conclusions from this work as it been limited to the laboratory and, in most cases, did not measure particle motion as the relevant cue. The planktonic larvae of fishes and invertebrates may experience acoustic masking from continuous sound sources like vessels. Several studies have shown that larvae are sensitive to acoustic cues, and may use these signals to navigate towards suitable settlement habitat (Montgomery et al. 2006; Simpson et al. 2005), to metamorphosize into their juvenile forms (Stanley et al. 2012), or even to maintain group cohesion during their pelagic journey (Staaterman et al. 2014). However, given the short range of such biologically relevant signals for particle motion-sensitive animals (Kaplan and Mooney 2016), the spatial scale at which these cues are relevant is rather small. If vessel transit areas overlap with settlement habitat, it is possible that vessel noise could mask some biologically relevant sounds (e.g., Holles et al. 2013), but these effects are expected to be short term and would occur over a small spatial area. Given the rapid attenuation of underwater vibrations with increasing distance from a sound source (Morley et al. 2014), it is unlikely that these stimuli will cause more than short-term behavioral effects (e.g., flight or retraction), masking, or physiological (e.g., stress) responses. Overall, effects on benthic invertebrates from vessel noise are expected to be short term and localized and are not anticipated to pose a risk to benthic invertebrates. Only a few individuals would be affected at any given time, and they are likely to return to normal behaviors after the noise is over. During the operational phase of offshore wind projects, vessel noise is expected to be less frequent (occurring mostly for maintenance work) and should be localized in extent, and thus is expected to have a negligible impact.

G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities. Site assessment and characterization activities are expected to occur intermittently within the geographic analysis area between 2023 and 2030. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity, impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves for shallow penetration of the seabed. Of the sources that may be used in geophysical surveys for offshore wind, only a handful (e.g., boomers, sparkers, bubble guns, and some sub-bottom profilers [SBPs]) emit sounds at frequencies that are within the hearing range of most fishes and invertebrates (see Appendix B, *Supplemental Information and Additional Figures and Tables*, Section B.5 for more detail on these sources [Crocker and Fratantonio 2016; Ruppel et al. 2022]). This means that side-scan sonars, multibeam echosounders, and some SBPs would not be audible, and thus would not affect them. Air guns used in high-resolution seismic site surveys produce low-frequency acoustic pulses with zero-to-peak (0-p) SLs for individual air guns typically ranging between 220 and 235 dB re 1µPa at 3.3 feet (1 meter) (~1–6 bar· m) at frequencies ranging from 10 Hz to over 5 kHz, with most of the energy produced in the range below 200 Hz (BOEM 2014). G&G surveys would most likely use electromechanical sources which operate at mid- to high-frequencies such as boomer, sparker, and chirp SBPs; multibeam depth sounders; and side-scan sonar (BOEM 2014). Boomers and sparkers have operating frequencies that range from 200 Hz to 16,000 Hz and peak pressure levels that do not exceed 220 dB re 1 µPa at 3.3 feet (1 meter); multibeam depth sounders have operational frequencies of 240 kHz and an SPL of 210 dB re 1 µPa at 3.3 feet (1 meter); and chirp SBPs have operating frequencies of 3.5 kHz, 12 kHz, and 200 kHz with an SL of 220 dB re 1 µPa at 3.3 feet (1 meter) (BOEM 2014). Side-scan sonar uses a low-energy, high-frequency signal (100 kHz or 400 kHz) and has an SPL that ranges from 212 to 218 dB re 1 µPa at 3.3 feet (1 meter), and has been widely used in the marine environment with little evidence of adverse impacts on marine organisms (MMS 2009; BOEM 2014). It is expected that behavioral impact ranges would less than 328 feet (100 meters) for particle motion-sensitive species, including invertebrates. Because most HRG sources are typically “on” for short periods with silence in between, only a few “pings” emitted from a moving vessel towing an active acoustic source would reach fish or invertebrates below, so behavioral effects would be intermittent and temporary. Overall, the level of disturbance from geophysical and geotechnical surveys is expected to be negligible for invertebrates due to the frequency range, the small spatial extent of sound propagation, and the short duration of exposure.

Operating WTGs generate non-impulsive underwater noise that may be detectable by some benthic invertebrates. Monitoring data indicate that root-mean-square sound pressure levels (SPL_{RMS}) produced by operating 0.2 to 6.15 MW WTGs are relatively low, generally ranging from 110 to 125 dB re 1 µPa (Tougaard et al. 2020). WTGs associated with planned offshore activities are expected to be larger than WTGs currently operating and may therefore produce higher noise levels; however, possible increased noise levels due to larger WTGs is not expected to significantly impact benthic organisms. Noise levels produced by WTGs are expected to decrease to ambient levels within a relatively short distance from the turbine foundations (Kraus et al. 2016; Miller and Potty 2017; Thomsen et al. 2015), and underwater vibrations would attenuate rapidly with increasing distance from a sound source (Morley et al. 2014). Given that noise levels generated by WTGs are relatively low and that underwater vibrations would attenuate rapidly, the low levels of elevated noise associated with operating WTGs are likely to have little to no impact on benthic invertebrates.

Planned offshore wind activities in the geographic analysis area, not including the Proposed Action, could generate impulsive pile-driving noise during foundation installation. Pile driving is expected to occur for 4 to 69 hours at a time as 366 WTGs and 11 OSSs are constructed between 2024 and 2030 (Appendix D, Tables D-3, D.A2-1, and D.A2-2) for planned offshore wind activities other than the Proposed Action in the geographic analysis area. Pile driving can cause injury and mortality to invertebrates in a small area around each pile. Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not likely to experience barotrauma from pile driving. Very few studies have examined the effects of substrate vibrations from pile driving, yet many have recently acknowledged that this is a field of urgently needed research (Hawkins et al. 2021; Popper et al. 2022b; Wale et al. 2021). Most of the research thus far has focused on water-borne particle motion, or even acoustic pressure, and is discussed briefly below.

Sessile marine invertebrates like bivalves are sensitive to substrate-borne vibrations and may be affected by pile-driving noise (Day et al. 2017; Roberts et al. 2015; Spiga et al. 2016). A recent study by Jézéquel et al. (2022) exposed scallops to a real pile-driving event at distances of 26 and 164 feet (8 and 50 meters) from the pile. Measured peak particle acceleration was 110 dB re 1 µm/s2 at the close site and 87 dB re 1 µm/s2 at the farther site. None of the scallops exhibited swimming behavior, an energetically expensive escape response. At the close site only, scallops increased valve closures during pile-driving noise, and did not show any acclimatization to repeated sound exposure. However, they returned to their pre-exposure behaviors within 15 minutes after exposure. Increased time spent with closed valves could reduce feeding opportunities and thus have energetic consequences, though the biological consequences of this effect have not been studied. Like other marine invertebrates, crustaceans are capable of sensing low-frequency sound through particle motion in the water or in the substrate (Popper et al. 2001; Roberts and Breithaupt 2016). Research on seismic air guns and crustaceans has not demonstrated any widespread mortality or major physiological harm (e.g., American lobsters: Payne et al. 2007; rock lobsters: Day et al. 2016a; snow crabs: Christian et al. 2003; Cote et al. 2020; Morris et al. 2020), though some sub-lethal effects on haemolymph biochemistry have been observed, and the biological consequences of these effects have not been well-studied. Pile-driving sounds have been shown to affect certain behaviors in crustaceans, such as reducing locomotor activity (Norway lobster: Solan et al. 2016), decreasing feeding activity (crabs: Corbett 2018), or inhibiting attraction to chemical cues (hermit crabs: Roberts and Laidre 2019). The research thus far indicates that marine crustaceans may alter their natural behaviors in response to pile-driving sounds, but further work is required to understand the biological significance of these changes, and whether substrate-borne or water-borne particle motion has a greater influence on their behavior. Disentangling these effects is important for understanding the spatial scale at which they may be affected by pile-driving noise.

Research on the effects of impulsive sounds on invertebrate larvae is limited and has yielded mixed results. Two studies found little effect of exposure to seismic airguns on the embryonic or larval stages of spiny lobster (received SEL: 185 dB re 1 µPa2s; Day et al. 2016b) or crab (received SPL: 231 dB re 1 µPa; Pearson et al. 1994). While Aguilar de Soto et al. (2013) did show that scallop larvae exposed to sounds of seismic airguns showed body abnormalities and developmental delays, the larvae were held 2–4 inches (5–10 centimeters) away from the speaker for 90 hours of playbacks, which does not represent real-world conditions. Sole et al. (2022) examined hatching and survival of cuttlefish eggs and larvae after exposure to 16 hours of pile-driving sound in the same chamber as in Bolle et al. (2012). They found lower hatching success in exposed eggs, but the received particle motion levels at which this occurred were not reported. Without better understanding of the sound field, it is difficult to extrapolate these findings to real-world conditions. Research suggests that fish larvae may be more resilient to pile-driving sounds than invertebrate larvae. Impacts would be limited to areas in very close proximity to pile driving, and effects are likely to be species specific. Given naturally high rates of mortality in marine larvae, it is unlikely to have significant population-level effects.

Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. These disturbances would be short term and local and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less pronounced than the impacts of the physical disturbance and sediment suspension. As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the mobile ensonified area, a given location would not be ensonified for more than a few hours. Therefore, it is unlikely that cable-laying noise would result in adverse effects on benthic invertebrates.

Cumulative impacts of noise related to planned wind-related activities would be localized to somewhat widespread in extent, short term, and minor. The most significant sources of noise are expected to be pile driving followed by vessels.

Presence of structures: Planned offshore wind development, not including the Proposed Action, would construct up to 366 WTGs and 11 OSSs in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). These structures may impact benthic resources by increasing the risk of fishing gear entanglement and loss, alterations to local hydrodynamics, and habitat conversion. The nature of these sub-IPFs and their impacts are discussed below.

Construction of underwater structures from planned wind-related development would present a risk of fishing gear entanglement and loss. Planned structures include WTG foundations (e.g., monopiles, lattice, gravity based) and their scour protection, buried cable armoring, buoys, and pilings. Fishing gear potentially entangled or lost on these structures includes mesh from trawls or other similar nets, traps, and angling gear (e.g., fishing line, hooks, lures with hooks). Lost gear actively continues to fish and may drift with currents. Marine organisms may become trapped or ensnared in lost or drifting gear, also known as "ghost" fishing gear, leading to injury or mortality. Crabs and lobsters are particularly vulnerable to entrapment in lost traps. Lost hooks, sometimes baited, and lures may be ingested by marine organisms, possibly causing harm.

The presence of tall, vertical structures, such as WTGs, can alter hydrodynamics and local water stratification characteristics in two main ways: through the potential reduction of wind-driven mixing of surface waters due to atmospheric wakes occurring downstream of WTGs (e.g., Christiansen et al. 2022) or through an increase in turbulent vertical mixing due to water flow around WTG foundation structures (e.g., Carpenter et al. 2016; Dorrell et al. 2022). Seasonal stratification cycles on continental shelf seas play an important role in carbon and nutrient cycling, phytoplankton production, and secondary production; and large-scale changes in seasonal stratification may impact these natural processes and cycles (Dorrell et al. 2022). Additionally, variation in the depth of the mixing layer could impact larval distribution of species with pelagic larvae (e.g., Chen et al. 2021). Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. Finfish aggregate trends along the mid-Atlantic shelf have been shifting northeast into deeper waters (NOAA 2022); the presence of structures may reinforce these trends. Based on earlier hydrodynamic modeling studies, foundation array structures would potentially disrupt water flow at a fine scale within the interarray area and immediately downstream, but flows would return to normal at short distances from the array (Cazenave et al. 2016; Miles et al. 2017). Modeled disturbances in flow from those studies ranged from 65.6 to 164 feet (20 to 50 meters) and are proportional to foundation pile diameter. In a separate shelf-scale model based on wind-related structures in the Irish Sea, a 5 percent reduction in peak water velocities was estimated based on arrays totaling 297 turbines (Cazenave et al. 2016). Reductions in peak velocities from that study were modeled to extend up to approximately 0.5 nautical mile (1 kilometer) downstream of monopiles. The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be undetectable to small, to be localized, and to vary seasonally.

The addition of planned offshore structures would likely convert soft-bottom habitat to complex structured habitat. This habitat conversion would occur within wind farm footprints and along cable routes. Soft-bottom habitat is the most extensive habitat in the Mid-Atlantic Bight subregion of the Large Marine Ecosystem (LME); therefore, wind-related structures would not significantly reduce this habitat and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). Due to the low availability of complex structured habitat in the Mid-Atlantic Bight subregion of the LME, planned offshore structures would present new habitat opportunities for communities associated with this habitat type in much the same way that artificial reefs function (Glarou et al. 2020). The physical structures would initially increase local diversity as they are colonized by biofouling invertebrates (e.g., barnacles, anemones) and introduce new feeding opportunities to new fish assemblages that typically occur in association with complex structure (e.g., black sea bass, tautog) (Degraer et al. 2018; Fayram and de Risi 2007; Griffin et al. 2016; Hooper et al. 2017a, 2017b), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). WTG foundations may also provide habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Coates et al. 2014; Goddard and Love 2008). Fish communities, especially species associated with structure, would aggregate around foundations, scour protection, and cable protection. Some of the newly attracted species may increase predation pressure on nearby undisturbed benthic habitats, resulting in adverse impacts on benthic communities in the immediate vicinity of the structure. These impacts are expected to be local and to persist as long as the structures remain. Depending on the balance of attraction and production, newly placed structures may affect the distribution of fish and shellfish among existing natural habitat, artificial reef sites, and newly emplaced structures.

New structures can be colonized by invasive species and also have the potential to facilitate range expansion of both native and nonnative aquatic species through the stepping-stone effect (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2018). Due to the pre-existing network of artificial reefs in the mid-Atlantic OCS, however, it is unlikely that additional structures would measurably increase the potential for this effect. Further discussion on invasive species can be found in the *Accidental releases* IPF of this section.

Cumulative impacts of the presence of structures associated with planned wind-related activities would be localized and long term. Construction of underwater structures from planned wind-related development would present a risk of fishing gear entanglement and loss, and alterations to local hydrodynamics may occur due to the presence of wind-related structures. Conversion of habitat due to the presence of hard structures would result in moderate adverse impacts on some benthic resources; however, fish aggregations from the addition of structurally complex hard-bottom habitat within the geographic analysis area, where such habitat is limited may have a moderate beneficial impact.

Port utilization: Increases in port utilization due to other offshore wind projects would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a period of 5 years (2026 to 2030) and would decrease during operations but increase again during decommissioning. Increased port utilization and expansion results in increased vessel noise and increased suspended sediment concentrations during port expansion activities. The impacts of vessel noise on benthic resources are expected to be short term and localized. Impacts on water quality associated with increased suspended sediment would also be short term and localized. Any port expansion and construction activities related to the additional offshore wind projects would add to the total amount of disturbed benthic area, resulting in disturbance and mortality of individuals and short-term to permanent habitat alteration. Existing ports are heavily modified or impaired benthic environments, and future port projects would likely implement BMPs to minimize impacts (e.g., stormwater management, turbidity curtains). The degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of the port expansion activities.

Cumulative impacts of increased port utilization would be negligible because the degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of port expansion activities.

Conclusions

I**mpacts of Alternative A – No Action.** Under the No Action Alternative, benthic resources would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing short-term, long-term, and permanent impacts (e.g., disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources primarily through regular maritime activity, offshore construction impacts, and emplacement and presence of structures. There are currently no ongoing offshore wind activities in the benthic resources geographic analysis area. BOEM anticipates ongoing activities associated with the No Action Alternative, including seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, to result in **negligible** to **moderate** impacts on benthic resources.

Cumulative Impacts of Alternative A – No Action. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and benthic resources would continue to be affected by the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, discharges/intakes, EMF, noise, presence of structures, and port utilization. Planned non-offshore wind activities including increasing vessel traffic and associated accidental releases and discharges, increasing construction, marine surveys, port expansion, and channel maintenance activities would also contribute to impacts on benthic resources. BOEM anticipates that the impacts of planned activities other than offshore wind development such as increasing vessel traffic; increasing construction; marine surveys; port expansion; channel deepening activities; and installing new towers, buoys, and piers would have **minor** impacts on benthic resources. BOEM expects the combination of ongoing and planned activities other than offshore wind development to result in **negligible** to **moderate** impacts on benthic resources.

Planned offshore wind activities are expected to contribute considerably to several IPFs, primarily cable emplacement and maintenance and the presence of structures, namely foundations and scour/cable protection. Planned offshore wind activities would increase vessel activity, which could lead to an increased risk of accidental releases and discharges. In addition, the planned construction and operation of Ocean Wind 1 in Lease Area OCS-A 0498, Ocean Wind 2 in Lease Area OCS-A 0532, and Atlantic Shores North in Lease Area OCS-A 0549 would add an estimated 366 WTGs and up to 11 OSSs into an area where no such structures exist (Appendix D, Tables D.A2-1 and D.A2-2), increasing the conversion of soft-bottom habitat to hard-bottom habitat, the amount of benthic habitat disturbed by cable emplacement and maintenance and anchoring, noise and EMF in the marine environment, and the risk of invasive species. BOEM anticipates that the cumulative impact of the No Action Alternative would result in **negligible** to **moderate** adverse impacts because the overall effect would be notable but would not result in population-level effects on benthic resources. **Moderate beneficial** impacts could result from emplacement of structures (habitat conversion to hard substrate).

3.5.2.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on benthic resources:

- The total amount of long-term habitat alteration from scour protection for the foundations, interarray cables, and offshore export cable corridor.
- The total amount of habitat temporarily altered by the installation method for the export cable in the offshore export cable corridor and for interarray and interlink cables in the WTA.
- The number and type of foundations used for the WTGs and OSSs.
- The methods used for cable laying, as well as the types of vessels used and the amount of anchoring.
- The amount of pre-cable laying dredging, if any, and its location.
- The time of year when foundation and cable installations occur. The greatest impact would occur if installation activities coincided with sensitive life stages for benthic organisms.
- The number of temporary metocean buoys installed within the WTA during construction.

Variability of the proposed Project design exists as outlined in Appendix C. Below is a summary of potential variances in impacts:

- The total amount of scour protection: The amount of scour protection installed for the foundations, interarray cables, and offshore export cables relates directly to the amount of soft-bottom habitat converted to hard-bottom habitat. This conversion would result in the displacement of soft-bottom species and possible habitat provision for hard-bottom species.
- The number and type of WTG and OSS foundations: The number and type of WTG and OSS foundations directly affects the magnitude of several of the most impactful IPFs on benthic resources, including pile-driving noise, the presence of structures and associated conversion of soft-bottom habitats to hard-bottom habitats, and the amount of sediment resuspended and deposited. More WTG and OSS foundations would result in a longer duration of pile driving, and larger WTG and OSS foundations would result in a larger ensonified area. More WTG and OSS foundations would result in greater impacts associated with the presence of structures, including risk of entanglement of commercial fishing gear, fish aggregation, hydrodynamic disturbances, and habitat conversion.

- The installation method of export cables, interarray cables, and interlink cables: Methods of cable installation have differing effects on sediments and benthic organisms. For example, the ploughing method minimizes resuspension of sediments by trenching, laying, and burying all in successive steps, and the water-jetting method would entrain and possibly injure or kill larvae of some benthic organisms.
- The amount of pre-cable laying dredging and the amount of anchoring: Pre-cable laying dredging and anchoring directly affect the amount of sediment disturbed and the level of risk of injury and mortality to benthic organisms.
- The time of year when foundation and cable installations occur: Migratory benthic and demersal organisms exhibit seasonal variation in migration patterns, such that certain species and life stages are present in the Project area at certain times of the year. The time of year during which construction occurs may influence the magnitude of impacts (e.g., noise, sediment resuspension and burial) on these species.
- The number of temporary metocean buoys: Metocean buoy anchors directly affect the amount of sediment disturbed and the level of risk of injury and mortality to benthic organisms.

3.5.2.5 Impacts of Alternative B – Proposed Action on Benthic Resources

As described in Section 2.1.2, the Proposed Action includes the construction and installation of both offshore and onshore facilities. Construction and installation would begin in 2024 and be completed in 2027. Proposed Offshore Project construction activities include the construction and installation of up to 200 WTGs and their foundations, up to 10 OSSs and their foundations, scour protection for foundations, 1 permanent met tower, up to four temporary metocean buoys, interarray cables, and offshore export cables. Proposed Onshore Project construction activities include the construction and installation of landfall sites for the submarine export cables, onshore export cable route(s), onshore substations or converter stations, and interconnection cables linking the onshore substations or converter stations to the POIs to the existing grid. The Proposed Action also includes 30 years of O&M over a 30-year commercial lifespan and decommissioning activities at the end of commercial life. BOEM expects the Proposed Action to affect benthic resources through the following primary IPFs.

Onshore Activities and Facilities

Accidental releases: The Proposed Action could increase accidental releases of fuels/fluids/hazardous materials, trash, and debris during construction and installation, O&M, and decommissioning activities at the export cable landfall sites. Additionally, components of anti-fouling paints and anti-corrosives may leach into surface waters. However, the incremental impacts of the Proposed Action would not increase the risk of accidental releases beyond that described under the No Action Alternative. Additionally, the Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste and Atlantic Shores would implement a SPCC Plan, further reducing the likelihood of an accidental release. Atlantic Shores has developed an OSRP with measures to avoid accidental releases and a protocol to respond to such a release (BEN-06). Atlantic Shores would also implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at the export cable landfall sites and estuarine portions of the export cable routes (BEN-02). Therefore, accidental releases are considered unlikely and would be quickly mitigated if one occurred. Construction and installation, O&M, and decommissioning activities at the export cable landfall sites are not expected to increase the risk of accidental releases of invasive species.

Cable emplacement and maintenance: The landfalls of the export cables would occur at Monmouth and Atlantic ECC landfall sites. The offshore-to-onshore transition is proposed to be accomplished using HDD, a trenchless method that will avoid nearshore impacts as well as impacts directly along the shoreline. HDD, in comparison to trenching, also results in a deeper burial depth for cables in the nearshore environment, facilitating sufficient burial over the life of the Project and decreasing the likelihood that cables will become exposed over time. An HDD bore will be completed for each of the export cables coming ashore, so each cable will be contained within its own HDD conduit. Up to two additional spare HDD conduits may be installed at each landfall site for a total of six HDD conduits at each landfall site. To support HDD activities, Atlantic Shores would establish an onshore staging area at each landfall site. At both sites, HDD would either be initiated or exit landward of the beach to avoid impacts on the beach. Onshore, each HDD path will originate or terminate in an excavated pit that is approximately 10 by 13 feet (3 by 4 meters) located at the landfall site's onshore staging area. The excavated pit will also serve to contain drilling fluid, which is a slurry of bentonite (an inert, nontoxic natural clay that poses little to no risk to the marine environment) and water that lubricates the drill head and extracts excavated material from the bore hole. Atlantic Shores would implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at the export cable landfall sites (BEN-02). HDD would also be used for cable installation at inshore portions of the export cable routes where necessary to avoid impacts on wetlands located along the Atlantic and Monmouth export cable routes and on seagrass resources located along the estuarine portion of the Atlantic export cable route. Although the detailed design of HDD activities has not yet been finalized, the HDD activities will be designed in coordination with USACE to minimize any conflicts with USACE projects. The estimated average burial depth of HDD-installed cables at export cable landfalls is approximately 16 to 131 feet (5 to 40 meters) below the seabed (COP Volume I, Section 4.7.1; Atlantic Shores 2023). The depth of other HDD-installed cables under channels and wetlands will depend on the length of the HDD and other site-specific considerations. Atlantic Shores will design each HDD activity using site-specific geotechnical data to ensure adequate clearance from the channel or wetland and to minimize the risk of unintended interaction between the HDD and the environment. Special consideration will be given to any dredged channels to minimize the risk associated with future dredge maintenance activities.

Cable installation at the landfall sites would result in suspended sediments in the vicinity of the Proposed Action. As discussed in Section 3.5.2.3, *Impacts of Alternative A,* impacts on benthic resources related to resuspension and deposition of sediments are expected to be minor. Although benthic organisms could be buried by deposited sediments during construction, measurable sediment deposition would be limited to the cable installation trench and the areas immediately adjacent. Currents, storms, and other oceanographic processes frequently disturb soft-bottom habitats, and native benthic organisms are adapted to respond to such disturbances (Guida et al. 2017). Indirect impacts on benthic resources from sediment suspension and deposition would be short term and minimal. The one-time disturbance associated with the installation of export cables at the Monmouth or Atlantic ECC landfall sites would not prevent natural recovery of benthic communities.

At decommissioning, export cables at the Monmouth and Atlantic landfalls and along the inshore cable routes would be removed. When underwater cables are removed, any overlying cable protection would need to be removed first, then the cables would be extracted from the seabed. Where these cables are buried in dense sediments, it may be necessary to fluidize overlying sediments before extracting the cables, resulting in suspended sediments in the vicinity of the Proposed Action. As discussed in Section 3.5.2.3, impacts on benthic resources related to resuspension and deposition of sediments are expected to be minor. The one-time disturbance associated with the decommissioning and removal of export cables at the Monmouth or Atlantic ECC landfall sites and in estuarine portions of the export cable routes would not prevent natural recovery of benthic communities.

Offshore Activities and Facilities

Accidental Releases: The Proposed Action would result in increased vessel activity, which in turn could increase accidental releases of fuels/fluids/hazardous materials, trash and debris, and invasive species during construction and installation, O&M, and decommissioning activities. The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste and Atlantic Shores would implement an SPCC plan, further reducing the likelihood of an accidental release (BEN-05). Atlantic Shores has developed an OSRP with measures to avoid accidental releases and a protocol to respond to such a release (BEN-06). Atlantic Shores would also implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at export cable landfall sites (BEN-02). Therefore, accidental releases are considered unlikely and would be quickly mitigated if one occurred. The increased vessel traffic associated with the Proposed Action, especially traffic from foreign ports, would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on benthic resources depend on many factors but could be widespread and permanent. The increase in the risk of accidental releases of invasive species attributable to the Proposed Action would be moderate.

Anchoring: Increased Project-related vessel activity would result in increased anchoring activity within the geographic analysis area. Project-related anchoring activity would be highest during the construction and decommissioning phases of the met tower, up to 200 WTGs, and up to 10 OSSs. The use of dynamic positioning systems could minimize the need for anchoring in some cases. Anchor contact with the seafloor would result in direct impacts on habitat and benthic organisms but would be limited to an approximate area of 714 acres (289 hectares) (Appendix D, Table D.A2-2). Direct impacts include temporary disturbance of bottom habitat and injury or mortality of organisms including benthic invertebrates. The severity of impacts for each event would depend on the specific location and habitat type, with greater effects expected when seafloor-disturbing activities interact with sensitive habitats, early life stages (e.g., egg and larvae), and sessile species such as Atlantic surfclam and ocean quahog (see Section 3.5.5 for a discussion of potential impacts on commercially important benthic invertebrate species). Immobile and early life stages of benthic invertebrate species in the direct path of anchor or jack-up vessel disturbance may be subject to injury or mortality; however, as described in Section

3.5.2.3, the benthic community is expected to recover, and benthic infauna and epifauna are expected to recolonize the area after physical disturbance ceases. Atlantic Shores would employ an anchoring plan for areas where anchoring is required to avoid direct impacts on sensitive, hard-bottom, and structurally complex habitats to the maximum extent practicable (BEN-08). Indirect impacts include increased turbidity from resuspension of sediments and burial of habitats or organisms from redeposition. Dispersal distances of resuspended sediments would depend on bottom currents. Burial of hard-bottom habitat is possible, but this habitat type is limited within the geographic analysis area. The impacts from anchoring within the geographic analysis area are expected to be minor to moderate. The expected minor to moderate impacts from anchoring are not expected to influence the current trends in benthic habitat and organisms.

Cable emplacement and maintenance: The Proposed Action would install up to 988 miles (1,590 kilometers) of export and interarray cables (Appendix D, Table D.A2-1). Emplacement of offshore interarray and export cables would result in the disturbance of up to 576 acres (233 hectares) of the seafloor (Appendix D, Table D.A2-2) (for a description of the range of impacts associated with the different methods of cable installation, see COP Volume I, Section 4.5.10.2, Table 4.5-2, and Section 4.11, Table 4.11-1; Atlantic Shores 2023). Much of the Project area is characterized as being mainly level and consistent, with sand bedforms of varying sizes and swales (COP Volume II, Section 2.1.1.2.2; Atlantic Shores 2023). The pre-lay grapnel runs and installation of interarray cables would cause short-term disturbance of sand bedforms, but tidal and wind-forced bottom currents would likely reform most areas within days to weeks. Areas that are more strongly influenced by extreme weather events would reform in response to Nor'easters and tropical systems. It is anticipated that the natural pattern of sand bedforms would return to preconstruction conditions within a few months. The submarine export cable routes were selected to minimize overlap with sensitive benthic habitats. Additionally, the Proposed Action is committed to a target cable burial depth of 5 to 6.6 feet (1.5 to 2 meters) (BEN-03). Given the influence of natural currents, as well as construction-related avoidance and conservation measures, adverse impacts on benthic resources due to construction activities associated with the Proposed Action would be short term and minor.

During export cable installation at the landfall sites, a temporary offshore platform (i.e., jack-up barge) may be needed to support the HDD drilling rig, resulting in seabed disturbance. If HDD is initiated onshore, when the pilot hole exits the seabed, the contractor may use water to carry drill cuttings back to the approach pit rather than drilling fluids to avoid release of clay to the water column. At the offshore HDD entrance/exit location, a shallow area of up to approximately 66 by 33 feet (20 by 10 meters) would be excavated. A backhoe dredge may be required to complete the excavation. Up to four temporary cofferdams may be constructed at each landfall site (for an overall total of eight). Each cofferdam would be approximately 98.4 feet by 26.2 feet (30 meters by 8 meters) in size. Construction of the HDD entrance/exit pit and cofferdams would remove sediments and likely injure or kill infaunal benthic organisms located within these sediments. After installation of the HDD conduit and export cables, the excavations for the cofferdams and the HDD entrance/exit pit would be filled and the seabed profile in the area would be restored. The level of impact of these excavations may vary seasonally, particularly in nearshore locations, and spatially, with the greatest impact occurring if the activities overlap spatially and temporally with areas of high benthic organism abundance. The sandy habitats located near the landfalls recover fairly quickly from disturbance, although recovery time varies by region, species, and type of disturbance. The seabed profile alterations associated with the excavations, while locally intense, are expected to have little impact on benthic resources in the Project area.

If an active cable is encountered during cable crossing surveys, Atlantic Shores, after developing a crossing agreement with the cable's owner, would remove any marine debris from around the crossing area. Depending on the status of the existing cable and its location, such as burial depth and substrate characteristics, cable protection may be placed between the existing cable and Atlantic Shores' overlying cable. However, if sufficient vertical distance exists, such protection may be avoided. If the presence of an existing cable prevents Atlantic Shores' cable from being buried to its target burial depth, it may be necessary to place cable protection on top of the cable. Further details on protocols for export cable crossings with active cables can be found in Chapter 2, *Alternatives,* Section 2.1.2.1.

As discussed in Section 3.5.2.3, impacts on benthic resources related to cable emplacement are expected to be minor. Although adult and juvenile individuals, demersal eggs, and larvae could be buried by deposited sediments during construction, measurable sediment deposition would be limited to the cable installation trench and the areas immediately adjacent. Currents, storms, and other oceanographic processes frequently disturb soft-bottom habitats, and native invertebrates are adapted to respond to such disturbances (Guida et al. 2017). Indirect impacts on benthic invertebrate resources from sediment suspension and deposition would be short term and minimal. Evidence of recovery following sand mining in the U.S. Atlantic and Gulf of Mexico indicates that soft-bottom benthic habitat in the Project area would fully recover within 3 months to 2.5 years (Brooks et al. 2006; BOEM 2015; Kraus and Carter 2018; Normandeau 2014). NMFS estimated that recovery of the soft-bottom benthic community at Block Island Wind Farm occurred within 3 years (NMFS 2015). The one-time disturbance associated with the construction of the proposed Project would not prevent natural recovery of benthic communities. Additionally, Atlantic Shores would minimize impacts on benthic resources by siting structures to avoid sensitive habitat and through the use of jet plow cable embedment to reduce sediment disturbance during the cable laying process (GEO-02, BEN-04). Therefore, impacts of sediment resuspension and deposition resulting from the Proposed Action would be short term, localized, and range from minor to moderate for benthic resources in the Project area.

During the O&M phase, cable surveys would be performed at regular intervals to identify any issues associated with potential scour and depth of burial. Annual surveys would be performed for the first few years of operation and, provided no excessive scour or changes in cable burial depth are detected during those initial surveys, less frequent surveys would continue for the life of the Project. Atlantic Shores would utilize an industry-recognized approach to determine inspection intervals based on trends established from inspection and measurement data collected during the first few years of operations and updated throughout the Project life as new inspections are completed. Additional surveys would be performed as appropriate in response to abnormal conditions or significant events, which include major storms, marine incidents in the area, and major maintenance activities. Atlantic Shores would employ monitoring systems on all major components which will alert the operator to potential issues and may trigger additional surveys as appropriate. Atlantic Shores would maintain a regular presence in the WTA during operations to perform ongoing maintenance and inspection activities. Any unusual observations made during these activities may trigger additional survey or inspection activities. See Chapter 2, Section 2.1.2.2 for more details regarding maintenance and inspection activities.

Cable terminations and hang-offs would be inspected and maintained during scheduled maintenance of foundations, OSSs, or WTGs. Scheduled maintenance of offshore facilities would be performed on a fixed, predetermined basis (e.g., annually) during non-winter months when accessibility would be highest. Scheduled cable survey and maintenance activities could result in increased vessel noise, anchoring impacts, and accidental releases of fuels/fluids/hazardous materials and trash and debris (see these IPFs for a description of their impacts). If portions of buried offshore cables require maintenance, the sediment cover may need to be removed for inspection and possible replacement of a portion of the cable. These activities would temporarily disturb the seafloor, but effects would be negligible, short term, and extremely localized.

During Project decommissioning, export cables, interarray cables, and interlink cables (if present) would be removed from the seabed. When cables are removed, any complex habitat communities that had formed on cable scour protection structures would be destroyed when the scour protection is removed during decommissioning. Soft-bottom associated species (e.g., Atlantic surfclam, squid, and winter flounder) (Greene et al. 2010; Guida et al. 2017) may recolonize the newly restored soft sediments. Impacts due to the conversion of hard-bottom habitat back to soft-bottom habitat would be local but moderate. Additionally, the removal of cables and associated scour protection would cause the resuspension of sediments, which would settle in and adjacent to the former submarine cable routes. Overall, impacts on benthic resources due to the removal of cables and associated scour protection would be localized and range from minor and short term (for sediment resuspension and deposition and sediment profile alterations) to moderate and permanent (for removal of scour protection).

Discharges/intakes: There would be increased potential for discharges from vessels during construction and installation, O&M, and decommissioning activities related to the Proposed Action, and it is expected that these discharges would be staggered over time and localized. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. Impacts on benthic resources from vessel discharges, if any, would be localized, short term, and negligible.

Electric and magnetic fields and cable heat: The Proposed Action would install up to 441 miles (710 kilometers) of 230–275 kV HVAC or 320–525 kV HVDC offshore export cables, as well as up to 547 miles (880 kilometers) 66–150 kV HVAC interarray cables (Appendix D, Table D.A2-1). If HVAC export cables are used, then four export cables would be installed per Project; if HVDC cables are used, then one export cable would be installed per Project. This would result in two to eight export cables being installed for the Proposed Action (two if both Projects 1 and 2 utilize HVDC cables; five if one Project utilizes HVAC and the other Project utilizes HVDC; and eight if both Projects 1 and 2 utilize HVAC cables). During operation, powered alternating current transmission cables would produce EMFs (Taormina et al. 2018) and heat. The strength of the EMF increases with electrical current, but rapidly decreases with distance from the cable (Taormina et al. 2018). Atlantic Shores would bury cables to a minimum target burial depth of 5 to 6.5 feet (1.5 to 2 meters) below the surface to minimize detectible EMFs, well below the aerobic sediment layer where most benthic infauna live (BEN-03).

The scientific literature provides some evidence of faunal responses to EMFs by marine invertebrates, including crustaceans and mollusks (Hutchison et al. 2018; Normandeau et al. 2011; Taormina et al. 2018), although some reviews (Albert et al. 2020; Gill and Desender 2020) indicate the relatively low intensity of EMFs associated with marine renewable projects would not result in impacts. Effects of EMFs may include interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018). Studies on the effects of EMFs on marine animals have mostly been restricted to commercially important species. The consequences of anthropogenic EMFs have not been well studied in benthic resources (Albert et al. 2020; Gill and Desender 2020; Snyder et al. 2019). However, the available information suggests that benthic invertebrates with limited mobility would not be affected by Project-associated EMF (Exponent 2018). In the case of mobile species, an individual exposed to EMFs would cease to be affected when it leaves the affected area. An individual may be affected more than once during long-distance movements; however, there is no information on whether previous exposure to EMFs would influence the impacts of future exposure. Therefore, BOEM expects localized and long-term, though not measurable, impacts on benthic resources from EMFs from the Proposed Action. See Section 3.5.5 for a discussion of the impacts of EMF on elasmobranchs.

Heat emission would occur along the planned 988 miles (1,590 kilometers) of Project cables. Heat emission from above-sediment cables would be minimized by cooling from bottom water and mitigated by cable sheathing or armoring. However, heat from buried cables may radiate at considerable distances relative to burial depths, depending on cable source heat and sediment substrate (Emeana et al. 2016). Based on controlled experiments, cable emitted heat radiated less than two meters for cable heat 19°C or less above ambient temperature (Emeana et al. 2016). At source heat 43°C and higher, radiation distances approach two meters (Emeana et al. 2016). Alternating current cables emit higher heat than direct current cables (Taormina et al. 2018). As mentioned in the previous paragraph, Project cables would be buried to a target depth of 5 to 6.5 feet (1.5 to 2 meters) where possible, providing some measure of mitigation depending on actual cable temperatures (BEN-03).

Gear utilization: Atlantic Shores would implement benthic monitoring surveys in the Offshore Project area to establish pre-construction baselines, measure disturbances, and monitor recovery of habitats and biological communities (BEN-01, BEN-08). Atlantic Shores has also proposed to implement fisheries monitoring surveys (FIN-12). Benthic survey gear types include benthic grab samplers, multibeam echosounders, and underwater video cameras. Proposed fisheries survey gear types include clam dredges, demersal fish trawls, and fish pots.

Impacts from gear utilization related to benthic and fisheries monitoring surveys performed in support of the Proposed Action would likely range from negligible to minor. Impacts from the surveys are expected to be localized, and soft-bottom habitats would be expected to recover fairly quickly from the disturbance in the short term; however, disturbance to hard-bottom habitat would take longer to recover from. The time period for recovery would depend on the mobility and life stage of each species, with sessile organisms less able to avoid impacts and mobile organisms more able to avoid impacts.

Noise: The Proposed Action would result in noise from vessels, G&G surveys, pile driving, operational WTGs, and cable burial or trenching. The natures of these sub-IPFs and of their impacts on benthic resources are described in Section 3.5.2.3. Benthic habitat is composed of various types of sediment, structural features that are formed by that sediment (e.g., interstitial spaces between boulders, sand waves), and organisms that reside in and on the sediment. Substrates and associated structural features are unaffected by underwater noise. Benthic invertebrates are sensitive only to the particle motion component of noise. Invertebrates may experience a range of impacts from underwater sound depending on physical qualities of the sound source and the environment, as well as the physiological characteristics and the behavioral context of the species of interest. Detectable particle motion effects (e.g., startle responses, valve closure, changes to respiration or oxygen consumption rates) on invertebrates are typically limited to within 7 feet (2 meters) of the source or less (Carroll et al. 2017; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007).

Vessel noise includes non-impulsive sounds that arise from a vessel's engines, propellers, and thrusters. Sound levels emitted from vessels depend on the vessel's operational state (e.g., idling, in-transit) and are strongly weather dependent. Zykov et al. (2013) and McPherson et al. (2019) report a maximum broadband source level of 192 dB re 1 µPa for numerous vessels with varying propulsion power. Noise from the Project's vessels is likely to be similar in frequency characteristics and sound levels to existing commercial traffic in the region, and Project vessels would only represent a small fraction of the large volume of existing traffic in the geographic analysis area. Moreover, given the rapid attenuation of underwater vibrations with increasing distance from a sound source (Morley et al. 2014), it is unlikely that these stimuli would cause more than short-term behavioral effects (e.g., flight or retraction) or physiological (e.g., stress) responses. Overall, effects on benthic invertebrates from vessel noise are expected to be short term and localized and are not anticipated to pose a risk to benthic invertebrates.

The most impactful noise is expected to be produced by pile-driving activities during construction, and specifically during impact pile driving to install turbine foundations. The Proposed Action would produce noise from pile driving during installation of up to 200 WTG foundations, 10 OSS foundations, and 1 met tower foundation for 4 to 6 hours per day. Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not likely to experience barotrauma from pile-driving. Vibration from impact pile driving can be transmitted through sediments. Sessile marine invertebrates like bivalves are sensitive to substrate-borne vibrations and may be affected by pile-driving noise (Day et al. 2017; Roberts et al. 2015; Spiga et al. 2016). Additionally, recent research (Jones et al. 2020, 2021) indicates that longfin squid, an EFH species, can sense and respond to vibrations from impact pile driving at a greater distance based on sound exposure experiments. The research thus far indicates that marine crustaceans may alter their natural behaviors in response to pile-driving sounds, but further work is required to understand the biological significance of these changes, and whether substrate-borne or water-borne particle motion has a greater influence on their behavior. Infaunal organisms may also exhibit short-term stress and behavioral responses over a smaller area due to the vibrations created by vibratory pile driving used for cofferdam installation. Given that most benthic species in the region are either mobile as adults or planktonic as larvae, disturbed areas would likely be recolonized naturally and in the short term, and the overall impact on benthic resources would be moderate. Behavioral effects of pile driving on fish and commercially important invertebrates are discussed in *Section 3.5.5*.

As discussed in Section 3.5.2.3, operating WTGs generate non-impulsive underwater noise that may be detectable to some benthic invertebrates. However, maximum noise levels anticipated from operating WTGs would be below levels thought to cause injury and behavioral effects, and vibrations would dissipate rapidly with distance from turbine foundations. Noise impacts on benthic invertebrates from operating WTGs are expected to be negligible, localized, and long term.

As described in Section 3.5.2.3, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and cable protection installation. The Proposed Action includes the laying of 988 miles (1,490 kilometers) of export and interarray cables; however, the impacts of related noise-producing activities would be incremental, are not expected to exceed noise impacts of cable-laying activities under the No Action Alternative and are not expected to result in adverse effects on benthic resources.

G&G surveys would be conducted in support of Project-associated site assessment and characterization activities. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration, and detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources, but may overlap with behavioral impacts of pile-driving noise. Overlapping sound sources are not anticipated to result in a greater, more-intense sound; rather, the louder sound prevents the softer sound from being detected (Hawkins and Popper 2014). Impacts of G&G surveys on benthic resources are expected to be short term and negligible.

The negligible (for most noises) to moderate (for pile-driving noise) impacts (disturbance, injury, and mortality) of the Proposed Action on benthic resources would be in addition to the noise that would occur under the No Action Alternative, which is expected to result in similar short-term and local impacts.

Port utilization: Because the Proposed Action would cause no appreciable change in port utilization, the impacts of this IPF on benthic resources attributed to the Proposed Action would be negligible.

Presence of structures: Under the Proposed Action, the presence of structures could result in various impacts. The nature of these sub-IPFs and their impacts on benthic resources are described in Section 3.5.2.3. The Proposed Action would construct up to 200 WTGs, 10 OSSs, and 1 met tower, and 289 acres (117 hectares) of scour protection around the foundations (Appendix D, Table D.A2-2), export cables, and interarray cables.

The presence of the Offshore Project structures would convert soft-bottom habitat to hard-bottom habitat. This would result in permanent losses of soft-bottom habitat, including ecologically important complex sand ridge habitat that is present at some proposed WTG locations within the Project area. Loss of soft-bottom habitat would displace soft-bottom associated species (e.g., Atlantic surfclam, squid, and winter flounder) (Greene et al. 2010; Guida et al. 2017). New complex habitat communities that would inhabit the created hard-bottom habitat would include fouling/encrusting organisms, creating an array of biogenic reefs (Degraer et al. 2018; Fayram and de Risi 2007; Griffin et al. 2016; Hooper et al. 2017a, 2017b). Abundances and densities of new species assemblages at WTG foundations would be influenced by the amount of surface area and seasonal availability of larval recruits. Areas surrounding WTG foundations would accumulate remains of fouling and attached organisms, which may provide habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Coates et al. 2014; Goddard and Love 2008). Colonization of new species could result in local increases (i.e., around wind -related structures) in biomass and diversity (Causon and Gill 2018), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). Impacts due to habitat conversion would be local and range from negligible to moderately beneficial and would persist for the operating life of each structure (i.e., until decommissioning and removal of the structures). Complex habitat communities that had formed on these hard structures would be destroyed when the hard structures are removed during decommissioning. Soft-bottom associated species (e.g., Atlantic surfclam, squid, and winter flounder) (Greene et al. 2010; Guida et al. 2017) could recolonize the newly restored soft sediments. Impacts due to the removal of structures and subsequent conversion of hard-bottom habitat back to soft-bottom habitat would be local and permanent but moderate. It is possible that, pending environmental assessment and regulatory approval, some foundations may be left in place as artificial reefs. In addition, scour protection and armoring associated with foundations and cables may be removed or left in place pending future environmental assessment. Although the removal of structures associated with the Proposed Action would greatly impact the organisms that utilize them, the removal would not result in population-level effects due to the presence of other hard structures in the geographic analysis area, including those associated with offshore wind.

Fishing gear including mesh from trawls or other similar nets, traps, and angling gear (e.g., fishing line, hooks, lures with hooks) could potentially become entangled or lost on structures associated with the Proposed Action. Lost gear actively continues to fish and may drift with currents. Marine organisms may become trapped or ensnared in lost or drifting gear, also known as “ghost” fishing gear, leading to injury or mortality. Crabs and lobsters are particularly vulnerable to entrapment in lost traps. Lost hooks, sometimes baited, and lures may be ingested by marine organisms, possibly causing harm. The increased risk of gear loss would persist for the operating life of the Project (i.e., until decommissioning/removal of structures). Atlantic Shores would regularly visually monitor all offshore structures as part of their normal O&M activities. If fishing gear is found to be entangled in wind farm structures, Atlantic Shores would assess potential safety risks as well as potential risks to marine life and navigation to inform a path forward (SEA-02). Impacts of gear loss due to the presence of Project-related structures on benthic resources are expected to be negligible.

Once Project construction is complete, the presence of the WTG, OSS, and met tower foundations could result in some alteration of local water currents, which could alter local seasonal stratification of the water column, produce sediment scouring, and alter benthic habitat. Local changes in scour and sediment transport close to a foundation may alter sediment grain sizes and benthic community structure (Lefaible et al. 2019), though this impact is expected to be minimal due to the use of scour protection for each foundation. These effects, if present, would exist for the duration of the Proposed Action and would be reversed only after the Project has been decommissioned, although they may be permanent if scour protection is left in place.

New structures can be colonized by invasive species and also have the potential to facilitate range expansion of both native and nonnative aquatic species through the stepping-stone effect (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2018). Due to the pre-existing network of artificial reefs in the mid-Atlantic OCS, however, it is unlikely that the additional structures associated with the Proposed Action would measurably increase the potential for this effect. Further discussion on invasive species can be found in the *Accidental releases* IPF of Section 3.5.2.3. Although considered unlikely, the establishment of invasive species as a result of the Proposed Action could have strongly adverse, widespread, and permanent impacts on benthic resources if the species were to become established and out-compete native fauna.

Impacts due to fishing gear entanglement/loss and hydrodynamic disturbances are anticipated to be negligible, localized, and long term. Impacts due to habitat conversion and provision of hard structures are anticipated to be moderately beneficial, localized, and long term.

Impacts of the Connected Action

As described in Chapter 2, as part of the Proposed Action, an O&M facility would be constructed in Atlantic City, New Jersey, on a site within the Inlet Marina area that was previously used for vessel docking or other port activities. The O&M facility would involve construction of a new building and associated parking structure, repairs to the existing docks, and installation of a new bulkhead and new dock facilities. Bulkhead repair and/or installation and maintenance dredging in coordination with Atlantic City's dredging of the adjacent basins would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead and dredging activities are considered to be a connected action and are evaluated in this section. The City's maintenance dredging program would reestablish a water depth of 15 feet (4.6 meters) below the plane of MLW plus 1.0 foot (0.3 meter) of allowable overdredge and 4:1 slide slopes within the site. Up to 142,823 cubic yards (109,196 cubic meters) of sediment within Clam Creek and Farley's Marina may be dredged as part of the connected action. Dredging would be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. The hydraulic cutterhead dredge would be the primary dredge method, with the mechanical dredge utilized to access small marina, canal, or lagoon areas. All resultant dredged material at the site would be removed and disposed of at Dredged Hole (DH) #86, a 14.4-acre (5.8-hectare) subaqueous borrow pit restoration site with degraded habitat, in Beach Thorofare in Atlantic City, New Jersey, and in accordance with Department of the Army Permit Number NAP-2020-00059-95. DH #86 is owned and maintained by NJDOT-OMR. Placement of dredged material into DH #86 is contingent upon execution of a use agreement between Atlantic City and NJDOT-OMR.

The connected action would affect benthic resources in the geographic analysis area through the following IPFs: accidental releases, anchoring, discharges/intakes, noise, and port utilization.

Accidental releases: The connected action could increase accidental releases of fuels/fluids/hazardous materials, trash and debris, and invasive species during bulkhead construction and dredging activities at the O&M facility. BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Therefore, incremental impacts of the connected action would not increase the risk of accidental releases beyond that described under the No Action Alternative. In the event of a release, it would be an accidental, localized event in the vicinity of the O&M facility, and therefore Project-related accidental releases would only have a localized, negligible, short-term effect on benthic resources.

Anchoring: The connected action could cause impacts due to increased anchoring of vessels associated with construction activities at the Inlet Marina area. Anchor/chain contact with the seafloor could cause injury to and mortality of benthic resources, as well as physical damage to their habitats. Impacts on seafloor habitats could be long term if they occur on hard-bottom habitat; however, sediments in the area of the connected action are primarily fine (sandy silt/clay). Mortality of organisms may occur, but affected areas are expected to be recolonized quickly. Resuspension of sediments and burial from redeposition are indirect impacts from anchoring. Dispersal of resuspended sediments is dependent on bottom currents, and burial of benthic organisms is possible. Mobile organisms may avoid burial by repositioning in the sediments or moving away. Recovery from non-permanent impacts in the silty sediments of the area of the connected action is expected to occur rapidly; therefore, impacts from anchoring activities associated with the connected action are expected to be negligible, localized, and short term.

Discharges/intakes: There would be increased potential for discharges from vessels during construction and operational activities related to the connected action, and it is expected that these discharges would be staggered over time and localized. At least three vessels (dredge vessel, tug, and scow) would be required to conduct dredging operations associated with the connected action. Dredging operations would not result in a permanent increase in vessel traffic because the vessels would only be present during dredging. Vessel traffic associated with construction activities for the connected action would not be permanent. Furthermore, use of Inlet Marina following construction would not result in a net increase in commercial vessel traffic and is not expected to exceed an increase of two non-commercial vessels. All vessels associated with the connected action are expected to comply with environmental permitting standards for discharged materials. Additionally, most permitted discharges, including uncontaminated bilge water and treated liquid wastes, occur offshore from ports. Impacts on benthic resources from vessel discharges associated with the connected action, if any, would be localized, short term, and negligible.

Noise: The connected action would result in elevated levels of underwater noise due to construction and installation activities, vessels, pile driving, and dredging (see Section 3.5.2.3 for a detailed description of the impacts of these activities on benthic resources). Construction vessels would include at least three vessel types (dredge vessel, tug, and scow) during a temporary construction window.

Additionally, in-water construction activities, including the installation of sheet piles, are only expected to create a small amount of noise. Impacts from increased vessel noise and in-water construction activities are expected to be negligible, localized, and short term.

Little is known about the effects of noise on benthic invertebrates. Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not likely to experience barotrauma from pile driving. Vibration from impact pile driving can be transmitted through sediments. As described in Section 3.5.2.3, benthic invertebrates are sensitive to the particle motion component of noise. Detectable particle motion effects on invertebrates are typically limited to within 7 feet (2 meters) of the source or less (Carroll et al. 2017; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007). The research thus far indicates that marine crustaceans may alter their natural behaviors in response to pile-driving sounds, but further work is required to understand the biological significance of these changes, and whether substrate-borne or water-borne particle motion has a greater influence on their behavior. The overall impacts of noise from pile installation activities would be minor, temporary, and localized.

Port utilization: The connected action includes the repair/replacement of a bulkhead and maintenance dredging. Up to 142,823 cubic yards (109,196 cubic meters) of sediment within Clam Creek and Farley's Marina may be dredged as part of the connected action. All dredging work conducted within the small marina area of the connected action would be performed using a mechanical dredge. Sediments within the area of the connected action are primarily sandy silt/clay. Dredging and bulkhead replacement conducted during construction as part of the connected action would also result in increased total suspended sediment concentrations in the area. Mechanical dredging activities could result in total suspended sediment concentrations of up to 445 mg/L above ambient conditions (NMFS 2021). Pile driving could result in total suspended sediment concentrations of approximately 5 to 10 mg/L above ambient conditions within approximately 300 feet (91 meters) of the point of origin (FHWA 2012). However, these elevated total suspended sediment concentrations are below the short-term (1 to 2 days) concentrations shown to have adverse effects on benthic communities (390 mg/L) (USEPA 1986). Elevated suspended sediment levels would be temporary, and most fish and invertebrates are capable of mediating temporary increases in suspended sediment by expelling filtered sediments or reducing filtration rates (NYSERDA 2017; Bergstrom et al. 2013; Clarke and Wilber 2000). Disturbed sediments that are resuspended into the water column may drift or disperse to nearby locations before settling. Resuspended sediments may include resuspension of chemical contaminants, especially in coastal and inland waters. Redeposition of disturbed sediments may temporarily or permanently alter nearby complex hard-bottom habitats and may bury benthic organisms. possibly resulting in mortality of benthic organisms and benthic and demersal life stages (e.g., eggs and larvae). In response to moderate sediment deposition, infaunal organisms (e.g., marine worms) may reposition in the sediments to avoid smothering (Hinchey et al. 2006), while mobile organisms (e.g., fishes, crustaceans) may actively avoid areas of deposition. However, some demersal eggs and larvae (e.g., longfin squid, winter flounder, ocean pout) could be buried by suspended sediment that settles in following dredging. Impacts from sediment suspension and deposition on benthic invertebrates would be temporary and localized to the 20.6-acre (8.3-hectare) dredge footprint.

Habitat disturbance and modification associated with dredging could result in short-term habitat disturbance and modification within the dredge footprint, where all benthic organisms would be removed and the post-dredging surface substrates would consist of unconsolidated sediments. It is anticipated that sediments within the dredge footprint would quickly be recolonized by benthic organisms from surrounding, undisturbed sediments. Sandy or silty habitats, which are abundant in the geographic analysis area and in the vicinity of the connected action, recover fairly quickly from disturbance, although recovery time varies by region, species, and type of disturbance. For a more detailed discussion on the recovery of soft sediment benthic communities after disturbance, see the *Cable emplacement and maintenance* IPF in Section 3.5.2.3. Dredging may increase water depths by up to 21 feet (6.4 meters), which is not expected to have a significant impact on benthic community composition following recolonization of the dredged area. Dredging is not expected to alter the sediment composition compared to the existing substrate in the dredge area. Given there would be no change in sediment composition, subsequent changes in benthic community composition would not be expected. However, the surface sediments following dredging may contain increased concentrations of contaminants, which may affect recolonizing benthic invertebrates. Impacts from habitat disturbance and modification on benthic invertebrates would be short term and localized to the 20.6-acre (8.3-hectare) dredge footprint.

All dredged material would be mechanically and hydraulically placed at DH #86 in Beach Thorofare. The volume of dredged material from the connected action would represent a small fraction of the total dredged material placed within DH #86. Within DH #86, the depth below the surrounding natural seabed ranges from approximately 5 feet (1.52 meters) below MLW to 57 feet (17.37 meters) below MLW. DH #86 is approximately 14 acres (5.7 hectares) in size and is characterized by a rapidly changing and uneven bathymetry and steep sides (McKenna et al. 2018). Sediment, benthic infauna and epifauna, fish, and water quality field surveys were conducted from 2016 to 2018 to characterize the existing habitat in DH #86 and other dredged holes in the area (McKenna et al. 2018). Sediments within DH #86 were finer (silts and clays) and had a higher total organic content (TOC) (ranging from 8.34 percent to 10.77 percent) than the surrounding seabed, which was composed of very fine sand and a much lower organic content (TOC ranging from 2.8 percent to 6.92 percent). Elevated levels of arsenic, copper, and chromium, and slightly elevated levels of carbon disulfide and methylene chloride were detected in composite sediment samples taken from DH #86. Hypoxic conditions (2 mg/L) were observed during spring and summer surveys, but not during the winter survey. Water column total suspended sediment levels (ranging from 26 to 59 mg/L) greatly exceeded the desirable submerged aquatic vegetation (SAV) habitat limit of <15 mg/L as defined by Batiuk and others (2000). Although NJDEP SAV surveys conducted in 1979 noted the presence of SAV in the vicinity of DH #86 (NJDEP 2022a), no SAV was observed within or surrounding DH #86 during the 2016–2018 surveys. Large patches of drift macroalgae, which provided habitat for summer and winter flounder and invertebrates, were present in areas less than 25 feet (7.62 meters) deep in DH #86 and in the nearby control area. Crustaceans and polychaetes were the most abundant benthic invertebrates collected in the surveys. Both the diversity and abundance of benthic organisms were low within DH #86 and the surrounding seabed, particularly so at depths greater than 15 feet (4.57 meters), and numbers of fish collected within DH #86 were also low. Based on these surveys, DH #86 provides generally poor-quality benthic habitat. The addition of dredge material of DH #86 to bring the bottom depth in line with that of the surrounding seabed (6 feet [1.83 meters]) would benefit the DH #86 area. The filling of DH #86 may help increase current flow over the area, minimize accumulation of detritus and decaying macroalgae, and alleviate seasonal anoxia, all of which would improve the habitat quality of the area (McKenna et al. 2018).

3.5.2.6 Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities that affect benthic resources in the geographic analysis area include development activities for undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; onshore development activities; and global climate change. The connected action involves the repair/replacement of an existing bulkhead to stabilize the shoreline and prevent additional erosion and maintenance dredging to maintain safe navigational depths for vessels. Planned offshore wind activities in the geographic analysis area for benthic resources include the construction, O&M, and decommissioning of the Ocean Wind 1 project in Lease Area OCS-A 0498, the Ocean Wind 2 project in Lease Area OCS-A 0532, and the Atlantic Shores North project in Lease Area OCS-A 0549.

Accidental releases: The cumulative impacts of onshore and offshore accidental releases from ongoing and planned activities on benthic resources would likely range from negligible, localized, short term (for fuels/fluids/hazardous materials, trash, and debris) to moderate, possibly widespread, and long term (for invasive species). BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, large-scale releases are unlikely, and impacts from small-scale releases would be localized and short term, resulting in little change to benthic resources. The risk of accidental release and possible establishment of invasive species in the geographic analysis area would be greater due to increased vessel traffic.

Anchoring: Anchoring impacts from ongoing and planned activities would be localized, and negligible to minor due to the relatively small size of the affected areas compared to the remaining area of the open ocean within the geographic analysis area and short-term nature of the impacts. Additionally, Project-related anchoring activity would be limited, as the use of vessel dynamic positioning systems is likely, and the construction and decommissioning phases would occur over a relatively short window.

Cable emplacement and maintenance: Ongoing and planned cable emplacement and maintenance for other offshore wind activities would generate comparable types of impacts to those of the Proposed Action for each offshore export cable route and interarray cable system. Offshore export cable and interarray cables for up to three other offshore wind projects could be under construction simultaneously while the Proposed Action is in operation. The Proposed Action in combination with the other planned offshore wind development within the geographic analysis area is estimated to result in

6,757 acres (2,734.5 hectares) of seabed disturbance in the geographic analysis area (Appendix D, Table D.A2-2), of which the Proposed Action represents 8.81 percent. Simultaneous construction of export and interarray cables for the three adjacent projects would have an additive effect, although it is assumed that only a portion of a project's cable system would be undergoing installation or maintenance at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export and interarray cable installation activities for other offshore wind projects outside of the geographic analysis area. As a result, the contribution of the Proposed Action to the impacts on benthic resources from cable installation from ongoing and planned activities would be localized, temporary, and intermittent. BOEM expects that the cumulative impacts of cable emplacement and maintenance on benthic resources would be minor to moderate. Overall impacts from cable emplacement and maintenance activities at the cable landfall at the Monmouth or Atlantic ECC landfall sites related to sediment resuspension and deposition would be short term, localized, and minor due to the relatively quick recovery time associated with soft-bottom communities in the area. Removal of cable scour protection during decommissioning activities may result in localized, moderate, and permanent impacts.

Discharges/intakes: There would be increased potential for discharges from vessels during construction, operations, and decommissioning activities related to the Proposed Action, connected action, and the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects; however, it is expected that these discharges would be staggered over time and localized. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Cumulative impacts of discharges resulting from ongoing and planned activities would be short term, localized, and minor.

Electric and magnetic fields and cable heat: Export and interarray cables from the Proposed Action and planned offshore wind development would add an estimated 2,604 miles (4,191 kilometers) of buried cable to the geographic analysis area (Appendix D, Table D.A2-1), producing EMF in the immediate vicinity of each cable during operation. EMF effects on benthic habitats could be behavioral or physiological and would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). BOEM would require these future submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. Cumulative impacts of EMF from ongoing and planned activities in the geographic analysis area would likely be minor and localized, based on current research; however, more research is needed to better understand the effects of EMF on benthic organisms.

Gear utilization: Cumulative impacts of gear utilization from ongoing and planned activities would likely be negligible, given the small amount of area that would be surveyed in comparison to the larger geographic analysis area.

Noise: Planned offshore wind activities and the connected action would generate comparable types of noise impacts to those of the Proposed Action. The most significant sources of noise are expected to be pile driving followed by vessels. If multiple piles are driven simultaneously, the areas of potential injury or mortality would not overlap. Project vessels would only represent a small fraction of the large volume of existing traffic in the geographic analysis area. The areas of behavioral impacts may overlap; although the noises from driving multiple piles are unlikely to overlap at any one time, individuals may be affected by noise from sequential events before they have fully recovered from previous exposures (Hawkins and Popper 2014). Cumulative noise impacts on benthic resources from ongoing and planned activities would likely range from negligible to moderate and would be short term and localized to somewhat widespread.

Port utilization: Increases in port utilization due to the Proposed Action, connected action, and planned offshore wind development would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a period of 4 years (2026–2030) and would decrease during operations but increase again during decommissioning. Increased port utilization and expansion results in increased vessel noise and increased suspended sediment concentrations during port expansion activities. Any port expansion and construction activities related to planned offshore wind projects would add to the total amount of disturbed benthic area, resulting in disturbance and mortality of individuals and short-term to permanent habitat alteration. Existing ports are heavily modified or impaired benthic environments, and future port projects would likely implement BMPs to minimize impacts (e.g., stormwater management, turbidity curtains). The degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of the port expansion activities. Cumulative impacts of port utilization associated with ongoing and planned activities would be localized and range from short term and negligible (for water quality and vessel noise impacts) to permanent and major (for port expansion activities that heavily modify benthic environments).

Presence of structures: The Proposed Action, in combination with the planned offshore wind activity, would add up to 566 WTGs and 22 OSSs and met towers (Appendix D, Tables D.A2-1 and D.A2-2), as well as hard scour protection around the WTG foundations and export and interarray cables in the geographic analysis area. The presence of these structures could impact local hydrodynamics, increase the risk of gear entanglement and loss, convert soft-bottom habitat to hard-bottom habitat, and increase the risk of establishment of invasive species. Cumulative impacts of the presence of structures from ongoing and planned activities would be minor, localized, and long term. Fish and invertebrate aggregations from the addition of structurally complex hard-bottom habitat within the geographic analysis area, where such habitat is limited, may have a moderate beneficial impact. Although considered unlikely, the establishment of invasive species could have strongly adverse, widespread, and permanent impacts on benthic resources if the species were to become established and out-compete native fauna.

Conclusions

I**mpacts of Alternative B – Proposed Action.** Activities associated with the Planned Action would result in **negligible** to **moderate** adverse impacts, with some **moderate beneficial** impacts on benthic resources in the geographic analysis area. IPFs generating negligible impacts during the construction and installation phase include accidental spills of fuels, fluids, hazardous materials, trash, and debris; discharges/intakes; noise generated from cable burial/trenching and G&G surveys; port utilization; and gear loss related to the presence of structures. Impacts from anchoring may be minor to moderate within the geographic analysis area. Other IPFs producing minor impacts include seabed profile alterations and sediment resuspension and deposition from cable emplacement and maintenance. Minor to moderate beneficial impacts are possible from habitat conversion due to the presence of structures. IPFs producing moderate impacts include risk of introduction of invasive species from ballast/bilge water and pile-driving noise.

IPFs generating negligible impacts during the O&M phase include accidental spills of fuels, fluids, hazardous materials, trash, and debris; anchoring; cable maintenance activities; discharges/intakes; EMF and cable heat; noise generated during O&M activities; port utilization; and gear loss related to the presence of structures. IPFs generating negligible impacts during the decommissioning phase include accidental spills of fuels, fluids, hazardous materials, trash, and debris; discharges; noise generated from vessels; port utilization; and gear loss related to the presence of structures. Impacts from anchoring may be minor to moderate within the geographic analysis area. The removal of WTG foundations would result in moderate adverse impacts on benthic resources due to the loss of hard-bottom habitat associated with these structures and the noise associated with their removal. These disturbances to the sediment profile and the resuspension and deposition of sediments as a result of cable and scour protection removal activities would result in minor adverse impacts.

BOEM expects that the connected action alone would have **negligible** to **minor** impacts on benthic resources due to noise from pile installation activities and habitat disturbance related to dredging activities.

Cumulative Impacts of Alternative B – Proposed Action. Cumulative impacts of the Proposed Action in combination with the connected action and other ongoing and planned activities would vary by individual IPF and would range from **negligible** to **moderate** adverse and **moderate beneficial.** The primary IPFs are noise from pile driving, accidental releases of invasive species, cable emplacement and maintenance, and the presence of structures. Considering all the IPFs together (accidental releases, anchoring, cable emplacement and maintenance, discharges, EMF and heat, gear utilization, noise, and port utilization), BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Proposed Action would have overall **negligible** to **moderate** adverse and **moderate beneficia**l impacts on benthic resources.

3.5.2.7 Impacts of Alternatives C, D, and E

Impacts of Alternatives C, D, and E. Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) involves the removal, or micrositing of up to 29 WTGs, 1 OSS, and associated interarray cables within the NMFS AOCs to avoid and minimize impacts on important habitats. Under Alternative C1, up to 16 WTGs, 1 OSS, and associated interarray cables within the Lobster Hole designated area (AOC 1) as identified by NMFS would be removed. Under Alternative C2, up to 13 WTGs and associated interarray cables within the NMFS-identified sand ridge complex in the southernmost portion of the Lease Area (AOC 2) would be removed. Under Alternative C3, up to six WTGs located within 1,000 feet (305 meters) of the sand ridge complex area identified by NMFS and further demarcated using NOAA's Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores would be removed.

Alternative C4 would involve the micrositing of up to 29 WTGs, 1 OSS, and associated interarray cables outside of the 1,000-foot (305-meter) buffer of the ridge and swale features within both AOC 1 and AOC 2. The “Lobster Hole” designated recreational fishing area (AOC 1) is a broad swale/depression that extends roughly from the middle of the eastern edge of the WTA towards its center. AOC 2 and the demarcated sand ridge complex are parts of a larger sand ridge and trough complex that crosses the WTA. The installation of WTGs and their associated scour protection and interarray cables within AOC 1, AOC 2, and/or the demarcated sand ridge complex would result in impacts on these important habitats through sediment resuspension and deposition and sediment profile alterations. Additionally, the presence of wind farm structures could alter hydrodynamics and predator-prey interactions in these habitats. The NMFS AOCs and the demarcated sand ridge complex all have pronounced bottom features and produce habitat value. Swale, trough, and ridge habitats provide complex physical structures, which are often associated with greater species diversity, abundance, overall function, and productivity. In the mid-Atlantic, sand ridges and troughs are areas of biological significance for migration and spawning of mid-Atlantic fish species, many of which are recreationally targeted in those specific areas. Alternative C1 would avoid or minimize impacts on AOC 1, and Alternative C2 would avoid or minimize impacts on AOC 2. A combination of Alternatives C1 and C2 would allow for the removal of up to 29 WTGs, 1 OSS, and associated interarray cables from both the AOC 1 and AOC 2 areas, thus avoiding or minimizing impacts on both NMFS AOCs and the valuable habitat contained within. Alternative C3 would avoid or minimize impacts on the valuable habitat located within the demarcated sand ridge complex. Alternative C4 would microsite 29 WTGs, 1 OSS, and associated interarray cables outside of the 1,000-foot (305-meter) buffer of the ridge and swale features within AOC 1 and AOC 2, serving to minimize impacts on the important habitat features located within these areas. Through one or more of the sub-alternatives of Alternative Cand the associated removal or micrositing of up to 29 WTGs, impacts on the valuable habitats present in AOC 1, AOC 2, and/or the demarcated sand ridge complex could be avoided or minimized, which would have beneficial impacts on benthic communities as well as fish species who utilize these areas.

Under Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), the layout and maximum number of WTGs would be adjusted to reduce visual impacts, which could result in the removal of up to 31 WTGs. The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters). Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) involves the removal or micrositing of up to 5 WTGs to establish a setback between the Atlantic Shores South and Ocean Wind 1 WTGs. All of these alternatives would be within the range of the design parameters outlined in the Atlantic Shores COP, and subject to applicable mitigation measures.

Construction and installation, O&M, and decommissioning of Alternatives C, D, and E would only differ from the Proposed Action for offshore activities and facilities. Onshore activities and facilities would be the same as those described under the Proposed Action (Section 3.5.2.5). Offshore construction and installation, O&M, and decommissioning activities under Alternatives C, D, and E would have potential impacts on benthic resources from IPFs similar to those of the Proposed Action. Alternatives C, D, and E would potentially benefit benthic resources through reduced effects on benthic habitats. The removal or micrositing of up to 29 WTGs and 1 OSS under Alternative C, removal of up to 31 WTGs under Alternative D, or removal or micrositing of up to 5 WTGs under Alternative E would result in a proportional decrease in the amount of EMF and noise impacts and benthic habitat disturbance and conversion related to the installation of foundations, interarray cables, and scour protection. Although impacts on benthic resources would be reduced under Alternatives C, D, and E, overall impacts on benthic resources would be similar to those under the Proposed Action.

Cumulative Impacts of Alternatives C, D, and E. The cumulative impacts of Alternatives C, D, and E would be similar to those for the Proposed Action. This determination is driven mostly by the effects of climate change, new cable emplacement and pile-driving activities, the presence of new offshore wind structures, and seafloor disturbances caused by dredging and bottom-tending fishing gear.

Conclusions

Impacts of Alternatives C, D, and E. The impacts on benthic resources resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives C, D, and E would be the same as or substantially similar to those described under the Proposed Action. None of the differences between these alternatives and the Proposed Action would have the potential to significantly reduce or increase overall impacts on benthic resources from the analyzed IPFs; however, Alternative C would reduce the impacts on the valuable habitat in AOC 1, AOC 2, and/or the demarcated sand ridge complex. All conclusions reached for the Proposed Action also apply to Alternatives C, D, and E, with impacts on benthic resources ranging from **negligible** to **moderate**, with some **moderate beneficial** impacts, depending on IPF, Project stage, and location (onshore, offshore).

Cumulative Impacts of Alternatives C, D, and E. The cumulative impacts of Alternatives C, D, and E would be **negligible** to **moderate** and **moderate beneficial.**

3.5.2.8 Impacts of Alternative F on Benthic Resources

Impacts of Alternative F. Alternative F (Foundation Structures) analyzes the use of piled (Alternative F1), suction bucket (Alternative F2), and gravity-based (Alternative F3) foundations for WTGs, OSSs, and the met tower. Different foundation types could be used for different components (e.g., WTGs and OSSs) of the Project. The foundation type selected for the WTGs may be different from the foundation type selected for OSSs or the permanent met tower. A combination of foundation types could also be used for WTGs within the Project.

Construction and installation, O&M, and decommissioning of Alternative F would only differ from the Proposed Action in offshore activities. Onshore activities and facilities and offshore facilities would be the same as those described under the Proposed Action (Section 3.5.2.5).

Though all potential offshore activities under Alternative F were evaluated under the Proposed Action, subalternatives of Alternative F may exclude some activities evaluated under the Proposed Action.

Activities would not differ between the Proposed Action and Alternative F1. Under Alternatives F2 and F3, no impact pile driving would be conducted; therefore, there would be no underwater noise impacts on benthic resources due to impact pile driving. The avoidance of impact pile-driving noise impacts would reduce overall construction and installation impacts on benthic resources under Alternatives F2 and F3 compared to the Proposed Action.

Though offshore construction activities would not differ between Alternative F and the Proposed Action, offshore impacts under some sub-alternatives may be reduced due to reductions in habitat conversion associated with some foundation types. Suction bucket foundations (Alternative F2) would result in the greatest area of habitat conversion due to scour protection, and the impacts were evaluated under the Proposed Action. Alternatives F1 and F3 would result in a reduction in scour protection compared to the Proposed Action and Alternative F2. Less scour protection would result in loss of less soft-bottom habitat. It would also result in a lower artificial reef effect compared to the Proposed Action and Alternative F2 but may also reduce risk of lost recreational fishing gear. Given that Alternatives F1 and F3 would result in reductions in both adverse and beneficial impacts, impacts on benthic resources under these alternatives are not expected to be measurably different from those anticipated under the Proposed Action.

Cumulative Impacts of Alternative F. The cumulative impacts of Alternative F would be similar to those proposed for the Proposed Action. This determination is driven mostly by the effects of new cable emplacement and pile-driving activities, the presence of new offshore wind structures, and seafloor disturbances caused by dredging and bottom-tending fishing gear.

Conclusions

Impacts of Alternative F. Impacts of Alternative F1 would not be measurably different from the impacts of the Proposed Action. Therefore, construction and installation, O&M, and decommissioning of Alternative F1 would result in **negligible** to **moderate** adverse impacts on benthic resources due to sediment resuspension and deposition related to cable-laying activities, anchoring, and accidental releases of fuels, fluids, hazardous materials, trash, and debris and could include **moderate beneficial** impacts due to habitat conversion by the presence of hard structures.

Impacts of Alternatives F2 and F3 would be measurably different from the impacts of the Proposed Action due to the avoidance of impact pile-driving noise impacts. Construction and installation, O&M, and decommissioning of Alternatives F2 and F3 would result in **negligible** to **minor** adverse impacts on benthic resources. Due to the reduction in scour protection and the beneficial hard-bottom habitat it provides, Alternative F could include only **minor beneficial** impacts.

Cumulative Impacts of Alternative F. The cumulative impacts of Alternative F would range from **negligible** to **moderate** adverse impacts and would also include **minor** to **moderate beneficial** impacts.

3.5.2.9 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed here in more detail (Table 3.5.2-4). This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.5.2-4 Proposed mitigation measures – benthic resources

Measure	Description	Effect
Marine debris awareness training	Vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP must complete marine trash and debris awareness training annually. Atlantic Shores must submit an annual report describing its marine trash and debris awareness training process and certifies that the training process was followed for the previous calendar year.	Marine debris and trash awareness training would minimize the risk of marine debris settling on the seafloor. While adoption of this measure would decrease risk to benthic resources under the Proposed Action, it would not alter the impact determination of negligible for accidental spills and releases.
Artificial reef buffer for turbines	Atlantic Shores must remove a single turbine approximately 150–200 feet (45.8–61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site).	This measure would reduce impacts on benthic resources by removing the footprint of one foundation. While adoption of this measure would reduce risk to benthic resources under the Proposed Action, it would not alter the impact determination of minor associated with the presence of structures.
Cable maintenance	In conjunction with cable monitoring, Atlantic Shores will develop and implement a Cable Maintenance Plan that requires prompt remedial burial of exposed and shallow-buried cable segments, review to address repeat exposures, and a process for identifying when cable burial depths reach unacceptable risk levels.	This measure would reduce the risk of EMF exposure to organisms by ensuring proper burial depth. While adoption of this measure would reduce risk to benthic resources and invertebrates under the Proposed Action, it would not alter the impact determination of minor associated with EMF.

3.5.2.10 Comparison of Alternatives

Construction and installation, O&M, and decommissioning of Alternatives C, D, E, and F1 would have the same **negligible** to **moderate** adverse impacts and **moderate beneficial** impacts on benthic resources as described under the Proposed Action. Alternative C would result in slightly less impacts on benthic resources due to the avoidance and minimization of impacts on sensitive habitats and the potential removal, relocation, or micrositing of up to 29 WTGs, 1 OSS, and associated interarray cables. Alternatives D and E would result in slightly less effects on benthic resources due to the potential removal or relocation of up to 31 WTGs and associated interarray cables or up to 5 WTGs and associated interarray cables, respectively.

Construction, O&M, and decommissioning of Alternatives F2 and F3 would have **negligible** to **minor** adverse impacts and **minor beneficial** impacts on benthic resources. This reduction in impacts would be due to avoidance of impact pile-driving noise effects on benthic resources.

3.5.3 Birds

This section discusses potential impacts on bird resources from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for birds. The geographic analysis area, as shown on Figure 3.5.3-1, includes a corridor extending from 0.5 mile (0.8 kilometer) inland to 100 miles (161 kilometers) off the U.S. Atlantic coastline, from Maine to Florida. When possible, more site-specific information about birds in the Mid-Atlantic Bight portion of this area and the proposed location of the Project is provided. The geographic analysis area for birds was established to capture resident species and migratory species that winter as far south as South America and the Caribbean, and those that breed in the Arctic or along the Atlantic Coast that travel through the area. The offshore limit was established to cover the migratory movement of most species in this group. The onshore limit was established to cover onshore habitats used by the species that may be affected by onshore and offshore components of the proposed Project.

3.5.3.1 Description of the Affected Environment and Future Baseline Conditions

This section discusses bird species that use onshore and offshore habitats, including both resident bird species that use the Project area during all (or portions of) the year and migrating bird species with the potential to pass through during fall or spring migration. Detailed information regarding habitats and bird species potentially present can be found in the COP (Volume II, Section 4.3.1; Atlantic Shores 2023). Given the differences in life history characteristics and habitat use between marine and terrestrial bird species, the following sections provide separate discussions of each group. This section also addresses federally threatened and endangered bird species, and bald and golden eagles, which are further evaluated in the BA currently being prepared for USFWS. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing, and results of the consultation will be presented in the Final EIS.

The Project is located in the Mid-Atlantic Bight, which describes the area between Cape Hatteras, North Carolina, and Martha's Vineyard, Massachusetts, extending westward into the Atlantic to the approximate 325-foot (100-meter) isobath (NOAA 2022). The mainland to the west of the Project location is overlapped by the Atlantic Flyway, a major migration route for many species of land birds and waterbirds. Chapter 4.2.4 of the Atlantic OCS Proposed Geological and Geophysical Activities Programmatic EIS (BOEM 2014a) discusses the use of Atlantic Coast habitats by migratory birds. Many species and higher taxonomic groups of birds may occur within the Project area because of its position along the Atlantic Flyway and the region in which the geographic ranges of many northern and southern species overlap. The mid-Atlantic supports populations of coastal and marine birds in summer, some of which breed in the area (e.g., gulls and terns) while others (e.g., shearwaters and storm-petrels) come from breeding grounds in the southern hemisphere. During autumn, there is turnover in the bird community as many breeding species migrate south for winter while birds that breed farther north migrate to the mid-Atlantic to overwinter.

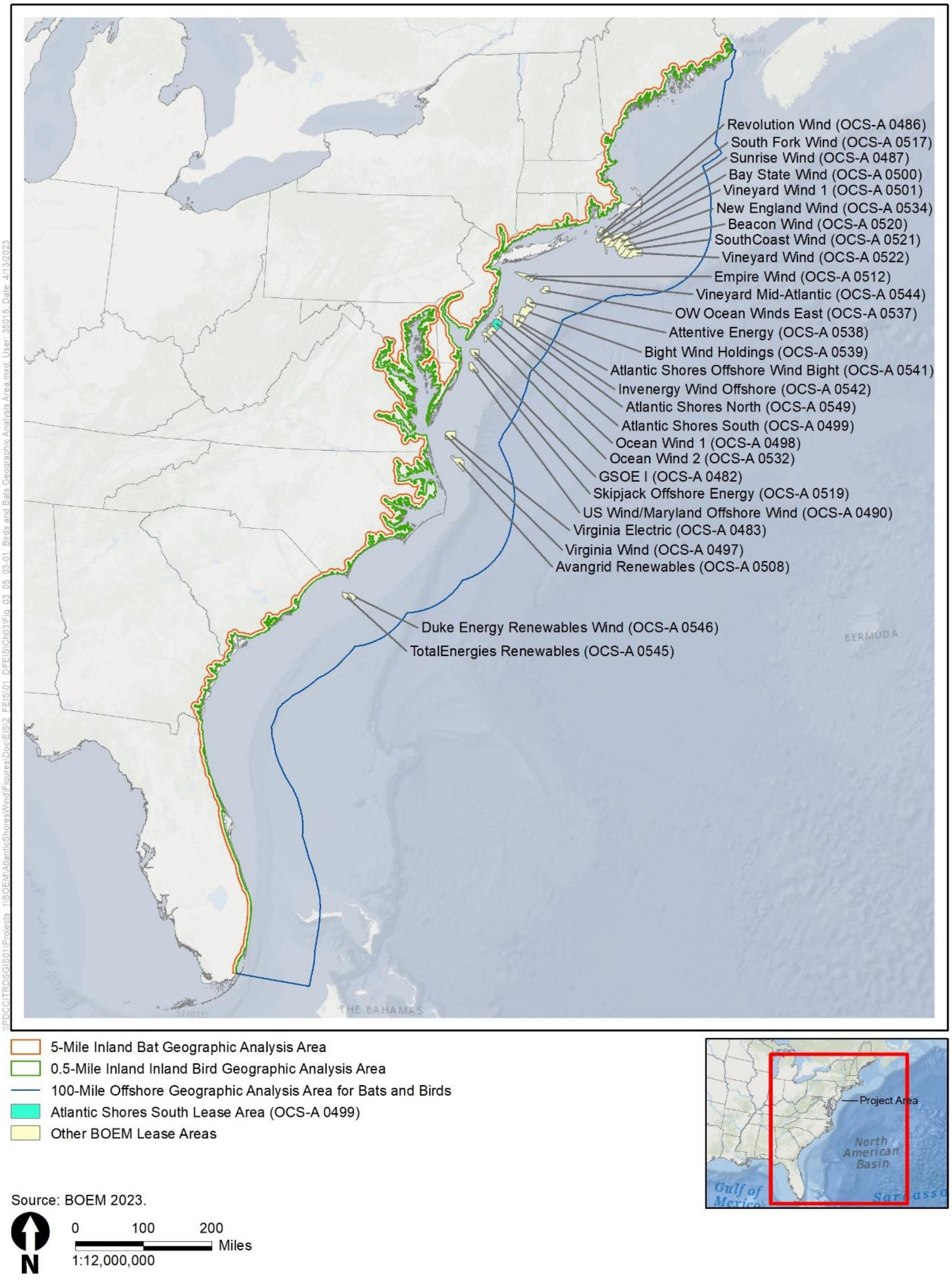


Figure 3.5.3-1. Bird geographic analysis area

The affected environment and baseline conditions for birds are described in detail on the basis of several sources of information:

- NJDEP Ocean/Wind Power Ecological Baseline Studies (Geo-Marine, Inc. 2010)
- Atlantic Shores digital aerial surveys (COP Volume II, Appendix II-F2; Atlantic Shores 2023)
- Marine-life Data and Analysis Team (MDAT) models (Curtice et al. 2018)
- NOAA Northwest Atlantic Seabird Catalog
- Tracking studies of ESA-listed species by Loring et al. (2018, 2019, 2021)
- Atlantic Shores red knot satellite telemetry study (COP Volume II, Appendix II-F3; Atlantic Shores 2023)

Birds that may pass through the Offshore Project area include land birds (e.g., songbirds and raptors), coastal waterbirds (e.g., shorebirds, long-legged waders), and marine birds (e.g., loons and sea ducks) (Table 3.5.3-1). The vast majority of birds that occur in the offshore environment are marine birds, such as sea ducks, loons, gulls, scoters, terns, auks, gannets, shearwaters, and petrels. Digital aerial surveys in the WTA found the distribution of marine birds to vary among species and seasons (COP Volume II, Appendix II-F2; Atlantic Shores 2023). These and other birds with potential to occur in the WTA, on the basis of the information sources above, are listed in Table 3.5.3-2.

Table 3.5.3-1. Taxonomic groups of birds with potential presence in the Offshore Project area

Taxonomic Group	Potential Presence in the Offshore Project Area
Non-Marine Migratory Birds	
Shorebirds	Shorebirds are coastal breeders and foragers, and generally avoid flights far offshore over deep waters during the breeding season. Among shorebirds, only red phalarope (*Phalaropus fulicarius*) and red-necked phalarope (*P. lobatus*) are generally considered marine species. Overall, exposure of shorebirds to the offshore infrastructure would be limited to migration and, with the exception of phalaropes, the offshore marine environment does not provide habitat for shorebirds.
Wading birds	Most wading birds, such as egrets and herons, breed and migrate in coastal and inland areas. Like shorebirds, wading birds are coastal breeders and foragers, and generally avoid straying out over deep waters, but may traverse the WTA during spring and fall migration periods. Site-specific NJDEP surveys found few wading birds within the WTA (see COP Volume II, Appendix II-F2; Atlantic Shores 2023). Satellite tracking of great blue herons (*Ardea herodias*) suggests some individuals may pass through the WTA and have the potential to fly within the RSZ (COP Volume II, Appendix II-F2; Atlantic Shores 2023).
Raptors	The degree to which raptors might occur offshore is dictated primarily by their morphology and flight strategy (i.e., flapping versus soaring), which influences a species' ability or willingness to cross large expanses of open water where thermal formation is poor. Among raptors, falcons are the most likely to be encountered in offshore settings. Merlins (*Falco columbarius*) are the most abundant raptor observed at offshore islands during migration. Migrating merlins have been observed offshore on vessels and offshore oil platforms considerable distances from shore. Bald eagles *(Haliaeetus leucocephalus)* and ospreys *(Pandion haliaetus),* two piscivorous raptors commonly found over open

Taxonomic Group	Potential Presence in the Offshore Project Area
	water, typically remain close to shore. The merlin is therefore the raptor species that is the most likely to pass through the WTA, and only during migration.
Songbirds	Songbirds almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine environment except when aloft, during migration. Songbirds regularly cross large bodies of water and there is some evidence that some species migrate over the northern Atlantic. Some songbirds may briefly fly over the water while others, like the blackpoll warbler *(Setophaga striata*), can migrate over vast expanses of ocean. Evidence for a variety of songbird species suggests that overwater migration in the Atlantic is much more common in fall than in spring, possibly because of the assistance and energy savings provided by tailwinds that consistently come from the northwest during fall. Cruising altitudes of migrating songbirds are typically well above the RSZ of offshore WTGs. Overall, exposure of songbirds to the WTA would be limited to migration and would be minimal.
Coastal Waterbirds	Coastal waterbirds (including waterfowl) use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. The species in this group are generally restricted to freshwater, and saltmarshes, beaches, and other strictly coastal habitats. They are therefore unlikely to pass through the WTA.
Marine Birds	
Loons	Common loons (*Gavia imme*r) and red-throated loons *(G. stellata)* are known to use the Atlantic OCS in winter. Analysis of satellite-tracked red-throated loons, captured and tagged in the mid-Atlantic area, found their winter distributions to be largely inshore of the mid-Atlantic WEAs, although they did overlap with the WTA during spring migration. Loons were also observed within the Project area during site-specific surveys (COP Volume II, Appendix II-F2; Atlantic Shores 2023).
Sea ducks	Sea ducks use the Atlantic OCS heavily in winter. Most sea ducks forage on mussels and other benthic invertebrates, and generally winter in shallower inshore waters or out over large offshore shoals, where they can access benthic prey. During tracking studies along the Mid-Atlantic Bight, sea ducks have been found to remain largely in inshore areas, with the exception of surf scoter (*Melanitta perspicillata*) and black scoter (*M. americana*) during spring migration. Site-specific surveys found sea ducks in the Offshore Project area, although modeled exposure level was determined to be minimal to low (COP Volume II, Appendix II-F2; Atlantic Shores 2023).
Petrel group	This group consists mostly of shearwaters and storm-petrels that breed in the southern hemisphere and visit the northern hemisphere during the austral winter (boreal summer) and may pass through the WTA. These species use the Atlantic OCS region heavily, but mostly concentrate offshore and in the Gulf of Maine.
Gannets, cormorants, and pelicans	Northern gannets (*M. bassanus*) use the Atlantic OCS during winter and migration. They are opportunistic foragers, capable of long-distance oceanic movements, and may pass through the WTA regularly during the non-breeding period. The double-crested cormorant (*Phalacrocorax auritus*) is the most likely species of cormorant exposed to the WTA, but regional MDAT abundance models show that cormorants are concentrated closer to shore and not commonly encountered well offshore. Brown pelicans (*Pelecanus occidentalis*) are rare in the area, and unlikely to pass through the WTA in any numbers.
Gulls, skuas, and jaegers	Regional MDAT abundance models show these birds have wide distributions, ranging from near shore (gulls) to offshore (jaegers). Herring gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*) are resident in the region year-round and are found farther offshore outside of the breeding season. The parasitic jaeger (*Stercorarius parasiticus*) is often observed closer to shore during migration than the other species, and great skuas (*Stercorarius skua*) may pass along the Atlantic OCS outside the breeding season.

Taxonomic Group	Potential Presence in the Offshore Project Area
Terns	Black tern (*Chlidonias niger*), least tern (*Sternula antillarum*), common tern (*Sterna hirundo*), Forster's tern (*S. Forsteri*), roseate tern *(S. dougallii)*, and royal tern (*Thalasseus maximus*) have been observed in the Offshore Project area (COP Volume II, Appendix II-F2; Atlantic Shores 2023). Terns generally restrict themselves to coastal waters during breeding and foraging, although they may pass through the WTA during migration. Roseate terns are federally listed.
Auks	Auks present in the Project area are generally northern or Arctic breeders that winter along the Atlantic OCS. The annual abundance and distribution of auks along the eastern seaboard in winter is erratic, and dependent upon broad climatic conditions and the availability of prey. MDAT abundance models show that during winter auks are generally concentrated offshore, along the shelf edge, and southwest of Nova Scotia.

Sources: Geo-Marine Inc. (2010), Curtice et al. (2018), Loring et al. (2018, 2019, 2021), APEM Atlantic Shores digital surveys, NOAA Northwest Atlantic Seabird Catalog, COP Volume II, Appendix II-F2 (Atlantic Shores 2023).

Table 3.5.3-2. Bird species detected within the WTA and federally listed species that may occur in the Project area

		Source				Conservation Status	
Common Name	Scientific Name	DEP[1]	MDAT[2]	APEM[3]	IPaC[4]	Federal	State
Ducks, geese, and swans							
Snow goose	*Anser caerulescens*	•					
American black duck	*Anas rubripes*	•					
Sea ducks							
Surf scoter	*Melanitta perspicillata*	•	•		•		
White-winged scoter	*Melanitta fusca*	•	•	•	•		
Black scoter	*Melanitta americana*	•	•		•		
Red-breasted merganser	*Mergus serrator*	•	•		•		
Loons							
Red-throated loon	*Gavia stellata*	•	•	•	•		
Common loon	*Gavia immer*	•	•	•	•		
Herons and egrets							
Great blue heron	*Ardea herodias*	•					SC
Black-crowned night-heron	*Nycticorax*	•					T
Petrels and shearwaters							
Black-capped petrel	*Pterodroma hasitata*					Cand.	
Cory's shearwater	*Calonectris diomedea*	•	•			BCC	
Sooty shearwater	*Ardenna grisea*	•	•				
Great shearwater	*Ardenna gravis*	•	•		•		
Audubon's shearwater	*Puffinus lherminieri*	•	•			BCC	
Wilson's storm-petrel	*Oceanites oceanicus*	•	•		•		
Gannets							
Northern gannet	*Morus bassanus*	•	•	•			
Cormorants and pelicans							
Double-crested cormorant	*Phalacrocorax auritus*	•	•		•		
Brown pelican	*Pelecanus occidentalis*	•	•		•		

Common Name	Scientific Name	Source				Conservation Status	
		DEP[1]	MDAT[2]	APEM[3]	IPaC[4]	Federal	State
Jaegers and gulls							
Parasitic jaeger	*Stercorarius parasiticus*	•	•				
Black-legged kittiwake	*Rissa tridactyla*	•	•	•			
Bonaparte's gull	*Chroicocephalus philadelphia*	•	•	•			
Laughing gull	*Leucophaeus atricilla*	•	•	•			
Ring-billed gull	*Larus delawarensis*	•	•		•		
Herring gull	*Larus argentatus*	•	•	•			
Great black-backed gull	*Larus marinus*	•	•	•			
Terns							
Black Tern	*Chlidonias niger*	•					
Common Tern	*Sterna hirundo*	•	•				SC
Forster's Tern	*Sterna forsteri*	•					
Roseate Tern	*Sterna dougallii*	•			•	E	E
Royal Tern	*Thalasseus maximus*	•	•		•		
Auks							
Dovekie	*Alle*	•	•		•		
Common Murre	*Uria aalge*	•	•		•		
Razorbill	*Alca torda*	•	•		•		
Atlantic Puffin	*Fratercula arctica*	•	•		•		
Shorebirds							
Black-bellied Plover	*Pluvialis squatarola*	•					
Piping Plover	*Charadrius melodus*					T	E
Red Knot	*Calidris canutus rufa*					T	E
Sanderling	*Calidris alba*	•					SC
Least Sandpiper	*Calidris minutilla*	•					
Red-necked Phalarope	*Phalaropus lobatus*	•	•				
Red Phalarope	*Phalaropus fulicarius*	•	•				
Passerines							
Purple Martin	*Progne subis*	•					
Tree Swallow	*Tachycineta bicolor*	•					
Barn Swallow	*Hirundo rustica*	•					
House Finch	*Haemorhous mexicanus*	•					
Pine Siskin	*Spinus pinus*	•					
American Goldfinch	*Spinus tristis*	•					
Song Sparrow	*Melospiza melodia*	•					
Red-winged Blackbird	*Agelaius phoeniceus*	•					
Brown-headed Cowbird	*Molothrus ater*	•					
Northern Waterthrush	*Parkesia noveboracensis*	•					

Common Name	Scientific Name	Source				Conservation Status	
		DEP[1]	MDAT[2]	APEM[3]	IPaC[4]	Federal	State
Northern Parula	*Setophaga americana*	•					SC
Yellow-rumped Warbler	*Setophaga coronate*	•					
Black-throated Green Warbler	*Setophaga virens*	•					

[1] New Jersey Department of Environmental Protection (Geo-Marine, Inc. 2010).
[2] Marine-life Data and Analysis Team (Curtice et al. 2018).
[3]APEM Ltd. Atlantic Shores digital surveys, NOAA Northwest Atlantic Seabird Catalog, COP Volume II, Appendix II-F2 (Atlantic Shores 2023).
[4] U.S. Fish and Wildlife Service, Information for Planning and Consultation system.
BCC = Birds of Conservation Concern (migratory birds that USFWS considers of highest conservation priority and likely to become candidates for listing under the ESA without additional conservation action): Cand. = Candidate; SC = Special Concern; T = Threatened.

Three ESA-listed birds have potential to pass through the Offshore Project area—the roseate tern (Endangered), piping plover (Threatened), and red knot (Threatened)—during spring and fall migration only. The New Jersey Baseline Studies rarely observed these species near the WTA, as they mainly occur in the coastal portions of New Jersey during spring and summer (Geo-Marine 2010). They were not detected during the Atlantic Shores digital aerial surveys. Automated radiotelemetry tracking studies of these species have also found extremely minimal, infrequent passage through the Lease Area, including the New Jersey WEA (Loring et al. 2018, 2019, 2021; COP Volume II, Appendix II-F2 and F3; Atlantic Shores 2023). Of the 11 tagged red knots that successfully yielded data during a 2020 study (COP Volume II, Appendix II-F3; Atlantic Shores 2023), only one was recorded flying through the WTA at an altitude of 1,886 feet (575 meters). The altitudes of the red knots varied during their offshore flights and ranged from approximately 66 feet (20 meters) to over 9,843 feet (3,000 meters). (COP Volume II; Appendix II-F3; Atlantic Shores 2023). Tagging in 2021 yielded data on 29 additional red knots (Feigin et al. 2022). None of these red knots were recorded within the WTA, but interpolated flight paths and uncertainty estimates suggest that eight red knots may have flown through the WTA (Feigin et al. 2022). Overall, 18 of the 40 total tagged birds that provided data over the two years of the study may have crossed the WTA based on direct detections, straight-line connections of points, and modeling, collectively (Feigin et al. 2022).

Eagles are federally protected under the Bald and Golden Eagle Protection Act (BGEPA). Bald eagles (*Haliaeetus leucocephalus*) generally remain near shore in marine environments. Williams et al. (2015) observed bald eagles only within 3.7 miles (6 kilometers) of shore in digital aerial surveys of the mid-Atlantic offshore region, and no eagles were observed offshore during the NJDEP vessel-based surveys (COP Volume II, Appendix II-F2; Atlantic Shores 2023). Golden eagles (*Aquila chrysaetos*) are also not expected to fly offshore. Both eagle species primarily rely on thermal updrafts for flight, which are largely absent or weak over water, thus discouraging long-distance flights of these and most other raptors over large bodies of water (Kerlinger 1985). Because eagles are not expected in the WTA, they are not further evaluated herein.

The Atlantic Shores South Project would have one onshore substation and associated interconnection cables routed through the onshore environment. The interconnection cables would be installed underground, mostly along existing roads, paths, and utility ROWs. This would greatly reduce the amount of bird habitat that would be altered or lost, and limit land disturbance mostly to areas that are already disturbed or developed. The substation and/or converter station sites would be adjacent to fragmented habitat that is of relatively low value to native birds, such that minor vegetation removal for their construction would not impact high-quality or large areas of habitat.

Under future baseline conditions, birds in the geographic analysis area will continue to face population pressures from ongoing anthropogenic activities, such as onshore construction, marine minerals extraction, port expansions, installation of new structures in the OCS, and interactions with fisheries and fishing gear. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction and will remain so under future baseline conditions unless significant conservation actions are taken (NABCI 2016). This is likely representative of the conditions for birds within the geographic analysis area. The northeastern United States is also home to more than one-third of the human population of the nation. As a result, species that live or migrate along the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including habitat loss and degradation, hunting (approximately 86,000 sea ducks harvested annually [Roberts 2019]), commercial fisheries by-catch (approximately 2,600 seabirds are killed annually on the Atlantic [Hatch 2017; Sigourney et al. 2019]), and climate change. Increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, and increased erosion and sediment deposition as a result of climate change have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing.

More than half of offshore North American bird species (57 percent, 31 species) have been placed on the North American Bird Conservation Initiative watch-list as a result of small ranges, small and declining populations, and threats to required habitats. This watch-list identified species of high conservation concern based upon high vulnerability to a variety of factors, including population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, and population trend (NABCI 2016). Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015), including those that forage, breed, and migrate over the Atlantic OCS. These conditions and trends for offshore bird species are expected to continue under future baseline conditions.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch-list. Many of these coastal species have small population size or restricted distributions, making them especially vulnerable to habitat loss or degradation and other stressors (NABCI 2016). Models of vulnerability to climate change estimate that, throughout New Jersey, 29 percent of New Jersey's 248 bird species are vulnerable to climate change across all seasons (Audubon 2019), some of which occur in the geographic analysis area. A rapidly changing climate could lead to population declines if species are not able to adapt. In addition, the reshuffling of bird communities at a continental scale will bring together species that previously lived in isolation, leading to unpredictable interactions. Disruptions in food and nesting resources would further compound vulnerabilities to climate change. These ongoing impacts on coastal birds would continue under future baseline conditions regardless of the offshore wind industry.

3.5.3.2 Impact Level Definitions for Birds

As described in Section 3.3, *Definitions of Impact Levels,* this Draft EIS uses a four-level classification scheme to characterize potential impacts of alternatives, including the Proposed Action. The definitions of potential impact levels for birds are provided in Table 3.5.3-3.

Table 3.5.3-3. Impact level definitions for birds

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

3.5.3.3 Impacts of Alternative A – No Action on Birds

When analyzing the impacts of the No Action Alternative on birds, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for birds. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*. This analysis is limited to impacts within the geographic analysis area for birds, as shown on Figure 3.5.3-1, which includes a corridor extending from 0.5 mile (0.8 kilometer) inland to 100 miles (161 kilometers) off the U.S. Atlantic coastline, from Maine to Florida.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for birds as described in Section 3.5.3.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on birds are generally associated with onshore impacts (including onshore construction and coastal lighting), activities in the offshore environment (e.g., vessel traffic, commercial fisheries), and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bird species through temporary and permanent habitat removal or conversion, temporary noise impacts related to construction, collisions (e.g., presence of structures), and lighting effects, which could cause avoidance behavior and displacement as well as injury to or mortality of individual birds. However, population-level effects would not be anticipated. Activities in the offshore environment could result in bird avoidance behavior and displacement, but population-level effects would not be anticipated. Impacts of climate change, such as increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, and increased erosion and sediment deposition, have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing. See Appendix D, Table D.A1-4 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for birds.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on birds include:

- Continued O&M of the BIWF (five WTGs) installed in Massachusetts state waters;
- Continued O&M of the CVOW pilot project (two WTGs) installed in OCS-A 0497 approximately 27 miles (44 kilometers) off the coast of Virginia Beach, Virginia; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 approximately 14 miles (23 kilometers) offshore of Nantucket, Massachusetts, and approximately 14 miles (23 kilometers) offshore Martha’s Vineyard, Massachusetts, and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517 approximately 19 miles (31 kilometers) southeast of Block Island, Rhode Island, and 35 miles (56 kilometers) east of Montauk Point, New York.

Ongoing O&M of the BIWF and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect birds through the primary IPFs of accidental releases, cable emplacement and maintenance, land disturbance, lighting, noise, presence of structures, and traffic (aircraft). Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and land disturbance described in detail in the *Cumulative Impacts of Alternative A – No Action* section for planned offshore wind activities, but the impacts would be of lower intensity.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect birds include installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Section D.2 in Appendix D for a description of planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in temporary and permanent impacts on birds including disturbance, displacement, injury, mortality, habitat degradation, and habitat conversion.

The sections below summarize the potential impacts of planned offshore wind activities on birds during construction, O&M, and decommissioning of the projects. In addition to the four ongoing offshore wind projects, 31 additional offshore wind projects are planned to be constructed in the geographic analysis area for birds. These 31 planned projects, along with the four ongoing projects, would result in an additional 2,974 WTGs and 41 OSSs/ESPs in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). The impacts of ongoing and planned offshore wind projects are discussed in this section. BOEM expects planned offshore wind development activities to affect birds through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids, other contaminants, and trash and debris could occur as a result of planned offshore wind activities. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Ingestion of fuel and other hazardous contaminants has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in oiling of feathers can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities, including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). However, based on the volumes potentially involved (refer to Table D.A2-3 in Appendix D), the likely amount of releases associated with planned offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities and would represent a negligible impact on birds.

Vessel compliance with USCG regulations would minimize discharge of trash or other debris; therefore, BOEM expects accidental trash releases from offshore wind vessels to be rare and localized in nature. In the unlikely event of a release, lethal and sublethal impacts on individuals could occur as a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019). Given that accidental releases are anticipated to be rare and localized, BOEM expects that accidental releases of trash and debris would not appreciably contribute to overall impacts on birds.

Cable emplacement and maintenance: Generally, emplacement of submarine cables would result in increased suspended sediments that may affect diving birds, result in displacement of foraging individuals or decreased foraging success, and have impacts on some prey species (e.g., benthic assemblages) (Cook and Burton 2010). The total area of seafloor disturbed by offshore export and interarray cables for ongoing and planned offshore wind facilities is estimated to be 35,612 acres (14,412 hectares) (Appendix D, Table D.A2-2). Impacts associated with cable emplacement would be short term and localized, and birds would be able to successfully forage in adjacent areas not affected by increased suspended sediments. Any dredging necessary prior to cable installation could contribute to additional impacts. Disturbed seafloor from construction of planned offshore wind projects may affect some bird prey species; however, assuming planned projects use installation procedures similar to those proposed in the Atlantic Shores South COP, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance. Section 3.5.2, *Benthic Resources*, and Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, provide more information. Impacts would be negligible because increased suspended sediments would be temporary and generally localized to the emplacement corridor, and no individual fitness or population-level effects on birds would be expected.

Land disturbance: The construction of onshore components of offshore wind farms has the potential to result in impacts on birds due to habitat loss or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing onshore development activities. In general, onshore construction would be expected to occur in previously disturbed habitats, and no individual fitness or population-level impacts on birds would be expected to occur; therefore, onshore construction impacts associated with planned offshore wind development would be negligible and would not be expected to appreciably contribute to overall impacts on birds.

Lighting: Offshore wind development would result in additional nighttime light from vessels and offshore wind structures, which could attract birds to the area. Under the No Action Alternative, up to 2,974 WTGs and 41 OSSs would have hazard and aviation lighting that would be incrementally added beginning in 2023 and continuing through 2030 (Appendix D, Tables D.A2-1 and D.A2-2). Vessel lighting would result in short-term and localized, impacts on birds; structure lighting may pose an increased collision or predation risk (Hüppop et al. 2006), although this risk would be localized in extent and minimized through the use of red flashing FAA lighting and other BOEM lighting guidelines (BOEM 2019; Kerlinger et al. 2010). BOEM anticipates lighting impacts related to offshore wind structures and vessels would be negligible.

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

Noise from low-flying aircraft may cause birds to flush, resulting in increased energy expenditure. Disturbance to birds, if any, would be short term and localized, with impacts dissipating once the aircraft has left the area. No individual- or population-level effects would be expected.

Construction of up to 2,974 offshore WTGs and up to 41 OSSs (Appendix D, Tables D.A2-1 and D.A2-2) would create noise and may temporarily affect diving birds. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise transmitted through water has the potential to result in temporary displacement of diving birds in a limited space around each pile and can cause temporary stress and behavioral changes ranging from mild annoyance to escape behavior (BOEM 2014b, 2016). Additionally, noise impacts on prey species may affect bird foraging success. Similar to pile driving, geological and geophysical site characterization surveys for offshore wind facilities would create high-intensity impulsive noise around sites of investigation, leading to similar impacts on birds.

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

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

Presence of structures: The presence of structures can lead to long-term effects on birds, both beneficial and adverse, through fish aggregation and associated increase in foraging opportunities, as well as entanglement with lost fishing gear, migration disturbances, and WTG strikes and displacement. These impacts may arise from buoys, meteorological towers, foundations, scour and cable protections, and transmission cable infrastructure.

The primary threat to birds from the presence of structures would be from collision with WTGs. The Atlantic Flyway is an important migratory corridor for as many as 164 species of waterbirds, and a similar number of land birds, with the greatest volume of birds using the Atlantic Flyway during spring and fall migration (Watts 2010). Along the Atlantic Flyway, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). While both groups may occur over land or water within the flyway and may extend considerable distances from shore, the highest diversity and density are centered on the shoreline. Building on this information, Robinson Willmott et al. (2013) evaluated the sensitivity of bird resources to collision and displacement due to offshore wind development on the Atlantic OCS and included the 164 species selected by Watts (2010) plus an additional 13 species, for a total of 177 species that may occur on the Atlantic OCS from Maine to Florida during all or some portion of the year. As discussed in Robinson Willmott et al. (2013) and consistent with Garthe and Hüppop (2004), Furness and Wade (2012), and Furness et al. (2013), species with high scores for sensitivity for collision include gulls, jaegers, and the northern gannet (*Morus bassanus*). In many cases, high collision sensitivity is driven by high occurrence on the OCS, low avoidance rates with high uncertainty, and time spent in the RSZ. Many of the species addressed in Robinson Willmott et al. (2013) have low collision sensitivity, including passerines that spend very little time on the Atlantic OCS during migration and typically fly above the RSZ. As discussed by Watts (2010), 55 seabird species could encounter operating WTGs on the Atlantic OCS. However, generally the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (Figure 3.5.3-2). Of the 55 bird species, 47 have sufficient survey data to calculate the modeled percentage of a species population that would overlap with the anticipated offshore wind development on the Atlantic OCS (Winship et al. 2018); the relative seasonal exposure of these species is generally very low, ranging from 0.0 to 5.2 percent (Table 3.5.3-4). The estimated percentage of federally listed species and Birds of Conservation Concern populations that overlap offshore wind development areas ranges only 0.0 to 0.9 percent (Table 3.5.3-4). BOEM assumes that the 47 species (85 percent) with sufficient data to model the relative distribution and abundance on the Atlantic OCS are representative of the 55 species that may overlap with offshore wind development on the Atlantic OCS.

Offshore wind development would add up to 2,974WTGs in the bird geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). In the contiguous United States, bird collisions with operating onshore WTGs are relatively rare events, with an estimated 140,000 to 500,000 (mean = 320,000) birds killed annually from about 49,000 onshore wind turbines in 39 states (USFWS 2018). Bird collisions with onshore turbines in the eastern United States is estimated at 6.86 birds per turbine per year (USFWS 2018). Based on this mortality rate, an estimated 19,693 birds could be killed annually from the 2,974 WTGs that would be added for offshore wind development. This represents a maximum-case scenario and does not consider mitigating factors, such as landscape and weather patterns, or bird species that are expected to occur. Given that the relative density of birds in the OCS is low, relatively few birds are likely to encounter offshore WTGs (see Figure 3.5.3-2). Potential annual bird kills from offshore WTGs would be relatively low compared to other causes of migratory bird deaths in the United States; feral cats are the primary cause of migratory bird deaths in the United States (2.4 billion per year), followed by collisions with building glass (599 million per year), collisions with vehicles (214.5 million per year), poison (72 million per year), collisions with electrical lines (25.5 million per year), collisions with communication towers (6.6 million per year), and electrocutions (5.6 million per year) (USFWS 2021).

Not all individuals that occur or migrate along the Atlantic Coast are expected to encounter the RSZ of one or more operating WTGs associated with planned offshore wind development. Generally, only a small percentage of a species' seasonal population would potentially encounter operating WTGs (Table 3.5.3-4). The addition of WTGs to the offshore environment may result in increased functional loss of habitat for those species with higher displacement sensitivity. However, a recent study of long-term data collected in the North Sea found that despite the extensive observed displacement of loons in response to the development of 20 wind farms, there was no decline in the region's loon population (Vilela et al. 2021). Furthermore, substantial foraging habitat for resident birds would remain available outside of the proposed offshore lease areas, and no individual fitness or population-level impacts would be expected to occur.

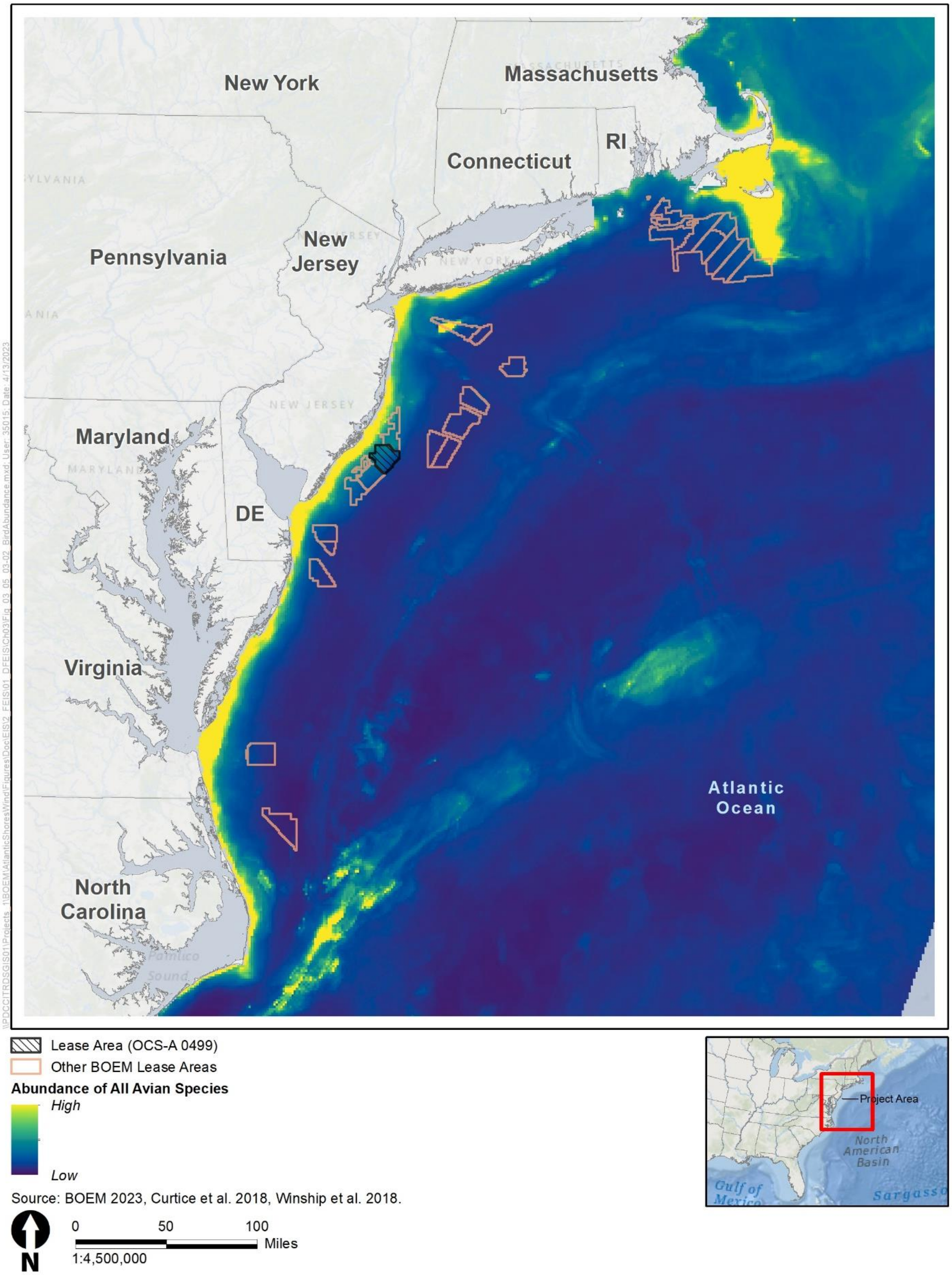


Figure 3.5.3-2. Total bird relative abundance distribution map

Table 3.5.3-4. Percentage of Atlantic seabird population overlap with anticipated offshore wind energy development on the Outer Continental Shelf

Species	Spring	Summer	Fall	Winter
Artic tern (*Sterna paradisaea*)	NA	0.2	NA	NA
Atlantic puffin (*Fratercula arctica*)[1]	0.2	0.1	0.1	0.2
Audubon shearwater (*Puffinus lherminieri*)[4]	0.0	0.0	0.0	0.0
Black-capped petrel (*Pterodroma hasitata*)[3]	0.0	0.0	0.0	0.0
Black guillemot (*Cepphus grille*)	NA	0.3	NA	NA
Black-legged kittiwake (*Rissa tridactyla*)[1]	0.7	NA	0.7	0.5
Black scoter (*Melanitta americana*)	0.2	NA	0.4	0.5
Bonaparte’s gull (*Chroicocephalus philadelphia*)	0.5	NA	0.4	0.3
Brown pelican (*Pelecanus occidentalis*)	0.1	0.0	0.0	0.0
Band-rumped storm-petrel (*Oceanodroma castro*)	NA	0.0	NA	NA
Bridled tern (*Onychoprion anaethetus*)	NA	0.1	0.1	NA
Common eider (*Somateria mollissima*)[1]	0.3	0.1	0.5	0.6
Common loon (*Gavia immer*)	3.9	1.0	1.3	2.1
Common murre (*Uria aalge*)	0.4	NA	NA	1.9
Common tern (*Sterna hirundo*)[1]	2.1	3.0	0.5	NA
Cory’s shearwater (*Calonectris borealis*)[4]	0.1	0.9	0.3	NA
Double-crested cormorant (*Phalacrocorax auritus*)	0.7	0.6	0.5	0.4
Dovekie (*Alle alle*)	0.1	0.1	0.3	0.2
Great black-backed gull (*Larus marinus*)[1]	1.3	0.5	0.7	0.6
Great shearwater (*Puffinus gravis*)	0.1	0.3	0.3	0.1
Great skua (*Stercorarius skua*)	NA	NA	0.1	NA
Herring gull (*Larus argentatus*)[1]	1.0	1.3	0.9	0.5
Horned grebe (*Podiceps auritus*)	NA	NA	NA	0.3
Laughing gull (*Leucophaeus atricilla*)	1.0	3.6	0.9	0.1
Leach’s storm-petrel (*Oceanodroma leucorhoa*)	0.1	0.0	0.0	NA
Least tern (*Sternula antillarum*)	NA	0.3	0.0	NA
Long-tailed ducks (*Clangula hyemalis*)	0.6	0.0	0.4	0.5
Manx shearwater (*Puffinus puffinus*)[1]	0.0	0.5	0.1	NA
Northern fulmar (*Fulmarus glacialis*)[1]	0.1	0.2	0.1	0.2
Northern gannet (*Morus bassanus*)[1]	1.5	0.4	1.4	1.4
Parasitic jaeger (*Stercorarius parasiticus*)	0.4	0.5	0.4	NA
Pomarine jaeger (*Stercorarius pomarinus*)	0.1	0.3	0.2	NA
Razorbill (*Alca torda*)[1]	5.2	0.2	0.4	2.1
Ring-billed gull (*Larus delawarensis*)	0.5	0.5	0.9	0.5
Red-breasted merganser (*Mergus serrator*)	0.5	NA	NA	0.7
Red phalarope (*Phalaropus fulicarius*)	0.4	0.4	0.2	NA
Red-necked phalarope (*Phalaropus lobatus*)	0.3	0.3	0.2	NA
Roseate tern (*Sterna dougallii*)[2]	0.6	0.0	0.5	NA
Royal tern (*Thalasseus maximus*)	0.0	0.2	0.1	NA
Red-throated loon (*Gavia stellate*)[1]	1.6	NA	0.5	1.0
Sooty shearwater (*Ardenna grisea*)	0.3	0.4	0.2	NA
Sooty tern (*Onychoprion fuscatus*)	0.0	0.0	NA	NA
South polar skua (*Stercorarius maccormicki*)	NA	0.2	0.1	NA
Surf scoter (*Melanitta perspicillata*)	1.2	NA	0.4	0.5

Species	Spring	Summer	Fall	Winter
Thick-billed murre (*Uria lomvia*)	0.1	NA	NA	0.1
Wilson's storm-petrel (*Oceanites oceanicus*)	0.2	0.9	0.2	NA
White-winged scoter (*Melanitta deglandi*)	0.7	NA	0.2	1.3

Source: Winship et al. (2018).
[1] Species also included in collision risk modeling by Winship et al. (2018).
[2] U.S. Endangered
[3] U.S. Candidate
[4] Bird of Conservation Concern

Vattenfall (a European energy company) recently studied bird movements within an offshore wind farm situated 1.9–3 miles (3–4.9 kilometers) off the coast of Aberdeen, Scotland (Vattenfall 2023). The purpose of the study was to improve the understanding of seabird flight behavior inside an offshore wind farm with a focus on the bird breeding period and post-breeding period when densities are highest. The study was robust in that seabirds were tracked inside the array with video cameras and radar tracks, which allowed for measuring avoidance movements (meso- and micro-avoidance)[1] with high confidence and at the species level. Detailed statistical analyses of the seabird flight data were enabled both by the large sample sizes and by the high temporal resolution in the combined radar track and video camera data. Meso-avoidance behavior showed that species avoided the RSZ by flying in between the turbines with very few avoiding by changing their flight altitude in order to fly either below or above the rotors. The most frequently recorded adjustment under micro-avoidance behavior was birds flying along the plane of the rotor; other adjustments included crossing the rotor either obliquely or perpendicularly, and some birds cross the rotor-swept area without making any adjustments to the spinning rotors. The study concluded that, together with the recorded high levels of micro-avoidance in all species (>0.96), it is now evident that seabirds will be exposed to very low risks of collision in offshore wind farms during daylight hours. This was substantiated by the fact that no collisions or even narrow escapes were recorded in over 10,000 bird videos during the 2 years of monitoring covering the April–October period. The study's calculated micro-avoidance rate (above 0.96) is similar to Skov et al. (2018).

Because most structures would be spaced 0.6 to 1 nautical mile (1.1 to 1.9 kilometers) apart, ample space between WTGs should allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. The effects of offshore wind farms on bird movement ultimately depends on the bird species, the size of the offshore wind farm, the spacing of the turbines, and the extent of extra energy cost incurred by the displacement of flying birds (relative to normal flight costs pre-construction) and their ability to compensate for this degree of added energy expenditure. Little quantitative information is available on how offshore wind farms may act as a barrier to movement, but Madsen et al. (2012) modeled bird movement through offshore wind farms using bird (common eider) movement data collected at the Nysted offshore wind farm in the western Baltic Sea just south of Denmark. After running several hundred thousand simulations for different layouts/configurations for a 100 WTG offshore wind farm, the proportion of birds traveling between turbines increased as distance between turbines increased.

[1] Micro-avoidance is flight behavior within and in the immediate vicinity of individual wind turbine rotor-swept areas (i.e., last second action to avoid collision); meso-avoidance is flight behavior within and in the immediate vicinity of the wind farm (i.e., anticipatory/impulsive evasion of rows of turbines in a wind farm).

With eight WTG columns at 0.1 nautical mile (200-meter spacing, no birds passed between the turbines. However, increasing inter-turbine distance to 0.27 nautical mile (500 meters) increased the percentage of birds to more than 20 percent, while a spacing of 0.54 nautical mile (1,000 meters) increased this further to 99 percent. The 0.6- to 1-nautical mile (1.1- to 1.9-kilometer) spacing estimated for most structures that will be proposed on the Atlantic OCS is greater than the distance at which 99 percent of the birds passed through in the model. As such, adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of offshore wind lease areas would not be expected to be biologically significant. Any additional flight distances would likely be small for most migrating birds when compared with the overall migratory distances traveled, and no individual fitness or population-level effects would be expected to occur.

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

The presence of new structures could result in increased prey items for some marine bird species. Offshore wind foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017). Additionally, the new structures may create habitat for structure-oriented and hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind energy facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for individuals of some marine bird species. BOEM anticipates that the presence of structures may result in permanent moderate beneficial impacts. Conversely, increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs.

Traffic: General aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2021). Because aircraft flights associated with offshore wind development are expected to be minimal in comparison to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic impacts would be negligible and would not be expected to appreciably contribute to cumulative impacts on birds.

Impacts of Alternative A – No Action on ESA-Listed Birds

Planned offshore wind development activities without the Proposed Action are not expected to have the potential to significantly impact populations of ESA-listed species, including the roseate tern, piping plover, red knot, eastern black rail, and saltmarsh sparrow due to low degrees of exposure. No modeled roseate tern flight paths were estimated in the WTA by Loring et al. (2019) or in the NJDEP Baseline Studies data (Geo-Marine, Inc. 2010), indicating minimal exposure (COP Volume II, Appendix II-F2; Atlantic Shores 2023). Further, flight height estimates and records suggest roseate terns have a low probability of flying within the RSZ (COP Volume II, Appendix II-F2; Atlantic Shores 2023). Occurrence of piping plovers within the WTA has been found to be minimal (Loring et al. 2019). They have also been found to fly relatively high and during clear weather conditions that reduce chances of collisions with structures (Loring et al. 2019). Tracking data from red knots suggest that some long-distance, southbound migrants may pass through the WTA. Loring et al. (2018) found red knots to fly at heights ranging from 72 feet (22 meters) to 2,893 feet (882 meters), indicating some potential exposure to the RSZ. Flights across WEAs occurred under clear conditions, however, reducing the likelihood of collisions (Loring et al. 2018). During red knot tracking studies performed for Atlantic Shores in 2020–2021, all but 1 of the 15 birds suspected to cross the Lease Area during their migration flew below the RSZ (altitudes of 3.3 to 72 feet [1 to 22 meters]), with the remaining red knot flying well above the RSZ at an altitude of 1,887 feet (575 meters) (Feigin et al. 2022). Taken together, low abundance and flight heights either below or above the RSZ during clear conditions make the exposure level for red knots low and unlikely to significantly impact their populations.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, birds would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on birds primarily through construction and climate change. Given that the abundance of bird species that overlap with ongoing wind energy facilities on the Atlantic OCS is relatively small, ongoing wind activities would not appreciably contribute to impacts on birds. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. The No Action Alternative would result in **minor** impacts on birds.

Cumulative Impacts of Alternative A – No Action. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and birds would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on birds due to habitat loss from increased onshore construction and interactions with offshore developments.

BOEM anticipates that the overall impacts associated with offshore wind activities in the geographic analysis area would result in adverse impacts but could potentially include beneficial impacts because of the presence of structures. The majority of offshore structures in the geographic analysis area would be attributable to offshore wind development. Migratory birds that use the offshore wind lease areas during all or parts of the year would either be exposed to new collision risk or experience long-term functional habitat loss due to behavioral avoidance and displacement from wind lease areas on the OCS.

The offshore wind development would also be responsible for the majority of impacts related to new cable emplacement and pile-driving noise, but effects on birds, including ESA-listed species, resulting from these IPFs would be localized and short term and would not be expected to be biologically significant.

BOEM anticipates that the cumulative impacts of the No Action Alternative would have **moderate** adverse impacts on birds but could also include **moderate beneficial** impacts because of the presence of offshore structures.

3.5.3.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on birds:

- The proposed new onshore substations and/or converter stations, which could require the removal of trees and shrubs in or on the edge of the construction footprint;
- The routing variants within the selected onshore export cable system, which could require removal of trees and shrubs along the construction corridor;
- The number, size, and location of the WTGs;
- The size and location of the met tower;
- The number, size, and location of metocean buoys; and
- The time of year during which construction occurs.

Variability of the proposed Project design exists as outlined in Appendix C. Below is a summary of potential variances in impacts:

- Onshore export cable routes and substation footprints: the route chosen (including variants within the general route) and substation footprints would determine the amount of habitat affected.
- WTG number, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to birds.
- Met tower size and location: The level of hazard related to the met tower may be affected by the size and location of the met tower; a larger met tower may present more of a hazard to birds.
- Metocean buoy numbers, sizes, and locations: The level of hazard related to met towers and metocean buoys is proportional to the number of met towers and metocean buoys installed; fewer met towers and metocean buoys would present less hazard to birds.

- Season of construction: The activity and distribution of birds exhibit distinct seasonal changes. For instance, summer and fall months (generally May through October) constitute the most active season for birds in the Project area, and the months on either side coincide with major migration events. Therefore, construction during months in which birds are not present, not breeding, or less active would have a lesser impact on birds than construction during more active times.

3.5.3.5 Impacts of Alternative B – Proposed Action on Birds

The following sections summarize the potential impacts of the Proposed Action on birds during the various phases of the proposed Project. This includes construction and installation, O&M, and decommissioning both onshore and offshore, as described in Chapter 2, *Alternatives.*

Onshore Activities and Facilities

Construction and installation of onshore facilities has the potential to affect birds through habitat loss, noise disturbance, and artificial lighting at night.

Land disturbance: Generally, onshore activities are not expected to pose any significant impacts (i.e., hazards) on birds because activities would disturb little if any habitat that is not already disturbed or developed, and the transmission lines would be below ground. Bird communities in these areas are composed of mostly disturbance-tolerant generalists that would not be expected to be affected at the population level by the construction, O&M, and decommissioning of the onshore facilities. The proposed onshore interconnection cables would travel underground from landfall sites to onshore substations and/or converter stations, and open trenching and direct impacts would be almost entirely limited to existing roads and other ROWs where existing levels of human disturbance are already high (COP Volume II, Appendix II-F2; Atlantic Shores 2023). Tree clearing and other land disturbance for two of the proposed substations and/or converter stations would occur in an urbanized, fragmented landscape, have a small footprint, and would not eliminate high-quality habitat for birds. This long-term but negligible effect on bird habitat would occur for the duration of the Project's operational lifetime. Approximately 18 acres (7.3 hectares) of permanent tree clearing could occur at the Fire Road Onshore Substation/Converter Station site. No more than 14~~2.4~~ acres (~~0.97~~ 5.7 hectares) of permanent tree clearing could occur at either the Lanes Pond Road Substation/Converter Station site or the Randolph Road Substation/Converter Station site. Tree clearing at the potential Brook Road parcel would be performed by MAOD (or the designated lead state or federal agency, as appropriate) as part of the development under the SAA and is thereby not included as part of the Proposed Action. Atlantic Shores would minimize required bush and tree clearing to the maximum extent practicable and conduct bush and tree clearing during the winter months (BIR-12; Appendix G; Table G-1). Additionally, overhead transmission is not being proposed for this Project. Birds in habitats adjacent to these areas are inherently tolerant of human disturbances such that construction, O&M, and decommissioning activities for the onshore facilities would not be expected to have additional impacts.

Elsewhere, HDD would be used to avoid any surface disturbance to wetlands and beaches and other sensitive habitats, thereby avoiding impacts on marsh birds and plovers and other beach-nesting colonial waterbirds such as piping plovers and red knots. The use of HDD would not require construction vehicles in beach and wetland areas, thereby avoiding any impacts on sensitive habitats and sensitive species nesting in those areas. Disturbance to bird habitat is expected to be minimal overall, mainly limited to minor tree-clearing near the existing Cardiff and Larrabee substations and proposed new substation and/or converter station sites, where adjacent forest is already fragmented and otherwise degraded. This could reduce foraging and nesting habitat for some common bird species associated with degraded habitat fragments, but any such effects would not have measurable impacts on their local populations. Land disturbance that would occur during decommissioning would also be short term and limited to the footprint of the onshore facilities and their immediately adjacent, disturbed areas.

Lighting: Because the Onshore Project components are in developed areas, lighting would represent a negligible increase in existing levels of artificial lighting at night in the overall area during construction, O&M, and decommissioning. To the extent practicable, a communications antenna that would potentially be constructed on the O&M facility in Atlantic City would have obstruction lighting and other features designed in accordance with USFWS-recommended best practices for communications tower design to minimize potential for lighting and collision impacts on birds (BIR-15; Appendix G; Table G-1). Construction and decommissioning lighting would be short term, localized to the work area, and downlighted/shielded to the maximum extent practicable. Lighting during onshore O&M operations would be limited to the minimum required by regulation and for safety (BIR-14; Appendix G; Table G-1). Bird communities in the area would be composed of disturbance-tolerant generalists that would not experience significant impacts on their local populations as a result of lighting related to the construction, O&M, and decommissioning of the onshore facilities.

Noise: Construction and installation, O&M, and decommissioning noise from the operation of vehicles and equipment could displace birds from nearby habitats, although these effects would be short term and highly localized. Further, the bird community in the surrounding area is expected to be composed of disturbance-tolerant generalists given the fragmented and degraded habitat conditions, and high existing levels of human disturbance in the landscape. Birds in the area are therefore expected to be habituated to ambient noises typical of urban areas. Overall, noise from the construction, O&M, and decommissioning of onshore facilities would not have measurable population-level impacts on local birds.

Offshore Activities and Facilities

Construction and installation, O&M, and decommissioning of offshore facilities has the potential to affect birds through accidental release of waste and contaminants; disturbance to the seafloor and benthic prey communities due to WTG, OSS, and met tower foundations and cable installation and maintenance; vessel, WTG, OSS, and construction lighting; noise disturbance; aircraft traffic; and the presence of structures.

Accidental releases: Some potential exists for mortality, decreased fitness, and health effects on birds due to accidental release of fuel, hazardous materials, and trash and debris from vessels associated with the construction and installation, O&M, and decommissioning of the Proposed Action. Vessels associated with the Proposed Action may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with the Proposed Action would comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Atlantic Shores would remove any marine debris caught on offshore Project structures, when safe and practicable, to reduce the risk of bird entanglement (BIR-7; Appendix G; Table G-1). In addition, Atlantic Shores has prepared and would implement an OSRP (COP Volume I, Appendix I-D; Atlantic Shores 2023), which would minimize the potential for spills and identify procedures in the event of a spill. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on birds. Planned offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazardous materials exposure but, compared to the overall spill risk from ongoing activities, the contribution from planned offshore wind and the Proposed Action would be low.

Cable emplacement and maintenance: Construction and installation of offshore export cables associated with the Proposed Action would disturb up to 1,606 acres (650 hectares) of seafloor (Appendix D, Table D.A2-2), which would result in turbidity effects that have the potential to reduce marine bird foraging success or have short-term and localized impacts on the prey of marine birds. To evaluate the impacts of submarine export and interarray cable installation, a conservative analytical sediment transport model was developed using publicly available data and data provided by Atlantic Shores to quantify potential maximum plume dispersion and sediment concentrations and potential maximum sediment deposition thicknesses (see COP Volume II, Appendix II-J3 for details; Atlantic Shores 2023) Suspended sediments at above-ambient concentrations (TSS ≥ 10 mg/L) could be transported 1.6 and 1.8 miles (2.6 and 2.9 kilometers) at the Atlantic and Monmouth ECCs, respectively, and 1.1 miles (1.7 kilometers) at the interarray area. The sediment transport modeling indicated that the above-ambient TSS concentrations would be short-lived (fully dissipated in 6–24 hours), remain relatively close to the centerline of the export cable corridor routes, and would be generally constrained to the bottom of the water column. Sediment deposition of ≥ 0.04 inch (1 millimeters) in thickness would occur within 656 feet (200 meters) from the Monmouth ECC centerline, within 164 feet (50 meters) of the Atlantic ECC centerline, and within 361 feet (110 meters) of the centerline for jet trenching installation of the interarray cables. The maximum sediment deposition modeled was less than 0.2 inch (5 millimeters) for interarray cables, between 0.2 and 0.4 inch (5 and 10 millimeters) for the Atlantic ECC route, and between 0.4 and 0.8 inch (10 and 20 millimeters) for the Monmouth ECC route; however, in all scenarios maximum deposition was predicted to occur within 49 feet (15 meters) from each route's centerline.

Results from the analysis were also consistent with other sediment transport models completed for wind farm installation projects in the mid-Atlantic region. Data collections and modeling studies of plowing, trenching, and dredging projects showed that displacement of sediments is low, and they typically dissipated to background levels very close to the site (e.g., BERR 2008; Tetra Tech 2021). Individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement, and only non-measurable impacts, if any, on individuals or populations would be expected given the localized and short-term nature of the potential impacts. Given the localized nature of these impacts, impacts associated with the emplacement of cables for other offshore wind projects in the geographic analysis area are not anticipated to overlap spatially with the Proposed Action, and impacts would be unlikely.

Lighting: Under the Proposed Action, up to 200 WTGs, 1 met tower, 4 metocean buoys, and 10 OSSs would be lit with USCG navigational and FAA hazard lighting; these lights have some potential to attract birds and result in increased collision risk (Hüppop et al. 2006). In accordance with BOEM lighting guidelines (BOEM 2021), all WTGs in excess of 699 feet (213 meters) above ground level would be lit with two synchronized red flashing obstruction lights (with medium-intensity FAA model L-864 and light-emitting diode color between 800 and 900 nanometers) placed on the back of the nacelle on opposite sides, and up to three FAA model L-810 red flashing lights at mid-mast level, adding up to 1,000 new red flashing lights to the offshore environment where none currently exist. However, red flashing aviation obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010; Orr et al. 2013). Additionally, marine navigation lighting would consist of multiple types of flashing yellow lights on the corners of each OSS, corner-located WTGs, and significant peripheral structures such as a met tower, outer boundary WTGs, and interior WTGs. Atlantic Shores plans to use an FAA-approved ADLS (COP Volume II, Section 4.3.2.2; Atlantic Shores 2023), subject to FAA and BOEM approval, which is a lighting system that would only activate WTG and met tower lighting when aircraft enter a predefined airspace. For the Proposed Action, based on historical air traffic data, obstruction light activation under ADLS was estimated to occur approximately 9 hours over the course of 1 year for flights passing through the Project light activation volume, which equals less than 1 percent of the time that full-time obstruction lights would be active (COP Volume II, Appendix II-M4; Atlantic Shores 2023).

Lighting not required by FAA and USCG during offshore construction and installation, O&M, and decommissioning would be limited to reduce attraction of birds. Vessel lights during construction and installation would have short-term but minimal effects and would be limited to vessels transiting to and from construction areas.

The impact of the Proposed Action alone would not noticeably increase the impacts of light beyond those described under the No Action Alternative. BOEM expects impacts on birds, if any, to be long term but negligible from vessel, WTG, and OSS lighting.

Noise: The expected impacts of construction vessel, aircraft, G&G survey, pile-driving, and other noises associated with the construction and installation of the Proposed Action alone would not increase the impacts of noise on birds beyond those described under the No Action Alternative. The pile-driving noise impacts would be short term and would cease after piles are installed. Vessel and construction noise could temporarily disturb offshore bird species, but they would likely acclimate to the noise or move away and be able to return post-disturbance (BOEM 2012). BOEM anticipates the short-term impacts, if any, related to construction and installation of the offshore components would be negligible.

Presence of structures: The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, entanglement and fishing gear loss or damage, migration disturbances, and WTG strikes and displacement, are described in Section 3.5.3.3, *Cumulative Impacts of Alternative A – No Action*. The impacts of the Proposed Action alone as a result of presence of structures would be long term but minor and may include some beneficial impacts. Due to the anticipated use of flashing red tower lights, restricted time period of exposure during migration, and small number of migrants that could cross the Project area, the presence of structures from the Proposed Action would not be expected to adversely impact populations of migrating birds.

As previously described and shown in Figure 3.5.3-2, the locations of the OCS offshore wind lease areas were selected to minimize impacts on all resources, including birds. The majority of bird migration along the Atlantic Flyway is concentrated along the coastline, while relatively little bird migration occurs offshore (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). Nevertheless, operation of the Proposed Action would result in individual-level impacts on some offshore bird species and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs or other associated structures within the WTA, or through behavioral avoidance and habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Millman 2016). The predicted activity of bird populations that have a higher sensitivity to collision (as defined by Robinson Willmott et al. 2013) is relatively low in the OCS during all seasons of the year (Figure 3.5.3-2), suggesting that bird fatalities due to collision are likely to be low. When WTGs are present, many birds would avoid the WTG site altogether, especially the species that ranked “high” in vulnerability to displacement by offshore wind energy development (Robinson Willmott et al. 2013). In addition, many birds would likely adjust their flight paths to avoid WTGs and other structures by flying above, below, or between them (e.g., Desholm and Kahlert 2005; Plonczkier and Simms 2012; Skov et al. 2018) and others may take extra precautions to avoid WTGs when the WTGs are moving (Johnston et al. 2014). Several species have very high avoidance rates; for example, the northern gannet, black-legged kittiwake, herring gull, and great black-backed gull have measured avoidance rates of at least 99.6 percent (Skov et al. 2018).

Atlantic Shores performed an exposure and relative vulnerability assessment to estimate the collision and displacement risk of various offshore bird species encountering the Project area (COP Volume II, Appendix II-F2; Atlantic Shores 2023). As discussed below, most species were identified as having “minimal” to “low” overall exposure risk.

Land birds are generally considered to have minimal exposure to the Offshore Project elements because the Offshore Project elements are far enough offshore as to be beyond their range. Peregrine falcons (*Falco peregrinus*) can fly offshore during migration (DeSorbo 2014), and have been tracked adjacent to the WTA (COP Volume II, Appendix II-F2; Atlantic Shores 2023), but while falcons can be attracted to WTGs (Hill et al. 2014; Skov et al. 2016), falcon mortalities have not been documented at offshore wind projects in Europe. Uncertainty exists about what proportion of migrating peregrine falcons might be attracted to offshore wind energy projects for perching, roosting, and foraging, and the extent to which individuals might avoid WTGs and associated structures or collide with them. To minimize the introduction of perching structures to the offshore environment, Atlantic Shores has committed to installing bird deterrent devices, where appropriate, on offshore, above-water structures (COP Volume II, Section 4.3.2.6; Atlantic Shores 2023). Among other raptors, ospreys can make water crossings (Kerlinger 1985) and fly offshore, but satellite telemetry data indicate they generally remain close to the mid-Atlantic coast during fall migration (Bierregaard et al. 2020; COP Volume II, Appendix II-F2; Atlantic Shores 2023). Eagles and hawks are rarely observed offshore (DeSorbo 2014).

Migrating songbirds typically fly at heights well above or below the RSZ (72 feet to 1,043 feet [22 to 318 meters] above highest astronomical tide (HAT) (COP Volume II, Appendix II-F2; Atlantic Shores 2023). As shown in Robinson Willmott et al. (2013), species with low sensitivity scores include many songbirds that only cross the Atlantic OCS briefly during migration and typically fly well above the RSZ. It is generally assumed that inclement weather and reduced visibility cause birds to decrease their flight altitudes (Ainley et al. 2015), increasing potential for large-scale mortality events at structures. However, this has not been shown to be the case in studies of offshore wind facilities in Europe, with oversea migration completely, or nearly so, ceasing during inclement weather (Fox et al. 2006; Pettersson 2005; Hüppop et al. 2006), and with migrating birds avoiding flying through fog and low clouds (Panuccio et al. 2019). Furthermore, many songbird species have been documented in only relatively low numbers on the OCS during migration (Robinson Willmott and Forcey 2014). In addition, most of the activity (including blackpoll warblers) was during windspeeds less than 8.8 feet (2.68 meters) per second—below the turbine cut in speed (see Figure 109 in Robinson Willmott and Forcey 2014)—and thus of little risk to migrating songbirds, although songbirds elsewhere have been found to sometimes migrate during higher windspeeds (e.g., Abdulle and Fraser 2018; Chapman et al. 2016) and more remains to be learned about the associations of offshore songbird migration with weather conditions. Overall, population-level impacts are unlikely because exposure to the WTA is expected to be minimal to low and limited in duration.

All marine birds were identified as having minimal to low exposure except loons, which received a medium exposure assessment. Gulls were identified as having the highest vulnerability to collisions, but were still low to medium (see Table 3.5.3-5); (COP Volume II, Appendix II-F2; Atlantic Shores 2023; Wade et al. 2016). Sea ducks, auks, loons, petrels (including black-capped petrels), shearwaters, and storm-petrels are generally not considered vulnerable to collision because they avoid WTGs (Furness et al. 2013). Terns are thought to typically fly below the RSZ, although some studies indicate that terns as well as northern gannets may have some limited vulnerability to collision. COP Volume II, Appendix II-F2 (Atlantic Shores 2023) includes more detailed discussion, as well as supporting tables and maps for each species group's exposure and vulnerability assessment. In brief, while collisions with WTGs and associated structures may impact individual non-listed marine birds (i.e., gulls and cormorants), population-level impacts are not expected because the species vulnerable to collision have minimal to low exposure to the WTA. Furthermore, gulls and cormorants have minimal to medium overall population vulnerability.

Some marine bird species might avoid the WTA during its operation, leading to an effective loss of habitat. For example, loons (Dierschke et al. 2016; Drewitt and Langston 2006; Lindeboom et al. 2011;

Percival 2010; Petersen et al. 2006), grebes (Dierschke et al. 2016; Leopold et al. 2011; Leopold et al. 2013), sea ducks (Drewitt and Langston 2006; Petersen et al. 2006), and northern gannets (Drewitt and Langston 2006; Lindeboom et al. 2011; Petersen et al. 2006) typically avoid offshore wind developments (i.e., have high displacement sensitivity; Table 3.5.3-5). In such cases, the proposed Project would potentially no longer provide foraging opportunities to those species with high displacement sensitivity, but suitable foraging habitat would remain abundantly available in the surrounding region. A complete list of species included in the higher displacement sensitivity group can be found in Robinson Willmott et al. (2013). Because the WTA is not likely to contain important foraging habitat for the species susceptible to displacement, BOEM expects this loss of habitat to be insignificant. Population-level, long-term impacts resulting from habitat loss would likely be negligible.

Atlantic Shores has committed to developing and implementing an avian post-construction monitoring plan to assess any Project impacts on avian species (BIR-1; Appendix G; Table G-1). Any dead or injured birds would be reported to BOEM on an annual basis, and those with USFWS bands would be reported to the USGS Bird Banding Lab (BIR-9; Appendix G; Table G-1). Additionally, Atlantic Shores would install two Motus receiving antennae on separate metocean buoys to track the offshore movements of tagged bird species within the WTA (BIR-2; Appendix G; Table G-1).

Table 3.5.3-5. Summary of the assessment of potential exposure and vulnerability of marine birds

Group	Exposure	Relative Vulnerability to Collision	Relative Vulnerability to Displacement	Relative Vulnerability to Population
Sea ducks	min–low	low	med–high	low–med
Auks	min–low	min–low	med–high	low–med
Jaegers and gulls	min–low	low–med	low–med	min–med
Terns	min–low	low	med–high	low–high
Loons	min–med	low	high	low–med
Shearwaters, petrels, and storm-petrels	min–low	low	med	low–med
Gannets, cormorants, and pelicans	min–low	low–med	low–med	min–low

Source: COP Volume II, Table 4.3-4 (Atlantic Shores 2023). Methods of population vulnerability calculation detailed in COP Volume II, Appendix II-F2, Section 4.1.2.1 (Atlantic Shores 2023).

The expected impacts of the Proposed Action alone would increase only incrementally over those described under the No Action Alternative. The structures associated with the Proposed Action and the consequential impacts would be long term and would remain at least until decommissioning of the proposed Project is complete.

Traffic: The expected impacts of aircraft traffic associated with construction and installation, O&M, and decommissioning of the Proposed Action alone would not increase the impacts of this IPF beyond those described under the No Action Alternative. Impacts due to Project-related aircraft traffic are expected to be negligible.

Impacts of Alternative B – Proposed Action on ESA-Listed Birds

Due to the anticipated use of flashing red tower lights, restricted seasons of exposure, and small number of individuals that could cross the Project area, BOEM concluded that the Proposed Action would not likely adversely affect ESA-listed roseate terns, piping plovers, eastern black rails, or saltmarsh sparrows. Additionally, the use of HDD onshore would avoid impacts to coastal beach and wetland habitats of these ESA-listed birds. BOEM is preparing a BA for the potential effects on ESA-listed species. A preliminary draft found that the Proposed Action *may affect, but is not likely to adversely affect* the roseate tern, piping plover, eastern black rail, or saltmarsh sparrow, or their critical habitat. However, because collision modeling predicted the chances of annual and 35-year collision mortality of *rufa* red knots to be above zero, the preliminary draft of the BA found that the Proposed Action may adversely affect the *rufa* red knot. BOEM will request concurrence from USFWS on its conclusion that the impacts of the proposed activities are expected to be discountable and insignificant, and thus *may affect but are not likely to adversely affect* the piping plover, roseate tern, eastern black rail, or saltmarsh sparrow. The preliminary draft of the BA also found that the proposed activities would have *no effect* for the black-capped petrel and that there would be *no effect* on designated critical habitat by the Proposed Action. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing, and results of the consultation will be presented in the Final EIS.

Impacts of the Connected Action

As described in Chapter 2, bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). The bulkhead site and dredging activities are in-water activities that would be conducted within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area. Due to the mobility of birds, a variety of species have the potential to pass through the Inlet Marina area. However, due to its highly developed nature, the Marina Inlet area does not provide quality, undisturbed bird habitat. BOEM expects the activities associated with the connected action to affect birds primarily through the accidental releases and noise IPFs. Other IPFs considered under the Proposed Action do not apply (e.g., cable emplacement and maintenance, traffic [aircraft]), and because the surrounding area consists of existing structures and other infrastructure, the presence of structures IPF would not pose a substantial risk to birds. Additionally, because all activities associated with the connected action are in-water activities, the land disturbance IPF does not apply.

Accidental releases: In-water construction activities would require heavy equipment use, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Some potential exists for bird impacts (e.g., injury from exposure) due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with dredging and construction equipment in the aquatic and terrestrial environment around Inlet Marina. An SPCC plan would be developed and implemented to avoid, minimize, and contain spills. Accidental releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on birds. In addition, all dredging equipment/use of watercraft and in-water work would comply with federal, state, and local permitting (e.g., CWA Sections 404 and 401) requirements for prevention and control of petrochemical spills, including oil and fuel. Therefore, BOEM anticipates accidental releases associated with the connected action to be negligible.

Noise: The expected impacts of noise associated with the connected action activities could affect any birds that may be in the vicinity of the Inlet Marina area. However, similar to the Proposed Action, construction noise would be temporary and localized and would not be anticipated to be significantly different than the noise levels in the surrounding urban environment. If pile driving is necessary during construction, the noise would be temporary and would cease after piles are installed. Similarly, dredging vessels and other construction noise could temporarily disturb and displace bird species, but they are likely already acclimated to noise in an urban environment and would be able to move away from the noise. Normal operation at the O&M facility in the Inlet Marina area would generate continuous noise, but BOEM expects negligible long-term impacts when considered in the context of the other commercial and industrial noises in the Onshore Project area. Overall, BOEM anticipates noise impacts associated with the connected action to be negligible.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities related to installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS would contribute to impacts on birds through the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance. Construction related to the connected action could affect birds by generating temporary and localized noise, and with potential accidental releases of fuels and hazardous materials. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance. Given that the abundance of bird species that overlap with wind energy facilities on the Atlantic OCS is relatively small, offshore wind activities would not appreciably contribute to impacts on bird populations. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. Ongoing and planned offshore wind activities in combination with the Proposed Action would result in an estimated 3,174 WTGs, of which the Proposed Action would contribute 200 (or about 6.3 percent) and would include up 36,207 acres (14,652 hectares) of seafloor disturbed from the offshore export cable and interarray cables (Appendix D, Tables D.A2-1 and D.A2-2).

The cumulative impacts on birds would likely be moderate because, although bird abundance on the OCS is low, there could be unavoidable impacts offshore and onshore; however, BOEM does not anticipate the impacts to result in population-level effects or threaten overall habitat function. The Proposed Action would contribute a negligible impact to the cumulative accidental releases, lighting, cable emplacement and maintenance, noise, traffic (aircraft), presence of structures, and land disturbance impacts on birds.

Conclusions

Impacts of Alternative B – Proposed Action. Construction, installation, O&M, and eventual decommissioning of the Proposed Action alone would have **moderate** impacts on birds, depending on the location, timing, and species affected by an activity. The primary impacts of the Proposed Action affecting birds are habitat loss and potential collision-induced mortality from rotating WTGs, and long-term but minimal habitat loss and conversion from onshore construction. The Proposed Action would also result in potential **minor beneficial** impacts associated with foraging opportunities for marine birds. The primary impacts of the connected action are related to noise and accidental releases, which could affect birds in the area of Inlet Marina. Given the developed nature of the Inlet Marina area, birds are likely acclimated to activities similar to those related to the connected action; therefore, BOEM anticipates that impacts of the connected action would be **negligible**.

Cumulative Impacts of Alternative B – Proposed Action. The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action at the Inlet Marina in Atlantic City, New Jersey. BOEM anticipates that the cumulative impacts on birds in the geographic analysis area would be **moderate**, as well as **moderate beneficial**. The contribution of the Proposed Action to the cumulative impacts of individual IPFs resulting from ongoing and planned activities would range from negligible to moderate, as well as moderate beneficial impacts. The Proposed Action would contribute to the cumulative impact rating primarily through the permanent impacts from the presence of structures.

3.5.3.6 Impacts of Alternatives C, D, E, and F on Birds

Impacts of Alternatives C, D, E, and F. Construction and installation, O&M, and decommissioning of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization, D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would only differ from the Proposed Action for offshore activities and facilities. Onshore activities and facilities would be the same as those described under the Proposed Action (Section 3.5.3.5). Impacts on birds resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the offshore portion of the Project under Alternatives C, D, E, and F would be the same or substantially similar to those described under the Proposed Action. Alternative C would include removing up to 29 WTGs, 1 OSS and associated interarray cables with the goal of minimizing impacts on sensitive habitats including submerged vegetation. Alternative D would include removing up to 31 WTGs, with the height of the remaining WTGs restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters) AMSL to reduce visual impacts. Under Alternative E, modifications would be made to the wind turbine array layout to create a 0.81-nautical-mile (1,500--meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Lease Areas of Atlantic Shores South (OCS-A 0499) and Ocean Wind 1 (OCS-A 0498) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation. Alternative F would analyze the extent of potential impacts from alternative foundation types (piled, suction bucket, and gravity-based foundations). None of the differences between these alternatives and the Proposed Action would have the potential to significantly reduce or increase impacts on birds from the analyzed IPFs. All conclusions reached for the Proposed Action, with regard to adverse impacts on birds, would also apply to Alternatives C through F. Alternatives C, D, and E would potentially benefit birds through reduced effects on habitats that support prey for some waterbird species, but any such benefits would be negligible. Under Alternatives C, D, and E, there could be reduced potential for collisions with structures due to a lower number of WTGs operating, but the difference would have negligible population-level benefits to birds.

Cumulative Impacts of Alternatives C, D, E, and F. The cumulative impacts on birds would be moderate and moderate beneficial for the same reasons described for the Proposed Action. The negligible impacts contributed by Alternatives C, D, E, and F to the cumulative impacts of birds would be the same or similar to those described under the Proposed Action.

Impacts of Alternative C, D, E, and F on ESA-Listed Birds

Construction and installation, O&M, and decommissioning of Alternatives C, D, E, and F would only differ from the Proposed Action for offshore activities and facilities. Onshore activities and facilities would be the same as those described under the Proposed Action (Section 3.5.3.5). Under Alternatives C through F, impacts on ESA-listed bird species from construction and installation, O&M, and decommissioning of offshore facilities would be the same as described for the Proposed Action. Alternatives C, D, and E would potentially benefit birds through reduced construction and installation effects on habitats that support prey for roseate terns, but any such benefits would be negligible. Under Alternatives C, D, and E, there could be reduced potential for collisions of piping plovers, red knots, and roseate terns with structures due to a lower number of WTGs operating, but the difference would have negligible population-level benefits.

Conclusions

Impacts of Alternatives C, D, E, and F. The impacts on birds resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives C, D, E, and F would be the same or substantially similar to those described under the Proposed Action. None of the differences between these alternatives and the Proposed Action would have the potential to significantly reduce or increase impacts on birds from the analyzed IPFs. All conclusions reached for the Proposed Action also apply to Alternatives C through F, with **moderate** adverse impacts on birds, primarily due to habitat loss and potential collision-induced mortality from rotating WTGs, and potential **minor beneficial** impacts associated with foraging opportunities for marine birds.

Cumulative Impacts of Alternatives C, D, E, and F. The impacts contributed by Alternatives C, D, E, and F to the cumulative impacts of birds would be negligible. Because the impacts of the Proposed Action would not change under Alternatives C, D, E, or F, BOEM anticipates that the cumulative impacts of Alternatives C, D, E, and F would be the same or similar to those described under the Proposed Action. Therefore, cumulative impacts of Alternatives C, D, E, and F on birds would be **moderate** and **moderate beneficial**.

3.5.3.7 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed in Table 3.5.3-6 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.5.3-6. Proposed mitigation measures – birds

Mitigation Measure	Description	Effect
Tree clearing restrictions	Because many wildlife species overwinter in cavities and nests, any mature trees slated for removal should be checked (including for vacant raptor nests) and avoided if possible. If the tree must be taken down, this should occur between October 1 and February 28 or 29.	While this mitigation measure would reduce impacts birds located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs.

3.5.3.8 Comparison of Alternatives

Potential impacts on birds from the other action alternatives would be the same or substantially similar to each other and to the Proposed Action. Therefore, none of the differences among the other action alternatives and the Proposed Action would have potential to significantly increase or decrease potential impacts on birds onshore or offshore.

3.5.4 Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitat and fauna resources from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for these resources. The coastal habitat and fauna geographic analysis area, as shown on Figures 3.5.4-1 and 3.5.4-2, includes flora and fauna located within state waters (which extend 3 nautical miles [5.6 kilometers] from the shoreline) inland to the mainland, including the foreshore, backshore, dunes, and interdunal areas. The geographic analysis area also includes the area within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area that includes the export cable landfalls, onshore export cable routes, the onshore substations and/or converter stations, the connection from the onshore substations to the POI, and the O&M facility and an associated parking structure. BOEM expects the resources in this area to have small home ranges. These resources are unlikely to be affected by impacts outside their home ranges.

This section analyzes the affected environment and environmental consequences of the Proposed Action and alternatives on coastal flora and fauna, including special-status species that are not otherwise included in Sections 3.4.1, *Air Quality*; 3.4.2, *Water Quality*; 3.5.1, *Bats*; 3.5.2, *Benthic Resources*; 3.5.3, *Birds*; 3.5.5, *Finfish*, *Invertebrates, and Essential Fish Habitat*; 3.5.6, *Marine Mammals*; 3.5.7, *Sea Turtles*; or 3.5.8, *Wetlands*.

3.5.4.1 Description of the Affected Environment and Future Baseline Conditions

The New Jersey Coastal Management Zone (coastal zone) is managed by NJDEP in accordance with New Jersey Administrative Code 7:7. The coastal zone includes approximately 1,800 miles (2,897 kilometers) of tidal shoreline, including 126 miles (203 kilometers) of oceanfront from Sandy Hook to Cape May. The boundaries of the coastal zone include inland, seaward, and interstate areas (NJDEP 2020). The coastal portion of the geographic analysis area for coastal habitat and fauna is a small subset of this much larger coastal zone area. The geographic analysis area encompasses portions of coastal New Jersey within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area and includes tidal and non-tidal waters (including wetlands), maritime dune and beach areas, forested areas, and developed areas (e.g., residential, commercial, industrial, and linear development). The onshore export and interconnection cables, onshore substations and/or converter stations, and O&M facility are located primarily along or within existing roadway corridors and railroad ROWs.

Invasive plant species commonly associated with disturbed and urban areas occur, often at high densities, throughout the Onshore Project area. Due to the high level of development, impervious surfaces, and other such areas that are devoid of vegetation within the onshore export and interconnection cable construction corridors, onshore substations and/or converter stations, and O&M facility, invasive plant species are concentrated within and adjacent to disturbed wetlands and streams as well as along vegetated edges of public roadways.

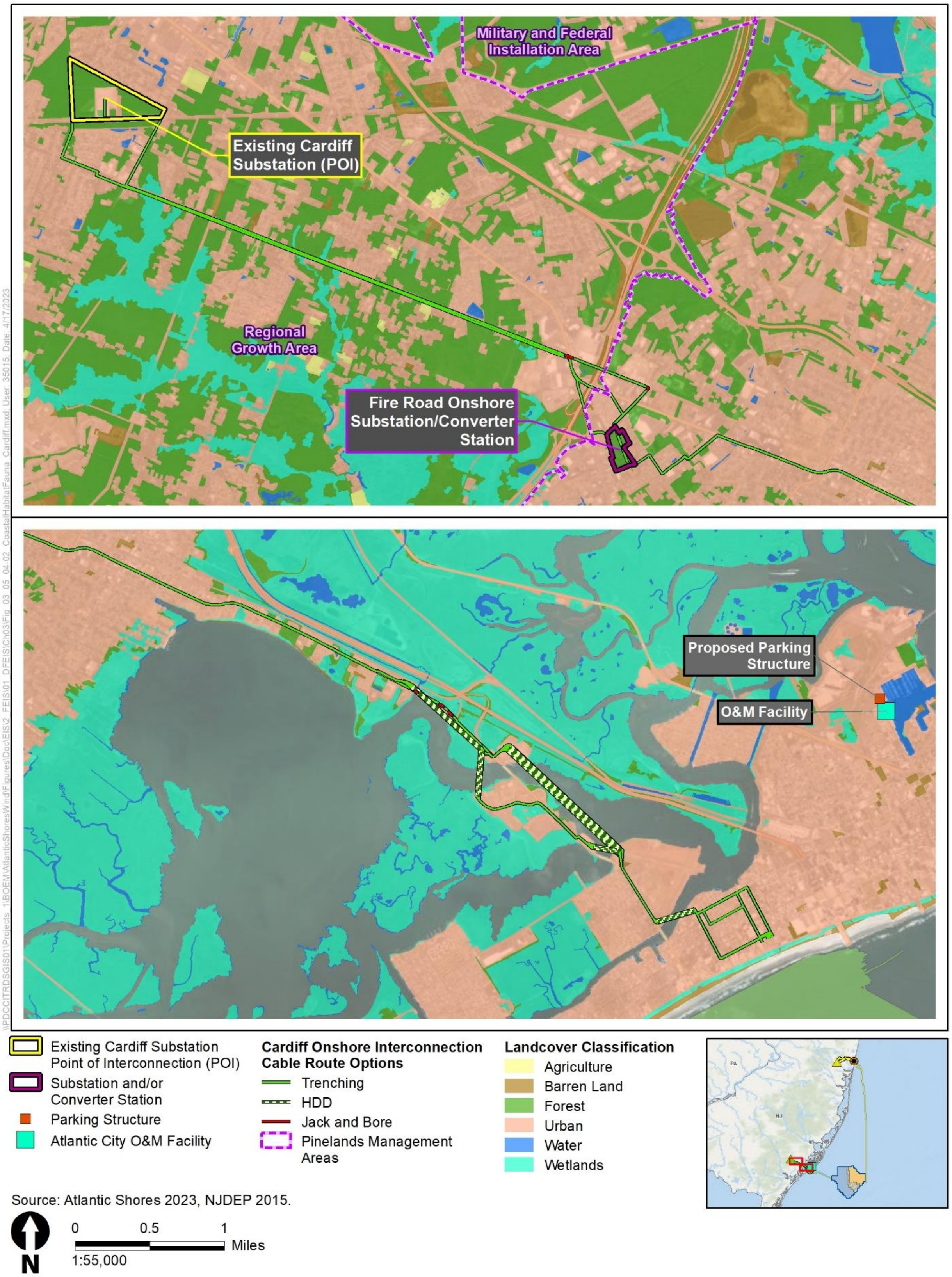


Figure 3.5.4-1. Coastal habitat and fauna geographic analysis area for Project 1

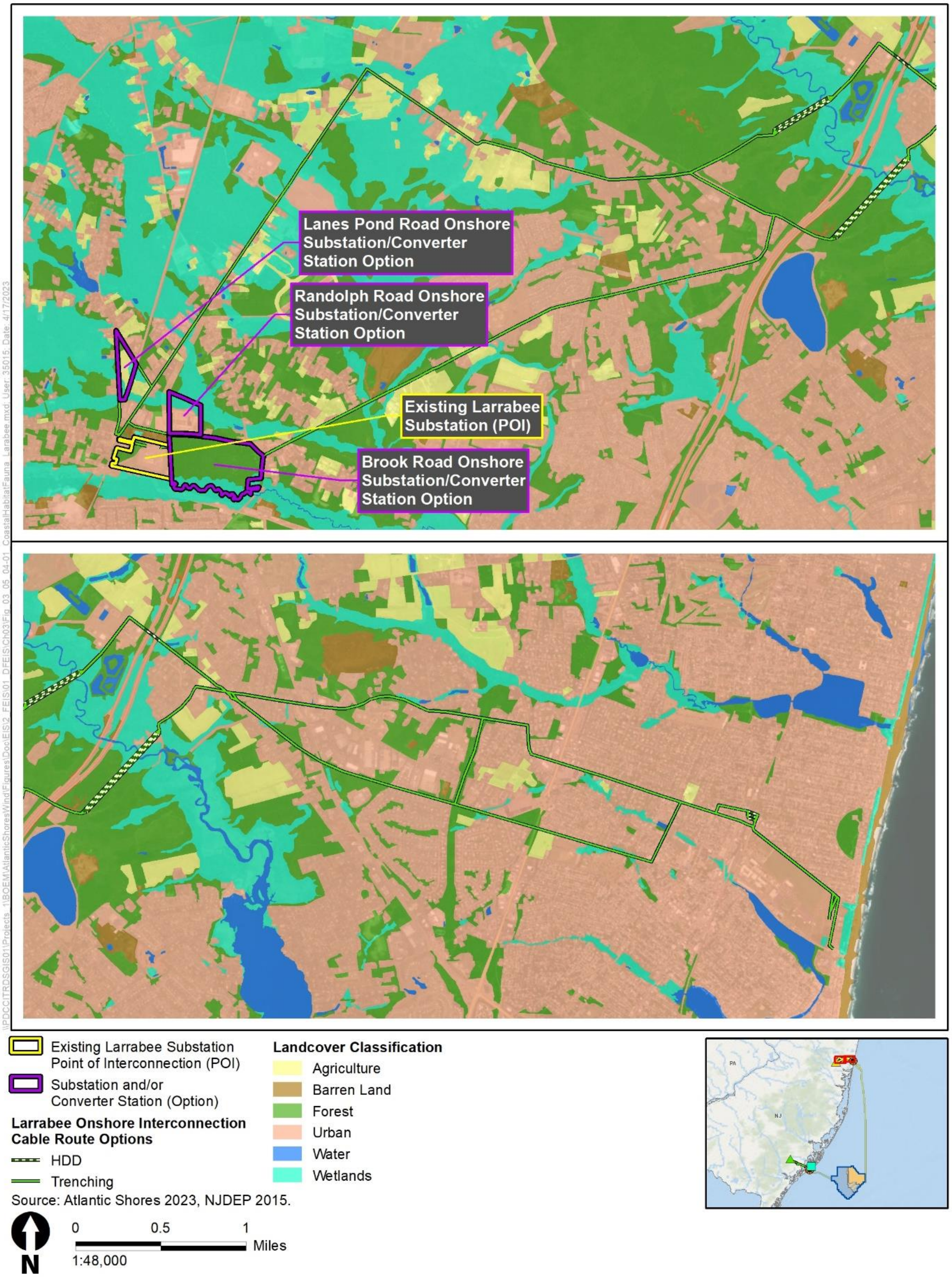


Figure 3.5.4-2. Coastal habitat and fauna geographic analysis area for Project 2

Project 1

Portions of the geographic analysis area associated with Project 1 within the Atlantic Shores South Project overlap with mapped New Jersey Pinelands shown on Figure 3.5.4-2. The Pinelands ecosystem covers a large area of southern New Jersey characterized by unconsolidated sand and gravel with a shallow aquifer that is characteristically acidic and nutrient poor, and specialized plant and animal species adapted to these conditions and to wildfires. The Pinelands area is protected under the Pinelands Protection Act (New Jersey Statutes Annotated 13:18-1 et seq.), managed by the Pinelands Commission and is defined by three separate zones: protected areas, managed use areas, and zones of cooperation. Part of the Onshore Project area for Project 1 overlaps with the Pinelands Area of Egg Harbor Township that is designated as a “Regional Growth Area” (i.e., a managed use area). The Onshore Project area for Project 1 does not intersect with any Pinelands designated protected area (State of New Jersey 2021a, 2021b; Pinelands Preservation Alliance 2021).

The Onshore Project area for Project 1 consists of approximately 59 percent developed or disturbed area. The remainder of the Onshore Project area consists of mixed forest, scrub-shrub wetlands, shrublands (i.e., evergreen, deciduous, and mixed shrublands), herbaceous fields, herbaceous tidal and non-tidal wetlands, and forested wetlands. Apart from tidal herbaceous wetlands and the mixed upland forest at the Cardiff POI and substation/interconnection substation site, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat. Table 3.5.4-1 summarizes the acreage of each habitat type observed within the Onshore Project area for Project 1 according to the Atlantic Shores Habitat Assessment Survey. These habitat types and locations are shown on the Habitat Assessment Mapping in COP Volume II, Appendix II-E1 (Atlantic Shores 2023).

Table 3.5.4-1. Estimated area and percent cover of habitat types within the Onshore Project area for Project 1 and temporary disturbance and permanent impacts of the Proposed Action

Habitat Type	Onshore Project Area (acres)	Percentage of Onshore Project Area	Temporary Disturbance (acres)	Permanent Impacts (acres)
Developed / Disturbed	323.84	58.70	51.50	37.76
Forest – Mixed	124.51	22.57	2.83	17.93
Water	58.27	10.56	0.00	0.00
Herbaceous Field	23.81	4.31	2.53	1.07
Herbaceous Wetland	14.93	2.71	0.04	0.31
Scrub-Shrub Wetland	0.00	0.00	0.00	0.00
Shrub – Deciduous	1.40	0.25	0.52	0.28
Shrub – Evergreen	1.08	0.20	0.01	0.01
Forested Wetlands	0.17	0.03	0.00	0.0
Scrub-Shrub	3.73	0.68	0.06	0.2
Total	**551.7**	**100.0**	**57.49**	**56.39**

Source: COP Volume II, Section 4.2.1.1, Table 4.2-1; Atlantic Shores 2023.

Due to existing levels of development and habitat degradation in the area, the wildlife community is expected to be dominated by urban-adapted, disturbance-tolerant generalist species, such as gulls (*Laridae* family), corvids (*Corvidae* family), pigeons (*Columbidae* family), starlings (*Sturnidae* family), squirrels (*Sciuridae* family), and racoons (*Procyon lotor*). Wildlife surveys conducted in the Onshore Project area for Project 1 found only urban-adapted birds, such as house sparrow (*Passer domesticus*), mourning dove (*Zenaida macroura*), herring gull (*Larus argentatus*), and laughing gull (*Leucophaeus atricilla*) and no reptiles, amphibians, or mammals (COP Volume II, Section 4.2.1.1; Atlantic Shores 2023). Coastal birds may forage or nest on beaches and in tidal wetlands adjacent to cable landfall locations, although cabling would be installed using HDD rather than open trenches to minimize disturbance to these habitats and their wildlife.

ESA-listed wildlife species included in the USFWS IPaC system (USFWS 2023) as potentially occurring in the vicinity of the Onshore Project area for Project 1 include: northern long-eared bat (*Myotis septentrionalis*; endangered), tri-colored bat (*Perimytis subflavus;* proposed endangered), piping plover (*Charadrius melodus;* threatened), red knot (*Calidris canutus;* threatened), eastern black rail (*Laterallus jamaicensis;* threatened), saltmarsh sparrow (*Ammospiza caudacuta*),[1] and monarch butterfly (*Danaus plexippus;* candidate). State-listed species recorded by NJDEP in the area include several birds, northern long-eared bat, spotted turtle (*Clemmys guttata*), and Pine Barrens treefrog (*Dryophytes andersonii*), as shown in Table 3.5.4-2 (COP Volume II, Appendix II-E1; Atlantic Shores 2023). However, none of the habitat in the Onshore Project area for Project 1 is suitable or federally or state-designated as "critical" for any of these species, because of existing levels of development and human disturbance. Beaches that have the potential to support ESA-listed piping plovers and red knots would not be affected by landfall or cabling routes for Project 1, because of below-ground cable installation using HDD rather than open trenches.

Four federally listed plant species (American chaffseed [*Schwalbea americana;* endangered], Knieskern's beaked-rush [*Rhynchospora knieskernii*; threatened], seabeach amaranth [*Amaranthus pumilus*; threatened], and swamp pink [*Helonias bullata*; threatened]) were identified as having the potential to be present within the Onshore Project area for Project 1. In addition, three state-listed plant species (seabeach knotweed [*Polygonum glaucum*; state-listed endangered], large-calyx goosefoot [*Chenopodium berlandieri* var. *macrocalycium*; plant species of concern], and seaside plantain [*Plantago maritima* var. *juncoides*; plant species of concern]) were identified as having the potential to be present within the Onshore Project area for Project 1. However, suitable habitat for these species (i.e., beaches) would be entirely avoided, because the export cable makes landfall via HDD from an offshore location.

Table 3.5.4-2. State-listed species recorded by NJDEP near the Onshore Project area for Project 1

Scientific Name	Common Name	New Jersey State Conservation Status
Falco peregrinus	Peregrine falcon	Endangered
Haliaeetus leucocephalus	Bald eagle	Endangered
Rynchops niger	Black skimmer	Endangered
Sternula antillarum	Least tern	Endangered
Nyctanassa violacea	Yellow-crowned night-heron	Threatened

[1] Included although not identified in IPaC. Currently under consideration by USFWS for ESA listing, but not a Candidate or Proposed species.

Scientific Name	Common Name	New Jersey State Conservation Status
Nycticorax	Black-crowned night-heron	Threatened
Bubulcus ibis	Cattle egret	Threatened
Pandion haliaetus	Osprey	Threatened
Strix varia	Barred owl	Threatened
Ardea herodias	Great blue heron	Special concern
Egretta caerulea	Little blue heron	Special concern
Egretta thula	Snowy egret	Special concern
Egretta tricolor	Tricolored heron	Special concern
Gelocehelidon nilotica	Gull-billed tern	Special concern
Helmitheros vermivorum	Worm-eating warbler	Special concern
Hydroprogne caspia	Caspian tern	Special concern
Plegadis falcinellus	Glossy ibis	Special concern
Sterna hirundo	Common tern	Special concern
Myotis septentrionalis	Northern myotis	Endangered
Clemmys guttata	Spotted turtle	Special concern
Dryophytes andersonii	Pine barrens treefrog	Endangered

Project 2

The Onshore Project area for Project 2 consists of approximately 57 percent developed or disturbed areas. The remainder of the Onshore Project area consists of edges of mixed forest; scrub-shrub old fields; herbaceous fields; beach with vegetation; agricultural pastures; and forested, scrub-shrub, and herbaceous non-tidal wetlands. Apart from wetlands and stream crossings, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat.

Table 3.5.4-3 and Figure 3.5.4-2 summarize the acreage of each habitat type observed within the Onshore Project area for Project 2 according to the Atlantic Shores Habitat Assessment Survey. These habitat types and locations are shown on the Habitat Assessment Mapping in COP Volume II, Appendix II-E2 (Atlantic Shores 2023).

Table 3.5.4-3. Estimated area and percent cover of habitat within the Onshore Project area for Project 2 and temporary disturbance and permanent impacts of the Proposed Action

Habitat Type	Onshore Project Area (acres)	Percentage of the Onshore Project Area	Temporary Disturbance (acres)	Permanent Impacts (acres)
Developed / Disturbed	359.02	57.4	58.90	64.57
Forest – Deciduous[1]	99.09	15.8	0.40	2.38
Forest – Mixed	76.23	12.2	1.94	11.62
Shrub – Evergreen	38.17	6.1	0.00	0.00
Forested Wetland	13.45	2.2	0.48	0.09
Agricultural	12.52	2.0	0.01	9.49
Herbaceous Field	10.53	1.7	0.40	2.72
Water	5.08	0.8	0.02	0.00
Forest Evergreen	7.36	1.2	0.13	0.08
Herbaceous Wetland	1.89	0.3	0.02	0.19

Habitat Type	Onshore Project Area (acres)	Percentage of the Onshore Project Area	Temporary Disturbance (acres)	Permanent Impacts (acres)
Scrub-Shrub	1.12	0.2	0.00	0.00
Beach with Vegetation	0.60	0.1	0.00	0.00
Scrub-Shrub Wetland	0.24	0.0	0.00	0.00
Total	**625.31**	**100.0**	**62.30**	**79.52**

Source: COP Volume II, Section 4.2.1.1, Table 4.2-2; Atlantic Shores 2023.
[1] The anticipated area of tree clearing provided here is the total for the Proposed Action; only one substation and/or converter station would be used for Project 2 (Lanes Pond Road Site, Brook Road Site, or Randolph Road Site); however, the Brook Road Site would be prepared and developed as part of New Jersey's SAA. All siting, environmental review, permitting, and other preparation activities for the Brook Road Site would be completed by MAOD (or the designated lead state or federal agency, as appropriate. Thus, no tree clearing at the Brook Road Site is included as part of the Proposed Action.

Due to existing levels of development and habitat degradation in the area, the wildlife community is expected to be dominated by urban-adapted, disturbance-tolerant generalist species. Wildlife surveys conducted in the Onshore Project area for Project 2 found only common, urban-adapted birds, such as herring gull, laughing gull, house sparrow, northern cardinal (*Cardinalis cardinalis*), eastern bluebird (*Sialia sialis*), and mourning dove; and no reptiles, amphibians, or mammals (COP Volume II, Section 4.2.1.2; Atlantic Shores 2023). ESA-listed wildlife species included in the USFWS IPaC system (USFWS 2023) as potentially occurring in the vicinity of the Onshore Project area for Project 2, include northern long-eared bat (endangered), tri-colored bat (proposed endangered), piping plover (threatened), red knot (threatened), piping plover (threatened) bog turtle (*Glyptemys muhlenbergii;* threatened) and monarch butterfly (candidate). State-listed species recorded by NJDEP in the area include several birds, reptiles, amphibians, and insects, as shown in Table 3.5.4-4. No suitable or critical habitat to support these species occurs in the Onshore Project area for Project 2, although some species may occur in adjacent areas where more suitable habitat is present (COP Volume II, Appendix II-E2; Atlantic Shores 2023).

Table 3.5.4-4. State-listed species recorded by NJDEP near the Onshore Project area for Project 2

Scientific Name	Common Name	New Jersey State Conservation Status
Circus cyaneaus	Northern harrier	Endangered
Charadrius melodus	Piping plover	Endangered
Haliaeetus leucocephalus	Bald eagle	Endangered
Sternula antillarum	Least tern	Endangered
Eremophila alpestris	Horned lark	Threatened
Falco sparverius	American kestrel	Threatened
Nyctanassa violacea	Yellow-crowned night-heron	Threatened
Nycticorax	Black-crowned night-heron	Threatened
Pandion haliaetus	Osprey	Threatened
Strix varia	Barred owl	Threatened
Accipiter cooperii	Coopers hawk	Special concern
Ardea herodias	Great blue heron	Special concern
Catharus fuscescens	Veery	Special concern
Egretta thula	Snowy egret	Special concern
Egretta tricolor	Tricolored heron	Special concern

Scientific Name	Common Name	New Jersey State Conservation Status
Haematopus palliatus	American oystercatcher	Special concern
Hylocichla mustelina	Wood thrush	Special concern
Plegadis falcinellus	Glossy ibis	Special concern
Toxostoma rufum	Brown thrasher	Special concern
Wilsonia citrina	Hooded warbler	Special concern
Glyptemys muhlenbergii	Bog turtle	Endangered
Glyptemys insculpta	Wood turtle	Threatened
Terrapene carolina	Eastern box turtle	Special concern
Hyla andersonii	Pine barrens treefrog	Threatened
Anaxyrus fowleri	Fowler's toad	Special concern
Gramma placentia	Plancentia tiger moth	Endangered
Metarranthis pilosaria	Coastal bog metarranthis	Special concern
Uvularia puberula var. *nitida*	Pine barren bellwort	Endangered

Source*:* COP Volume II, Appendix II-E2; Atlantic Shores 2023.

Three federally listed plant species (American chaffseed [*Schwalbea americana*; endangered], seabeach amaranth [*Amaranthus pumilus*; threatened], and swamp pink [*Helonias bullata*; threatened]) were identified as having the potential to be present within the Onshore Project area for Project 2. In addition, five state-listed plant species (seabeach knotweed, large-calyx goosefoot, seaside plantain, pale Indian plantain [*Arnoglossum atriplicifolium*; state-listed endangered], and salt-marsh spike-rush [*Eleocharis halophila*; plant species of concern] were identified as having the potential to be present within the Onshore Project area for Project 2. Suitable habitat for all of these species, with the exception of pale Indian plantain, would be entirely avoided because the export cable makes landfall via HDD from an offshore location. Suitable habitat for pale Indian plantain is present, and therefore this species is likely to occur within the Onshore Project area for Project 2.

O&M Facility

The Onshore Project area for the O&M facility, shown on Figure 3.5.4-2, is located in an urbanized area and consists of approximately 82 percent developed or disturbed land uses, with the remaining 18 percent consisting of the surface waters of Clam Creek (COP Volume II, Appendix II-E1; Atlantic Shores 2023).

Due to heavy levels of urban development in the Onshore Project area, the wildlife community is dominated by urban-adapted, disturbance-tolerant generalist species, such as gulls, pigeons, house sparrows, squirrels, striped skunk (*Mephitis mephitis*), and raccoons (COP Volume II, Appendix II-E1; Atlantic Shores 2023).

ESA-listed wildlife species included in the USFWS IPaC system (USFWS 2023) as potentially occurring in the vicinity of the Onshore Project area for Project 1 include: tri-colored bat (proposed) piping plover (threatened), red knot (threatened), and eastern black rail (threatened). ESA-listed plants include seabeach amaranth (threatened). State-listed species recorded by NJDEP in the vicinity of the O&M facility were reported in conjunction with those in the Project 1 area (see Table 3.5.4.4; COP Volume II,

Appendix II-E-2; Atlantic Shores 2023). However, given the highly developed nature of the O&M facility site, no occurrence of protected species is anticipated within the Onshore Project area for the O&M facility.

3.5.4.2 Impact Level Definitions for Coastal Habitat and Fauna

This Draft EIS uses a four-level classification scheme to characterize potential impacts of the alternatives, including the Proposed Action, as shown in Table 3.5.4-5. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions. There are no beneficial impacts on coastal habitat and fauna.

Table 3.5.4-5. Impact level definitions for coastal habitat and fauna

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

3.5.4.3 Impacts of Alternative A – No Action on Coastal Habitat and Fauna

When analyzing the impacts of the No Action Alternative on coastal habitat and fauna, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for coastal habitat and fauna. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for coastal habitats and fauna described in Section 3.5.4.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities (see Section D.2 in Appendix D for a description of ongoing activities). Ongoing activities within the geographic analysis area that contribute to impacts on coastal habitats and fauna include onshore residential, commercial, and industrial development and climate change. Ongoing onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect coastal habitats and fauna. Onshore construction activities and associated impacts are expected to continue and have the potential to affect coastal habitat and fauna through temporary and permanent loss of coastal habitat and temporary noise impacts, which can cause avoidance behavior and displacement. Injury or mortality of individual animals could occur, but population-level effects would not be expected.

Climate change would contribute to impacts on coastal habitats and fauna through global warming, sea level rise, and resulting modifications to species' habitat and ecology. Climate change and associated intense storms and sea level rise will result in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides in the mid-Atlantic and southern New England regions (USDA n.d.). Climate change may also affect coastal habitats through increases in instances and severity of droughts and range expansion of invasive species. Warmer temperatures will cause plants to flower earlier, will not provide needed periods of cold weather, and will likely result in declines in reproductive success of plant and pollinator species. Increased temperatures could lead to changes in mating, nesting, reproductive, and foraging behaviors of species. The effects of climate change on animals will likely include loss of habitat, population declines, increased risk of extinction, decreased reproductive productivity, and changes in species distribution; New Jersey is warming faster than other areas of the region (NJDEP 2020). See Appendix D, Table D.A1-5 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for coastal habitat and fauna.

There are no ongoing offshore wind activities within the geographic analysis area for coastal habitat and fauna.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered impacts of the No Action Alternative in combination with the other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned activities within the geographic analysis area that would contribute to impacts on coastal habitats and fauna would be similar to ongoing activities in terms of their nature and impacts (see Section D.2 in Appendix D for a description of planned activities). Planned activities may result in loss of coastal habitat and short-term or permanent displacement and injury or mortality of individual animals, but population-level effects would not be expected.

BOEM expects planned offshore wind development activities to affect coastal habitat and fauna through the following primary IPFs.

Land disturbance: BOEM anticipates that any planned offshore wind activities would require minimal disturbance of undisturbed lands and habitats given the extent of the highly developed areas and urbanized landscapes of the geographic analysis area. Some clearing of vegetation may be required for constructing the landfall, widening a transmission right-of-way, or clearing the substation footprint, but construction would be expected to generally occur in previously disturbed areas and areas generally fragmented or disconnected from other natural habitats. Traffic during the use of construction and maintenance equipment could result in collisions with wildlife. However, it is anticipated that these collisions would be rare because wildlife presence is expected to be limited due to the urban environment and because most individuals are expected to avoid construction areas or have the mobility to avoid construction equipment. Therefore, no individual fitness or population-level impacts on wildlife would be expected to occur during land disturbance activities. Furthermore, onshore construction associated with planned offshore wind development would not be expected to appreciably contribute to cumulative impacts on wildlife.

Lighting: Nighttime lighting associated with planned offshore wind activities would not be expected to affect coastal fauna at the individual or population level because of the high existing levels of development and associated light pollution in the geographic analysis area, and the anticipated placement of most onshore wind components within developed areas. Additional lighting associated with planned offshore wind development would not be expected to increase existing levels to an extent that would be capable of impacting coastal fauna.

Noise: Onshore construction noise associated with any planned offshore wind activities could result in temporary and highly localized impacts at the landing site, along the onshore export cable route, and at the onshore substation location. Impacts, if any, would be limited to behavioral avoidance of construction activity and noise. Displaced wildlife could use adjacent habitat and would likely return to these areas once construction ceases. Construction would likely occur in the highly developed and urbanized landscape areas where wildlife is already habituated to human activity and noise. Therefore, no individual fitness or population-level effects on wildlife would be expected.

Presence of structures: Additional structures and cables that are anticipated to be constructed in association with planned offshore wind activities would not be expected to affect coastal fauna at the individual or population level considering the high existing levels of development in the geographic analysis area and the anticipated placement of most onshore wind components within developed areas.

Traffic: Additional traffic that would occur in association with planned offshore wind activities would not be expected to affect coastal fauna at the individual or population level considering the high existing levels of development and human activity in the geographic analysis area and the anticipated placement of most onshore wind components within developed areas. Additional vehicle and equipment activity associated with future offshore wind would not be expected to increase existing levels to an extent that would impact coastal fauna.

Impacts of Alternative A – No Action on ESA-Listed Species

ESA-listed fauna and flora with the potential to occur in the geographic analysis area include the northern long-eared bat, tricolored bat, eastern black rail, saltmarsh sparrow, piping plover, roseate tern, *Rufa* red knot, bog turtle, monarch butterfly, American chafseed, Knieskern's beaked-rush, seabeach amaranth, and swamp pink. Planned non-offshore wind activities without the Proposed Action are not expected to significantly impact populations of ESA-listed species.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, baseline conditions for coastal habitats and fauna would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on coastal habitats and fauna, primarily through onshore construction and climate change. BOEM anticipates that the potential impacts on coastal habitats and fauna as a result of ongoing activities associated with the No Action Alternative would be **negligible** to **moderate** due to the previously disturbed and developed landscape in which the ongoing activities would occur and the temporary and localized nature of many of the disturbances that would occur as a result of the ongoing construction activities and climate change.

Cumulative Impacts of Alternative A – No Action. In addition to ongoing activities, BOEM anticipates that the impacts of planned activities other than offshore wind would be minor. BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in overall **negligible** to **moderate** impacts on coastal habitats, primarily driven by ongoing activities.

Currently, there are no planned offshore wind activities proposed in the geographic analysis area. If any were to occur, they would have some potential to result in temporary disturbance and permanent loss of onshore habitat. However, habitat removal is anticipated to be minimal due to the developed and urbanized landscape of the geographic analysis area. Any impacts resulting from habitat loss or disturbance would not be expected to result in population-level effects on species within the geographic analysis area.

3.5.4.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on coastal habitat and fauna:

- The onshore export cable routes, including routing variants, and extent of ground disturbance, which could require the removal of vegetation; and
- The onshore substations/converter stations, which could require the removal of trees and shrubs in or on the edge of the construction footprint for the substations.

Variability of the proposed Project design exists as outlined in Appendix D. Below is a summary of potential variances in impacts:

- Onshore export cable routes and substation/converter station footprints: The route chosen (including variations of the general route) and substation footprints would determine the amount of habitat affected.

3.5.4.5 Impacts of Alternative B – Proposed Action on Coastal Habitat and Fauna

This section summarizes the potential impacts of the Proposed Action on coastal habitat and fauna, including special-status species, during the various phases of the Project. Phases would include construction and installation, O&M, and conceptual decommissioning of the Project, as described in Chapter 2, *Alternatives*. Potential impacts of these phases are assessed for onshore and offshore activities and facilities.

Construction and installation, O&M, and decommissioning of the Proposed Action would include both onshore and offshore activities. Anticipated onshore activities would include installation of the interconnection cable and construction of the onshore substation or converter station; remote monitoring of offshore structures, maintenance of onshore substations or converter stations, and maintenance of interconnection cables; and removal of onshore cables. Time of year restrictions for construction would be followed, as required, through permitting and resource agency consultation (COA-06; Appendix G, Table G-1). Environmental/Construction Monitors would be assigned to ensure compliance with applicable permit conditions and BMPs during construction (COA-09; Appendix G, Table G-1). Anticipated offshore activities include installation of the submarine export cable, WTG foundations, interarray and interlink cables, and construction and commissioning of the WTGs and OSSs or OCS; inspection and maintenance of WTGs, structural inspection, and maintenance of OSSs; inspection and maintenance of scour protection at WTG foundations and along the interarray and export cables, and submarine cable surveys and maintenance; removal, disassembly, and shipment of WTGs and OSS structures to shore; potential removal of foundations from WTGs and OSSs; and potential removal of offshore cables and cable protection. Effects of IPFs associated with these activities on coastal habitat and fauna are discussed below.

Land disturbance: The potential impacts of onshore construction associated with the Proposed Action would not increase the impacts of this IPF beyond those described under the No Action Alternative. Onshore land-disturbing activities (e.g., trenching, excavating, and grading) associated with the Proposed Action would be limited to existing roadways, railroads, and other established ROWs, and adjacent disturbed habitat fragments to the maximum extent practicable (COA-01; Appendix G, Table G-1). Impacts on wildlife and their habitat are expected to be short term and localized.

Installation of the onshore interconnection cables would occur in disturbed upland areas via direct trenching and excavation. Trenchless installation (e.g., jack-and-bore, jack piping, and HDD) would be used to cross surface waters, wetlands, and other sensitive habitats (COA-03, GEO-15; Appendix G, Table G-1). Therefore, construction and installation of the onshore interconnection cables would result in minor impacts on wildlife and their habitat. Similarly, HDD would be used at the Atlantic and Monmouth Landfall sites to avoid sensitive maritime beach and dune habitats, and sensitive coastal wildlife, like beach-nesting birds. Onshore cables would be buried, to avoid collision risk to birds associated with overhead structures and conductors (BIR-10; Appendix G, Table G-1). Land-disturbing activities associated with the Proposed Action at the Monmouth Landfall site would occur in coordination with the U.S. National Guard Training Center’s local beach manager to ensure consistency with the Local Beach Management Plan and in consultation with NJDEP. In addition, use of HDD at the landfall sites and installation at depths designed to prevent exposure of the cable due to beach erosion (based on coordination with USACE, local geotechnical information, and hydrofracture analysis) would also prevent the potential of dune collapse at the landfall sites. No portions of the Onshore Project areas for the Atlantic Shores South Project would overlap with protected areas of the New Jersey Pinelands.

Tree trimming and clearing of immature trees during winter months would occur, and only where necessary during construction and installation of the Project, thereby minimizing impacts on wildlife and their habitat (COA-02; Appendix G, Table G-1). Brush/tree clearing would be minimized to the maximum extent practicable and would not include mature trees (BAT-07, BIR-12; Appendix G, Table G-1). Siting of onshore facilities would avoid bat habitat to the maximum extent practicable (BAT-06; Appendix G, Table G-1).

Construction and installation of the Project would comply with a New Jersey Division of Land Resource Protection approved New Jersey Pollutant Discharge Elimination System permit and a Stormwater Pollution Prevention Plan (including a Stormwater Management Control Plan, and would utilize BMPs, including implementation of a certified Soil Erosion and Sediment Control Plan from the appropriate County Conservation District, to avoid indirect impacts on sensitive habitats (COA-07; Appendix G, Table G-1). Temporarily disturbed areas would be restored to preconstruction conditions as required and where necessary through seeding or repaving, in accordance with the approved Soil Erosion and Sediment Control Plan (COA-08, GEO-20; Appendix G, Table G-1). BMPs would be used to properly contain excavated soils and sediments to avoid erosion and sediment runoff; BMPs would be regularly monitored (GEO-17, GEO-18, GEO-19; Appendix G, Table G-1). Potential impacts on the state-listed endangered pale Indian plantain would be coordinated through the New Jersey Division of Watershed Protection & Restoration, Endangered & Threatened Species Unit during the permitting process.

Lighting: Most of the area where Onshore Project components would be constructed is highly developed and urbanized; therefore, existing levels of artificial light at night are currently high. Wildlife inhabiting these areas is therefore inherently tolerant of artificial light at night and additional, highly localized nighttime lighting associated with the Onshore Project components would represent a negligible increase in current levels of light pollution that would not alter wildlife community composition, population sizes, or individual fitness. Furthermore, nighttime lighting associated with the Onshore Project components would not be present within sensitive maritime beach or dune habitats. Onshore construction lighting would be temporary and localized to the work area, and light would be limited during onshore operations to the minimum required by regulation and for safety, minimizing the potential for any light-driven attraction of birds (BAT-09, BIR-12 and BIR -13; Appendix G, Table G-1).

Noise: Construction noise could lead to temporary and highly localized disturbance and displacement of wildlife. Displaced individuals would likely return to the affected areas once the noise has ended. It is possible that individuals could experience repeated stress events if they returned to the site at night, when construction has paused, only for construction to drive them away again in the morning. Lower decibel construction equipment would be utilized when feasible (COA-04; Appendix G, Table G-1). Construction would also be conducted during permitted hours, to the maximum extent practicable, when ambient noise levels are highest (COA-05; Appendix G, Table G-1). BMPs would be implemented to minimize onshore construction noise (BAT-11; Appendix G, Table G-1). BOEM expects these impacts to be limited and short term in nature. Normal operation of the substation/converter stations would generate continuous noise, but BOEM expects minimal associated impacts in the context of existing noises near the proposed substations/converter stations that are generated from the highly developed and urbanized landscape around the substation sites. The impacts on coastal habitats and fauna of noise from the Proposed Action alone would add to the impacts of other anthropogenic noise. Terrestrial fauna may habituate to noise so that it has little to no effect on their behavior or biology (Kight and Swaddle 2011). Considering that most of the onshore area where the Onshore Project components would be constructed is highly developed and urbanized, terrestrial fauna in this area are likely to be already subject to and habituated to anthropogenic noise. Decommissioning noise could lead to temporary and highly localized disturbance and displacement of wildlife comparable to that assessed for construction and installation of the Proposed Action. Overall, the impacts on coastal habitats and fauna from noise associated with ongoing and planned actions, including the Proposed Action, are anticipated to be negligible, and no individual fitness or population-level effects on wildlife would be expected.

Presence of structures: Most of the area where Onshore Project components would be operating is highly developed and urbanized; therefore, the wildlife communities there are composed of disturbance-tolerant species inhabiting an area with numerous existing structures, cables, and other infrastructure. Additional structures and cables from the Onshore Project components would not alter the characteristics of the existing environment to an extent that would alter wildlife species composition, population sizes, or individual fitness.

Offshore construction and installation, O&M, and conceptual decommissioning activities for the Proposed Action are outside of the geographic analysis area for coastal habitat and fauna and would therefore not produce any IPFs for these resources.

Traffic: Most of the onshore area where the Onshore Project components would be constructed is highly developed and urbanized; therefore, the wildlife communities there are composed of disturbance-tolerant species inhabiting an area with high existing levels of motorized vehicle and equipment activity. HDD would be used at the Atlantic and Monmouth Landfall sites to avoid sensitive maritime beach and dune habitats, and sensitive coastal wildlife, like beach-nesting birds (COA-03; Appendix G, Table G-1). Therefore, no motor vehicle and equipment activity associated with the Onshore Project components would occur within maritime beach and dune habitats. Motor vehicle and equipment activity associated with the Onshore Project components would represent a negligible increase in baseline levels of anthropogenic noise and activity that would not alter the characteristics of the existing environment to an extent that would alter wildlife species composition, population sizes, or individual fitness. Individual fauna mortality due to collisions with vehicles and equipment may occur, particularly for species with limited mobility, but would not likely be a common occurrence.

Impacts of the Connected Action

As described in Chapter 2, bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per (40 CFR 1501.9(e)(1)). The bulkhead site and dredging activities are in-water activities that would be conducted entirely within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area, directly adjacent to the proposed O&M facility, with a majority of that area consisting of maintenance dredging. The surrounding land is characterized as an urbanized area and consists primarily of developed or disturbed land uses and surface waters.

Due to the developed and disturbed nature of the surrounding area, the wildlife community is dominated by urban-adapted, disturbance-tolerant generalist species, such as gulls, pigeons, house sparrows, squirrels, striped skunk, and raccoons. There are no documented occurrences of federally or state-listed threatened and endangered species within the Onshore Project area for the O&M facility, directly adjacent to the area of work for the connected action.

BOEM expects the activities associated with the connected action to affect coastal habitat and fauna primarily through the accidental releases and noise IPFs. Other IPFs considered under the Proposed Action do not apply (e.g., cable emplacement and maintenance, traffic [aircraft]), and because the surrounding area consists of existing structures and other infrastructure, the presence of structures IPF would not pose a substantial risk to birds. Additionally, because all activities associated with the connected action are in-water activities, the land disturbance IPF does not apply.

Accidental releases: In-water construction activities would require heavy equipment use, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Some potential exists for impacts on coastal fauna (e.g., injury from exposure) due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with dredging and construction equipment in the aquatic and terrestrial environment around Inlet Marina. An SPCC plan would be developed and implemented to avoid, minimize, and contain spills. Accidental releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on birds. In addition, all dredging equipment/use of watercraft and in-water work would comply with federal, state, and local permitting (e.g., CWA Sections 404 and 401) requirements for prevention and control of petrochemical spills, including oil and fuel. Normal operation at the O&M facility at Inlet Marina could result in accidental releases, but BOEM expects negligible impacts due to federal, state, and local requirements to contain and clean up releases. Therefore, BOEM anticipates the impacts from accidental releases associated with the connected action to be negligible.

Noise: As with the Proposed Action, construction noise could lead to temporary and highly localized disturbance and displacement of wildlife. Displaced individuals would likely return to the affected areas once the noise has ended. It is possible that individuals could experience repeated stress events if they returned to the site at night, when construction has paused, only for construction to drive them away again in the morning. Lower decibel construction equipment would be utilized when feasible. Construction would also be conducted during permitted hours, to the maximum extent practicable, when ambient noise levels are highest. BOEM expects these impacts to be limited and short term in nature. The impacts on coastal habitats and fauna of noise from the connected action alone would add to the impacts of other anthropogenic noise. Terrestrial fauna may habituate to noise so that it has little to no effect on their behavior or biology (Kight and Swaddle 2011). Considering that most of the onshore area adjacent to the connected action would be highly developed and urbanized, terrestrial fauna in this area are likely to be already subject to and habituated to anthropogenic noise, like noise that will occur during the in-water work. The cumulative impacts on coastal habitats and fauna from noise associated with the connected action are anticipated to be negligible, and no individual fitness or population-level effects on wildlife would be expected.

Impacts of Alternative B – Proposed Action on ESA-Listed Species

ESA-listed fauna and flora with the potential to occur in the geographic analysis area include the northern long-eared bat, tricolored bat, eastern black rail, saltmarsh sparrow, piping plover, roseate tern, *Rufa* red knot, bog turtle, monarch butterfly, American chafseed, Knieskern's beaked-rush, seabeach amaranth, and swamp pink. BOEM is preparing a BA for the potential effects on USFWS federally listed species. A preliminary draft found that the Proposed Action *may affect but is not likely to adversely affect* ESA-listed species in the Onshore Project area.[2] There is no critical habitat designated for this species. Consultation with USFWS pursuant to Section 7 of the ESA is ongoing, and results of the consultation will be presented in the Final EIS.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on coastal habitat and fauna through the primary IPFs of land disturbance and noise. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. BOEM is not aware of any planned offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for coastal habitat and fauna. However, if habitat removal is anticipated, it would be minimal, and any related impacts would not be expected to result in individual fitness or population-level effects in the geographic analysis area. The onshore cable routes and substation/converter station locations are within a previously disturbed and developed landscape. Most disturbance associated with the Proposed Action would be temporary and localized. Impacts of the Proposed Action when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be negligible to moderate within the geographic analysis area.

Conclusions

Impacts of Alternative B – Proposed Action. In summary, activities associated with the construction and installation, O&M, and conceptual decommissioning of the Proposed Action alone would have **negligible** to **minor** impacts on coastal habitats and fauna due to the developed and urbanized landscape that dominates the geographic analysis area and measures taken to avoid sensitive habitat. The primary impacts of the Proposed Action affecting coastal habitats and fauna would be long-term, but localized,

---

[2] Potential effects associated with the Offshore Project area for the Proposed Action on ESA-listed species are further discussed in Sections 3.5.1, *Bats*, and 3.5.3, *Birds*.

habitat loss and conversion from the presence of onshore substations/converter stations. The connected action activities would have **negligible** impacts on coastal habitats and fauna due to the developed and urbanized landscape that dominates the surrounding area where activities are proposed.

Cumulative Impacts of Alternative B – Proposed Action. BOEM anticipates that the cumulative impacts on coastal habitat and fauna in the geographic analysis area would range from **negligible** to **moderate** due to the previously disturbed and developed landscape in which the activities associated with the Proposed Action would occur and the temporary and localized nature of many of the disturbances that would occur as a result of the activities associated with the Proposed Action. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the impacts from ongoing and planned activities would result in **negligible** to **moderate** impacts on wildlife in the geographic analysis area. Ongoing and planned activities contributing to impacts on wildlife in the geographic analysis area include habitat impacts.

3.5.4.6 Impacts of Alternatives C, D, E, and F on Coastal Habitat and Fauna

Impacts of Alternatives C, D, E, and F. Impacts on coastal habitat and fauna under Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would be the same as those of the Proposed Action because these alternatives would differ only with respect to the offshore components of the Proposed Action, which would be outside of the geographic analysis area for these resources. Therefore, impacts resulting from individual IPFs associated with onshore construction and installation, O&M, and decommissioning under Alternatives C, D, E, and F on coastal habitat and fauna would be the same as those of the Proposed Action and are expected to be **negligible** to **minor**.

Construction and installation, O&M, and decommissioning of Alternatives C, D, E, and F would only differ from the Proposed Action in terms of offshore facilities. Onshore activities and facilities would be the same as those described under the Proposed Action.

Impacts associated with onshore construction and installation, O&M, and decommissioning activities for Alternatives C, D, E, and F would be identical to the impacts of onshore construction and installation, O&M, and decommissioning activities associated with the Proposed Action.

Offshore construction and installation, O&M, and decommissioning activities for Alternatives C, D, E, and F would not cause IPFs for coastal habitat and fauna.

Cumulative Impacts of Alternatives C, D, E, and F. The contribution of Alternatives C, D, E, and F to the impacts of ongoing and planned activities would be the same as that of the Proposed Action. Therefore, the cumulative impacts on coastal habitat and fauna from ongoing and planned activities in combination with each of these action alternatives would be the same as that described for the Proposed Action (**negligible** to **moderate**).

Impacts of Alternatives C, D, E, and F on ESA-Listed Species

Impacts of Alternatives C, D, E, and F on ESA-listed species are identical to the impacts previously described for the Proposed Action.

Conclusions

Impacts of Alternatives C, D, E, and F. The expected impacts associated with the Proposed Action alone would not change under Alternatives C, D, E, and F because each of these alternatives would only differ in terms of the offshore components, which would be outside of the geographic analysis area for these resources; the same onshore construction and installation, O&M, and conceptual decommissioning activities would occur for each of these alternatives.

The contribution of Alternatives C, D, E, and F to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action: **negligible** to **minor** due to the previously disturbed and developed landscape in which the activities associated with Alternatives C, D, E, and F would occur and the temporary and localized nature of many of the disturbances that would occur as a result of the activities associated with Alternatives C, D, E, and F.

Cumulative Impacts of Alternatives C, D, E, and F. Considering all IPFs together, BOEM anticipates that the contribution of Alternatives C, D, E, and F to the impacts from ongoing and planned activities would result in **negligible** to **moderate** impacts on wildlife in the geographic analysis area. Ongoing and planned activities contributing to impacts on wildlife in the geographic analysis area include habitat impacts.

3.5.4.7 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed in Table 3.5.4-6 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.5.4-6. Proposed mitigation measures – coastal habitat and fauna

Mitigation Measure	Description	Effect
Tree clearing restrictions	Because many wildlife species overwinter in cavities and nests, any mature trees slated for removal should be checked (including for vacant raptor nests) and avoided if possible. If the tree must be taken down, this should occur between October 1 and February 28 or 29.	While this mitigation measure would reduce impacts on wildlife species located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs.

3.5.4.8 Comparison of Alternatives

None of the other action alternatives would affect the types, placement, or areal extent of the onshore components of the Project or the offshore components of the Project that could affect coastal habitat and fauna. All of the other action alternatives would therefore have the same impacts as the Proposed Action on coastal habitat and fauna.

3.5.5 Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on finfish, invertebrates, and EFH from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.5.5-1, includes the Northeast Continental Shelf LME,[1] which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, encompasses population and movement ranges for most finfish and invertebrate species found in the Project Area. The northern portion of the geographic analysis area extends beyond U.S. waters while the width tapers to within U.S. waters towards the southern boundary. Due to the size of the geographic analysis area, the analysis in this Draft EIS focuses on finfish, invertebrates, and EFH that would be likely to occur in the Project area and be affected by Project activities. Many species that occur in the LME and Project area have broad ranges that extend beyond the geographic analysis area. Some of these species have distinct populations or stocks within the geographic analysis area that are not connected with populations or stocks of the same species outside of it (e.g., the red drum, *Sciaenops ocellatus*). The individual populations or stocks of these species are typically managed separately due to lack of connectivity and for practical reasons. In most cases individuals of one population rarely occur in the geographic extent of another population and may be genetically distinct, as is the case with red drum (Vaughan and Carmichael 1999). In some cases, however, individuals from one population may occur within the geographic extent of another (e.g., Atlantic sturgeon). Furthermore, some species only occur seasonally (e.g., giant manta ray). For the purposes of this analysis, nuances in species occurrence are stated explicitly while discussions are focused in the geographic analysis area.

Some Project vessels are expected to transit through the Gulf of Mexico to and from the Port of Corpus Christi (see Section 3.6, *Navigation and Vessel Traffic*). However, the 20 round trips anticipated to this port is a relatively small amount and would only occur during the construction phase of the Project. Typical vessel routes through the Gulf of Mexico to the Port of Corpus Christi have limited steam time within nearshore waters where two ESA-listed fish species occur, gulf sturgeon and giant manta ray (Farmer et al. 2022; Ross et al. 2009). Other vessel-related impacts that may occur in the Gulf of Mexico were evaluated to be unlikely (e.g., accidental releases) (Section.3.5.5.5, *Impacts of Alternative B – Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat*). For these reasons, impacts in the Gulf of Mexico are not considered further in this section.

[1] LMEs are delineated based on ecological criteria including bathymetry, hydrography, productivity, and trophic relationships among populations of marine species, and NOAA uses them as the basis for ecosystem-based management.

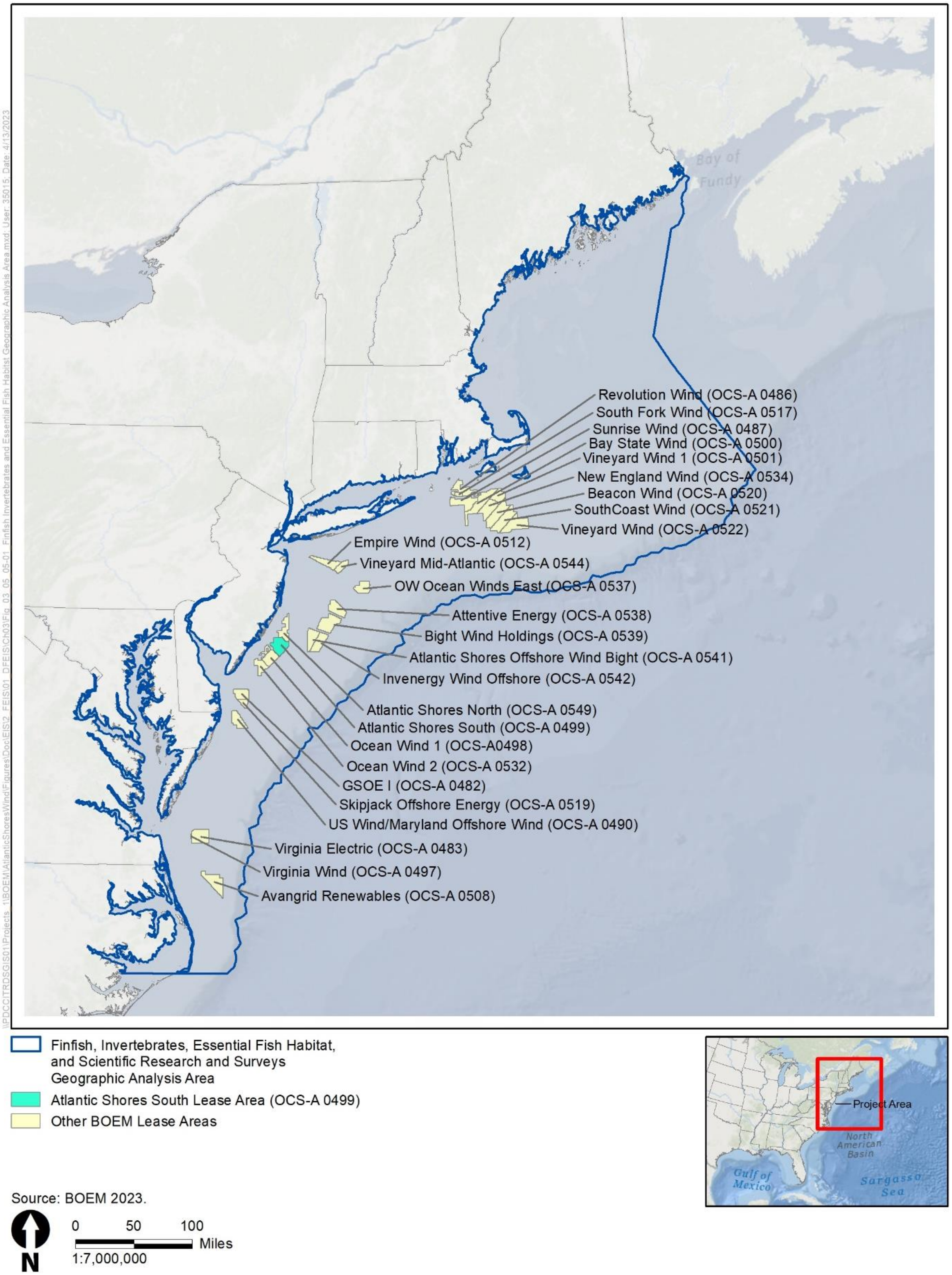


Figure 3.5.5-1. Finfish, invertebrates, and essential fish habitat geographic analysis area

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 USC 1802(10)). This section provides a qualitative assessment of the impacts of each alternative on finfish, invertebrates, and EFH, which has been designated under the MSA as “essential” for the conservation and promotion of specific fish and invertebrate species. A discussion of benthic species is provided in Section 3.5.2, *Benthic Resources*, and a discussion of commercial fisheries and for-hire recreational fishing is provided in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*.

3.5.5.1 Description of the Affected Environment and Future Baseline Conditions

Regional Setting

The geographic analysis area for finfish, invertebrate, and EFH species, as shown on Figure 3.5.5-1, is defined as the Northeast U.S. Shelf LME, which extends well beyond the boundaries of the Proposed Action to include the geographic extent of all life stages of transient/migratory species. Detailed, baseline descriptions of the affected environment are provided in COP Volume II, Section 4.5.1 and Appendices II-G1 through G4 (Atlantic Shores 2023) and summarized in this section.

The Northeast Atlantic OCS gradually slopes from shallow nearshore depths to maximum depths ranging between 262 to 394 feet (80 to 140 meters) along the outer edge (Emery 1966). In the Offshore Project area (Atlantic Shores South WTG and export cable areas), approximate depths range from 62 to 121 feet (19 to 37 meters) in the WTA, 0 to 72 feet (0 to 22 meters) in the Atlantic ECC, and 0 to 98 feet (0 to 30 meters) in the Monmouth ECC. Bathymetry in the OCS is predominately flat with sand wave bedform features (COP Volume II, Appendix II-J3; Atlantic Shores 2023).

The affected environment for finfish, invertebrate, and EFH resources includes the water column and the seafloor within the geographic analysis area. Ocean currents in the Mid-Atlantic Bight, where the Project area is located, are influenced by counter-clockwise shelf circulation from two main systems: a southwest along-shore current and the Gulf Stream (Lentz 2008; Stevenson et al. 2004; Ford et al. 1952). The net direction of currents on the shelf is southwest along the coast (Levin et al. 2018; Townsend et al. 2004). The southwest along-shore current entrains into the Gulf Stream near Cape Hatteras, North Carolina, forming a counter-clockwise circulation (Lentz 2008; Ford et al. 1952). Across the shelf in deeper waters, the current flows in the opposite direction of the shelf current (COP Volume II, Section 2.2.1.1 and Figure 2.2-1; Atlantic Shores 2023; Stevenson et al. 2004). Although ocean currents are largely stable, local-scale (i.e., meters to a few kilometers) variability in currents is observed, in part due to wind and tides and their combined effects. Beardsley and Winant (1979) have demonstrated that winds contribute to the along-shore southward flow of currents close to shore in the Mid-Atlantic Bight. In the Offshore Project area, winds from the southwest predominate but, by comparison, these winds are weaker than those from the north to northwest direction (wind speeds of > 33 feet/second [10 meters/second]) (COP Volume II, Appendix II-B2; Atlantic Shores 2023). Strong winds from the north-northwest occurring during winter Nor’easter storms may force nearshore currents in a shoreward direction (Beardsley and Butman 1974).

From 2003–2016, sea temperatures within the New Jersey WEA, from depth profile CTD casts taken at 3.3-foot (1-meter) intervals, decreased from surface to bottom between April and September (i.e., negative temperature gradient) and increased during the colder months (i.e., positive temperature gradient) (Guida et al. 2017). Average sea temperature ranged seasonally from < 41 to 75°F (< 5 to approximately 24°C) at the surface; < 41 to 66°F (< 5 to approximately 19°C) at the bottom (Guida et al. 2017). Within the geographic analysis area, two types of temperature-influencing water masses (i.e., relatively smaller areas with unique oceanographic properties) are present: (1) the mid-Atlantic cold pool (Chen et al. 2018) and (2) the Maine Bottom Water/Intermediate Water (Townsend et al. 2015). The mid-Atlantic cold pool is a seasonally occurring "cold" (i.e., temperatures below 50°F [10°C]) bottom water mass with salinities less than the average salinity of ocean water (35 practical salinity units). The cold pool forms in waters of the New England Shelf in spring and drifts southward along shore to shelf waters between the Hudson Shelf Valley and Cape May, New Jersey, in fall (Chen et al. 2018). Where present, the mid-Atlantic cold pool creates strong vertical stratification in the water column.

Within the Offshore Project area, surficial sediments are dominated by medium (0.01 to 0.02 inch [0.25 to 0.5 millimeter]) and coarse (0.01 to 0.04 inch [0.5 to 1.0 millimeter]) sands (COP Volume II, Section 4.5.1.1; Atlantic Shores 2023). Smaller areas of fine sands are also present (0.005 to 0.01 inch [0.125 to 0.25 millimeter]) (COP Volume II, Section 4.5.1.1; Atlantic Shores 2023). Fine sands are more prevalent in the south end of the Lease Area (COP Volume II, Appendix II-G4; Atlantic Shores 2023). Both ECCs are characterized by medium and coarse sands. Closer to shore, the Atlantic ECC transitions to fine sand while the Monmouth ECC transitions to medium and fine sands. As characterized from a benthic assessment study in the WTA, bottom sediments within the Project area are dominated by sand (COP Volume II, Appendix II-G2; Atlantic Shores 2023). From the same study, only 9 of 46 grab samples had ≥ 5 percent gravel and no samples had ≥ 30 percent gravel. Hard, structured, elevated relief (i.e., reef habitat) is scattered among the relatively flat, sandy, shelf seafloor of the Mid-Atlantic Bight and Southern New England but is scarce (Steimle and Zetlin 2000). Two artificial reef areas are located along the boundaries of the Monmouth ECC (COP Volume II, Appendix II-J2; Atlantic Shores 2023; Steimle and Figley 1996b). Other hard-bottom complex habitat near the Offshore Project area includes multiple shipwrecks (Steimle and Figley 1996a). Unique fish assemblages are associated with hard-bottom habitats (Ross et al. 2015; Steimle and Figley 1996a).

Finfish

Many of the finfish species within the Project area are common throughout the geographic analysis area. The fish communities within BOEM-defined Northeast U.S. WEAs were described in a BOEM-funded study by Guida et al. (2017) using 2003–2016 data from the long-term Northeast Fisheries Science Center's (NEFSC) spring and fall bottom trawl surveys. Other offshore monitoring surveys for finfish within the geographic analysis area include the Northeast Area Monitoring and Assessment Program survey, conducted annually since 2007 (Bonzek et al. 2017), and the 5-year (1995–1999) Belmar Borrow Area Finfish Collection survey (Burlas and Clarke 2001). Recent (2009–2019) site-specific NOAA Fisheries and NJDEP trawl survey data were used to characterize the finfish communities in the WTA and ECCs (COP Volume II, Section 4.6.1; Atlantic Shores 2023).

The offshore and estuarine trawl monitoring programs listed here primarily survey late-stage juvenile and adult fishes. Seasonal and long-term patterns of ichthyoplankton communities in the geographic analysis area have also been described from NEFSC's historical (1977–1987) monitoring program known as Marine Resource Monitoring Assessment and Prediction (Berrien and Sibunka 1999). Ichthyoplankton in the geographic analysis area continues to be monitored by the NEFSC's Ecosystem Monitoring Program (1992–present) (NOAA Fisheries 2018).

Species of finfish collected in these surveys can be categorized into two general groups based on the habitat they prefer: near-bottom or "demersal" fishes and those that occupy the water column or "pelagic." Demersal fishes in the geographic analysis area include Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), kingfish (*Menticirrhus* spp.), weakfish (*Cynoscion regalis*), scup (*Stenotomus chrysops*), black sea bass (*Centropristis striata*), northern sea robin (*Prionotus carolinus*), Atlantic butterfish (*Peprilus triacanthus*), cods (Gadiforms) (i.e., haddock [*Melanogrammus aeglefinus*], hakes [Merlucciidae and Phycidae], and Atlantic cod [*Gadus morhua*]), flounders (e.g., summer flounder [*Paralichthys dentatus*], winter flounder *[Pseudopleuronectes americanus*]), sand lances (*Ammodytes* spp.), monkfishes (*Lophius* spp.), spiny dogfish (*Squalus acanthias*), little skate (*Leucoraja erinacea*), clearnose skate (*Raja eglanteria*), and winter skate (*Leucoraja ocellata*) (MAFMC 2017; NOAA Office of National Marine Sanctuaries 2017; Bonzek et al. 2017; Guida et al. 2017; Wilber et al. 2003; Burlas and Clarke 2001). Black sea bass, cunner (*Tautogolabrus adspersus*), tautog (*Tautoga onitis*), and other demersal species are strongly associated with reefs or structured high relief habitat. Atlantic butterfish and sand lances are major forage fish for demersal predators. Of the demersal fish species, haddock, flounders, hakes, scup, black sea bass, spiny dogfish, and skates are commercially valuable (Guida et al. 2017; Petruny-Parker et al. 2015). Within the New Jersey WEA, the demersal finfish community is dominated by Atlantic croaker and scup during the warm season and little skate and spiny dogfish during the cold season (Guida et al. 2017). Common benthic species from recent surveys in the Offshore Project area include Atlantic butterfish, Atlantic croaker, northern sand lance (*Ammodytes dubius*), northern sea robin, scup (*Stenotomus chrysops*), spiny dogfish, spotted hake (*Urophycis regia*), silver hake (*Merluccius bilinearis*), weakfish, and windowpane flounder (*Scophthalmus aquosus*) (COP Volume II, Sections 4.6.1.1 and 4.6.1.2; Atlantic Shores 2023).

Common pelagic fishes within the geographic analysis area include bay anchovy (*Anchoa mitchilli*), striped anchovy (*A. hepsetus*), Atlantic menhaden (*Brevoortia tyrannus*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), Atlantic herring (*Clupea harengus*), bluefish (*Pomatomus saltatrix*), and striped bass (*Morone saxatilis*) (MAFMC 2017; Petruny-Parker et al. 2015; Guida et al. 2017; Bonzek et al. 2017). Pelagic fish also include species that are purely marine (i.e., species not known to enter estuarine habitats) including yellowfin (*Thunnus albacares*) and bluefin tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), blue shark (*Prionace glauca*), common thresher (*Alopias vulpinus*), and shortfin mako (*Isurus oxyrinchus*) (BOEM 2021a). Within the New Jersey WEA, the pelagic finfish community is dominated by Atlantic herring, occurring during the cold season (Guida et al. 2017). From recent surveys in the Offshore Project area, common pelagic species include Atlantic herring, bay anchovy, round herring (*Etrumeus teres*), and Atlantic silverside (*Menidia menidia*) (COP Volume II, Sections 4.6.1.1 and 4.6.1.2; Atlantic Shores 2023).

Many species from both demersal and pelagic groups can be found in both offshore and coastal, estuarine habitats (e.g., Atlantic croaker, weakfish, river herrings, striped bass). While many finfish species migrate into estuaries to spawn, others migrate into estuaries seasonally for other reasons, presumably to take advantage of favorable feeding opportunities (Haven 1959). The young of anadromous species typically remain in estuaries for the first few years of life, utilizing the estuarine habitat as a nursery prior to joining offshore populations of older juveniles and adults (Able and Fahay 1998). The young of some species that spawn offshore (e.g., Atlantic croaker, Atlantic menhaden) also utilize estuarine habitats as nurseries (Able and Fahay 1998). Larvae of these species hatch offshore and are assisted by ocean processes for transport and entry into coastal estuaries (Boehlert and Mundy 1988).

Egg and larval stages of fishes in the geographic analysis area may be benthic/demersal or pelagic, irrespective of their adult category. Examples of pelagic eggs and larvae from demersal adult fishes are Atlantic cod and black sea bass (BOEM 2021a). An example of benthic/demersal eggs from a pelagic adult fish is Atlantic herring (BOEM 2021a). Walsh et al. (2015) evaluated 39 larval Mid-Atlantic Bight OCS finfish species from pelagic trawl records in two periods (1977–1987 and 1999–2014). Their list of species included Atlantic cod, Atlantic croaker, Atlantic herring, weakfish, and sand lance, which are included in the list of common species found in the Offshore Project area. A species reported by Walsh et al. (2015) that is not commonly sampled in bottom trawl gear used to describe the fish community in the Offshore Project area is Atlantic menhaden (*Brevoortia tyrannus*). Finfish species potentially present in the Offshore Project area as egg and larvae include American eel (*Anguilla rostrata*), Atlantic cod, Atlantic menhaden, black sea bass, bluefish, cunner, monkfish, northern sand lance, and tautog (COP Volume II, Section 4.6.1, Appendix II-J2; Atlantic Shores 2023).

Fishes with pelagic early life stages (i.e., eggs, larvae, and juveniles) rely on ocean processes and conditions (e.g., ocean currents, mid-Atlantic cold pool) for retention or transport/dispersal, and, to some degree, recruitment success (i.e., survival of early life stages into later life stages) (Paris and Cowen 2004; Boehlert and Mundy 1988). Shifts in dispersal, including from changes in ocean conditions and climate (Walsh et al. 2015), may have consequences to recruitment success (Thaxton et al. 2020). Variability in distribution and abundance of fish eggs and larvae may occur on interannual and annual scales (Berrien and Sibunka 1999).

ESA-listed finfish species that occur in the geographic analysis area include Atlantic salmon (*Salmo salar*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), shortnose sturgeon (*A. brevirostrum*), giant manta ray (*Manta birostris*), and oceanic whitetip shark (*Carcharhinus longimanus*). Of these species, giant manta ray and Atlantic sturgeon occur in the Offshore Project area. Endangered Atlantic salmon are not expected to occur south of Central New England, and the natural spawning population in North America occurs primarily between West Greenland and the Labrador Sea (Rikardsen 2021; USASAC 2020). Adults of the endangered oceanic whitetip shark primarily occur on the outer edge of the shelf and prefer deep waters (Young and Carlson 2020). It is thought that juvenile oceanic white tip sharks utilize shallow reef habitats that do not occur in the geographic analysis area (Passerotti et al. 2020). The migratory giant manta ray is threatened and occurs in shelf waters of the Mid-Atlantic Bight and

Southern New England portion of the geographic analysis area, including in the WTG and ECC corridor areas, from June to October (Farmer et al. 2022).

All five distinct population segments (DPSs) of Atlantic sturgeon occur in nearshore shelf waters and in tributaries of the Mid-Atlantic Bight (Kazyak et al. 2021). Juvenile and adult Atlantic sturgeon occur in the offshore marine environment during fall, winter, and summer (Stein et al. 2004). Atlantic sturgeon have not been documented to spawn in tributaries between the Delaware and Hudson rivers (Hilton et al. 2016). The shortnose sturgeon is predominately a riverine/estuarine species that is less likely to occur in the Offshore Project area. However shortnose sturgeon have been documented to occasionally venture outside of estuaries and enter other rivers in the Gulf of Maine, migrating through nearshore marine habitats (Dionne et al. 2013). Both sturgeon species may occur in the inshore Project area along export cable routes nearest to landfall sites and in the Chesapeake and Delaware estuaries where Project-related vessel trips are planned. Atlantic sturgeon enter the Chesapeake Bay in July and continue migrating into the James, York, and Pamunkey Rivers in Virginia to spawn in September (Hager et al. 2020, 2014; Kahn 2014; Balazik et al. 2012). Few shortnose sturgeon have been documented in Chesapeake Bay tributaries (Balazik 2017; Kynard et al. 2009; Welsh et al. 2002). More information is needed to evaluate the downstream movements of shortnose sturgeon in the Chesapeake Bay and its tributaries; however, a single observation of a shortnose sturgeon at the mouth of the Rappahannock River, Virginia, indicates the downstream extent in the system (Welsh et al. 2002). In the Delaware Estuary, adult Atlantic sturgeon enter to spawn from April to May as in other mid-Atlantic estuaries (Smith and Clugston 1997). Spawning habitat in the Delaware River is thought to occur between river kilometers 118 and 141 (Hale et al. 2016), a segment of the estuary that Project vessels would transverse in route to the planned ports of Paulsboro Marine (river kilometer 145) and Repauno Port & Rail (river kilometer 139) terminals. Resident subadult Atlantic sturgeon also exist in the Delaware Estuary year-round (Hale et al. 2016). Shortnose sturgeon in the Delaware River have been rarely documented to occur south of Philadelphia, Pennsylvania (O'Herron et al. 1993; Dadswell et al. 1984; Brundage and Meadows 1982). BOEM is in the process of assessing the impacts of the Proposed Action on ESA-listed fish species in the BA. BOEM will continue to consult with NMFS under the ESA, and results of consultation will be included in the Final EIS.

Invertebrates

Marine invertebrates serve broad ecosystem roles including being part of the marine forage (i.e., food/prey) base and maintaining water quality (e.g., sequestering excess nutrients through filter feeding) (Anderson et al. 2011). Marine invertebrate communities within the Northeast U.S. WEAs were described by Guida et al. (2017) from a 14-year (2003–2016) subset of NEFSC's bottom trawl survey data, recent benthic grab samples taken by BOEM and sponsored by NEFSC in the Northeast U.S. WEAs, and drop camera surveys conducted by the University of Massachusetts Dartmouth School for Marine Science and Technology.

Invertebrate species can be categorized according to their habitat associations: benthic/demersal and pelagic. The broad benthic/demersal category can be further subdivided into "soft bottom" (e.g., sand, silt, clay sediment) and "hard bottom" (i.e., habitats such as reefs, boulders, cobble, or coarse gravel) associated species (BOEM 2021a). Soft-bottom habitat is the most commonly occurring within the geographic analysis area. Invertebrate communities associated with soft-bottom habitats of the Northeast U.S. WEAs include infaunal (i.e., burrowing) or surficial (i.e., on the seabed) organisms such as annelid worms (Oligochaeta and Polychaeta), flatworms (Platyhelminthes), and nematodes (Nematoda) (BOEM 2021a). Common soft-bottom crustaceans (Crustacea) include amphipods (Amphipoda), mysids (Mysida), copepods (Copepoda), and crabs (Brachyura) (BOEM 2021a). Echinoderms are another abundant soft-bottom group in the geographic analysis area that includes sand dollars (Clypeasteroida), starfishes (Asteroidea), and sea urchins (Echinoidea). Other soft-bottom invertebrates include commercially important shellfishes such as Atlantic surfclam (*Spisula solidissima*), ocean quahog (*Arctica islandica*), bay scallop (*Argopecten irradians*), and horseshoe crab (*Limulus polyphemus*) (BOEM 2021a; Cargnelli et al. 1999). Within the New Jersey WEA, the soft-bottom infaunal community is dominated by polychaetes; the surficial faunal community is dominated by sand shrimp, sea slugs, and sand dollars (Guida et al. 2017). Atlantic surfclam are present within the New Jersey WEA and the Offshore Project area (Guida et al. 2017).

Common invertebrate taxa found in hard-bottom habitats of the geographic analysis area include corals and anemones (Cnidaria), barnacles (Crustacea), sponges (Porifera), hydroids (Hydrozoa), bryozoans (Bryozoa), and bivalve mussels and oysters (Bivalvia) (BOEM 2021a). These organisms affix to hard substrate and have limited movement (BOEM 2021a). This group of invertebrates also includes free-living organisms such as American lobster (*Homarus americanus*), crabs, shrimps, amphipods, starfishes, and sea urchins (BOEM 2021a). Hard-bottom habitat is not common in the geographic analysis area, which likely limits abundance of these species and influences connectivity among local communities.

Pelagic invertebrates in the geographic analysis area include commercially important squids (longfin [*Doryteuthis pealeii*] and shortfin [*Illex illecebrosus*]) (BOEM 2021a). Pelagic mesozooplankton includes pelagic forms of copepods, amphipods, and water fleas (Cladocera) and pelagic early life stages of other invertebrates. Species in this group contribute to a major forage base in estuaries where they are preyed upon by intermittently abundant pelagic jellyfishes including comb jellies (Ctenophora) and medusae (Medusozoa) (Slater et al. 2020; Condon et al. 2013). Pelagic mesozooplankton and jellyfishes (Cnidaria) are also present in the shelf waters of the geographic analysis area but are not well documented. Within the New Jersey WEA, longfin squid are a common pelagic invertebrate species (Guida et al. 2017). Spatial and population dynamics of pelagic invertebrates and the pelagic early life stages of other invertebrates are influenced by ocean currents and conditions. Based on recent trawl surveys, longfin squid are a common pelagic invertebrate species in the Offshore Project area (COP Volume II, Section 4.6.1.4; Atlantic Shores 2023).

Benthic monitoring within the Lease Area identified sand dollars as the dominant taxa (Integral 2020). Other common taxa included large and small amphipod and polychaete tube mats, *Diopatra* polychaetes, burrowing anemones, hermit crabs (Paguroidea), nassariid snails, and mobile decapods (Integral 2020). Further benthic monitoring has been planned within the Offshore Project area (COP Volume II, Appendix II-H; Atlantic Shores 2023).

No ESA-listed invertebrate species occur within the geographic analysis area.

Essential Fish Habitat

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (50 CFR Part 600). BOEM is preparing an expanded EFH Assessment for the Proposed Action in consultation with NMFS, and the results of this consultation will be included in the Final EIS.

Of the 101 finfish and invertebrate species identified in NEFSC bottom trawl surveys (Guida et al. 2017), 43 species have designated EFH for at least one life stage in the Offshore Project area (COP Volume II, Appendix II-J2; Atlantic Shores 2023). Dominant species in the bottom trawl surveys in both cold (winter/spring) and warm seasons (fall) include skates (e.g., clearnose skate, little skate, winter skate) and silver hake (*Merluccius bilinearis*). Summer-/fall-dominant species included Atlantic butterfish, longfin squid, red hake, scup, and spiny dogfish, while winter-dominant species included Atlantic herring. All these species have designated EFH within the Project area. Several highly migratory species have EFH in the Project area, including tunas (e.g., albacore tuna [*Thunnus alalonga*], bluefin tuna, skipjack tuna [*Katsuwonus pelamis*], and yellowfin tuna), swordfish, and sharks (e.g., blue shark, common thresher shark, dusky shark [*Carcharhinus obscurus*], sandbar shark [*C. plumbeus*], sand tiger shark [*Carcharhinus taurus*], and shortfin mako). The Project area also contains finfish and invertebrates that are not federally managed (i.e., no EFH), but that provide a valuable forage resource for species that do have designated EFH in the area.

The Project area provides three general types of EFH that support managed species and their prey: water column, soft bottom, and hard bottom. All waters from the surface to the ocean floor are part of the water column. The water column is particularly important for planktonic eggs and larvae, planktivorous or filter-feeding species/life stages, and migratory pelagic species (NOAA Fisheries 2017; NEFMC 2017). The most numerically abundant component of the pelagic fish community in the open waters of the Project area is the ichthyoplankton assemblage. Soft-bottom habitats include unconsolidated rocks, gravel, cobble, pebbles, sand, clay, mud, silt, and shell fragments as well as the water-sediment interface. EFH for 43 species is present within the Offshore Project area (COP Volume II, Appendix II-J2; Atlantic Shores 2023). EFH species include New England finfish (e.g., Atlantic cod, monkfish, winter flounder), mid-Atlantic finfish (e.g., black sea bass, bluefish, summer flounder), South Atlantic finfish (king mackerel and Spanish mackerel), New England invertebrates (Atlantic sea scallop), mid-Atlantic invertebrates (Atlantic surfclam, ocean quahog, longfin inshore and northern shortfin squid), and highly migratory species (tunas and sharks). In Project-related towed video monitoring, EFH species identified in the Project area include black sea bass, clearnose skate, silver hake (*Merluccius bilinearis*), summer flounder, windowpane flounder (*Scophthalmus aquosus*), and winter flounder (COP Volume II, Appendix II-G3; Atlantic Shores 2023). Also, Atlantic surfclams were present in benthic grab samples from a Project-related benthic assessment within the export cable corridors (Morandi et al. 2021). Habitat Areas of Particular Concern (HAPCs) are a component of EFH that are defined as high-priority areas for conservation, additional management focus, or research because they are rare, sensitive, stressed by development, or important to ecosystem function (50 CFR Part 600). The only

HAPC potentially overlapping the Offshore Project area is for sandbar shark (COP Volume II, Appendix II-J2; Atlantic Shores 2023). Specifically, shallow habitat at the mouth of Great Bay, New Jersey, lower and middle Delaware Bay, Delaware, and lower Chesapeake Bay, Maryland, are HAPC for sandbar shark pups in the geographic analysis area. These habitats are important nursery grounds for pups in summer.

3.5.5.2 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

This Draft EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of the alternatives, including the Proposed Action, as shown in Table 3.5.5-1. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

Table 3.5.5-1. Impact level definitions for finfish, invertebrates, and essential fish habitat

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on species or habitat would be so small as to be unmeasurable.
	Beneficial	No effect or no measurable effect.
Minor	Adverse	Most impacts on species would be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts that do occur would be temporary or short term in nature.
	Beneficial	A small and measurable beneficial impact on species or habitat.
Moderate	Adverse	Impacts on species would be unavoidable but would not result in population-level effects. Impacts on habitat may be short term, long term, or permanent, and may include impacts on sensitive habitats but would not result in population-level effects on species that rely on them.
	Beneficial	A notable and measurable beneficial impact on species or habitat.
Major	Adverse	Impacts would affect the viability of the population and would not be fully recoverable. Impacts on habitats would result in population-level impacts on species that rely on them.
	Beneficial	A regional or population-level beneficial impact on species or habitat.

3.5.5.3 Impacts of Alternative A – No Action on Finfish, Invertebrates, and Essential Fish Habitat

When analyzing the impacts of the No Action Alternative on finfish, invertebrates, and EFH, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for finfish, invertebrates, and EFH. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH described in Section 3.5.5.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Impacts on finfish, invertebrates, and EFH within the geographic analysis area include ongoing and planned activities and global climate change. Ongoing non-offshore wind activities that contribute to impacts on finfish, invertebrates, and EFH include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); marine minerals use military use; marine transportation; fisheries use and management; research, monitoring, and survey activities; and oil and gas activities. See Appendix D, Table D.A1-10 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for finfish, invertebrates, and EFH.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH include:

- Continued O&M of the BIWF project (5 WTGs) installed in state waters;
- Continued O&M of the CVOW pilot project (2 WTGs) installed in OCS-00497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Impacts for ongoing activities and global climate change would continue to affect finfish, invertebrates, and EFH in the absence of the Proposed Action.

Ongoing O&M of the BIWF and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect finfish, invertebrates, and EFH through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, discharges/intakes, electric and magnetic fields and cable heat, gear utilization, lighting, noise, and presence of structures. Ongoing offshore wind activities would have the same type of impacts from these IPFs that are described in detail in *Cumulative Impacts of Alternative A – No Action* for planned offshore wind activities but the impacts would be of lower intensity.

Accidental releases of fuel, fluids, and hazardous materials, as well as the introduction of invasive species due to ongoing activities in the geographic analysis area, are chronic and frequent, and the risk of such accidental releases is expected to continue. Impacts of accidental releases of fuel, fluids, and hazardous materials can include mortality, decreased fitness, and contamination of habitat, but these impacts are localized and temporary and are not expected to produce population-level effects. Impacts of accidental releases of invasive species can be widespread and permanent in instances when invasive species are able to establish populations.

Anchoring activity would continue from vessel operations associated with ongoing military use, marine transportation, and fisheries use and management. Impacts of anchoring can be temporary to permanent and include increased turbidity levels, mortality of finfish and invertebrates, and degradation of sensitive habitat in areas where anchors and chains meet the seafloor.

Vessels and anthropogenic structures from ongoing activities would continue to generate artificial light at night, which may cause temporary attraction, avoidance, or other behavioral responses in some finfish and invertebrate species, potentially affecting localized animal distributions near the light source. Artificial light may also disrupt natural cycles (e.g., spawning), possibly leading to short-term impacts.

Cable emplacement and maintenance activities would continue to disturb bottom sediment, resulting in temporary increases in suspended sediment concentrations and short-term to long-term impacts from disturbance, displacement, injury, and habitat alteration.

Anthropogenic noise associated with ongoing aircraft, G&G surveys, offshore WTGs, and vessels is expected to continue. These noise sources have varying impacts on finfish, invertebrates, and EFH that are discussed below in *Cumulative Impacts of Alternative A – No Action*.

Continued or increased utilization of U.S. ports would result in more vessel activity and the need for port expansions at some locations. Undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; military activities; and oil and gas activities would continue to exist on the OCS. Impacts from the presence of these structures range from short term to permanent and include entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation, "stepping stones" for non-indigenous species, habitat conversion, and migration disturbances.

Regulated fishing would continue to affect finfish, invertebrates, and EFH through its influence on the nature, distribution, and intensity of fishing effort and its associated impacts (e.g., mortality, bottom disturbance).

Global climate change is an ongoing and developing phenomenon that would continue to occur and would cause ocean acidification, increasing ocean surface and bottom temperatures, and changes in ocean circulation patterns. The impacts of climate change are likely to affect habitat suitability for and distributions of finfish and invertebrates in the geographic analysis area, including several EFH species. In particular, rises in sea temperature within the geographic analysis area are thought to be responsible for documented northward shifts in species distributions (Gaichas et al. 2015; Hare et al. 2016; Lucey and Nye 2010; Friedland and Hare 2007).

Impacts of Alternative A – No Action on ESA-Listed Species

The No Action Alternative would have similar impacts on Atlantic sturgeon as other non-ESA species. Atlantic sturgeon migration may be impacted by IPFs including gear utilization during biological monitoring surveys, presence of structures, emplacement and maintenance of cables, and EMFs. Shortnose sturgeon make infrequent trips outside of estuaries but remain in nearshore habitats where impacts may occur from nearshore cable emplacement and maintenance and EMFs. Vessel strike risks is not an evaluated IPF but is discussed in Section 3.5.5.1. Shortnose and Atlantic sturgeon and giant manta ray are ESA-listed species at risk from vessel strikes. Other ESA-listed species in the LME are not likely to be impacted by the No Action Alternative.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned activities are expected to contribute to impacts on finfish, invertebrates, and EFH in the absence of the Proposed Action. Planned activities not related to the Proposed Action include cable emplacement and maintenance, navigation channel dredging, and installation for planned offshore oil and gas infrastructure Planned activities also include tidal energy projects, navigation channel maintenance dredging, reconnaissance studies for future sand resource use, offshore dredge material disposal, oil and gas projects, and planned onshore development.

Under the No Action Alternative, existing environmental trends within the geographic analysis area would continue, influenced by ongoing and planned activities and by other offshore wind and renewable energy projects and the associated port development that would support this industry. The Project-defined IPFs in this section are discussed in context of cumulative impacts from ongoing and planned offshore wind activities in the geographic analysis area absent the Proposed Action.

In addition to the four ongoing offshore wind projects, 29 additional offshore wind projects are planned to be constructed in the geographic analysis area. These 33 projects would result in an additional 2,844 WTGs and 39 OSSs/ESPs and met towers in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). The impacts of the ongoing and planned offshore wind projects are discussed in the subsections below.

BOEM expects planned offshore wind development activities to affect finfish, invertebrates, and essential fish habitats through the following primary IPFs.

Accidental releases: Offshore wind development is expected to increase vessel traffic within the geographic analysis area. Increased vessel traffic presents a greater risk of accidental releases of fuel, fluids, and hazardous materials, as well as a greater risk of introducing nonnative marine organisms. Some accidentally released pollutants may bioaccumulate in food webs if ingested by forage/prey species. The highest increases in vessel traffic would occur during the construction and decommissioning phases of each project. Impacts of such releases can include decreased condition or mortality of organisms and contamination of habitats, but these impacts are localized and short term and are not expected to produce population-level effects.

Approximately 32.1 million gallons (121.5 million liters) of fuel, fluids, and hazardous materials are expected to be contained in offshore wind facilities (Appendix D, Table D.A2-3). The risk of accidental releases would be highest during construction phases but would also be possible during the O&M and decommissioning phases (BOEM 2021a). Modeled rates of accidental releases have been estimated at 128 thousand gallons (434,533 liters) every 5 to 20 years, which is considered relatively low (BOEM 2021a). The risk of concurrent accidental releases from multiple facilities is lower still. Spills larger than 2,000 gallons (7,571 liters) are not likely. Based on the low risk of accidental releases of fuel, fluids, and hazardous materials from offshore wind-related activities, BOEM anticipates negligible to minor impacts on finfish, invertebrates, and EFH.

Ballast water and bilge water discharges from offshore wind vessel traffic would elevate the risk of accidental releases of invasive species into the aquatic environment. Successful establishment of introduced species depends on species characteristics that are favorable for survival, such as variability in life-history traits, high production, and wide-ranging tolerances to environmental conditions. Introductions of nonnative species do not always result in the establishment of viable populations;

however, the establishment of a nonnative species resulting from offshore wind activity has been documented. The colonial tunicate, *Didemnum vexillum*, is one of the first examples of invasive introductions due to offshore wind activities (HDR 2020). Additional introductions could have adverse impacts on existing finfish and invertebrate communities and EFH, including increased competition with native fauna or adverse habitat alteration. These impacts may be widespread and permanent in instances where invasive species are able to establish populations.

Anchoring: Vessel anchoring from offshore wind-related activities would mostly occur within WTG array and export cable areas. Vessel activities related to construction of up to 2,844 WTGs and 39 OSSs/ESPs and met towers are planned within the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). Anchoring activities would be highest during construction and demolition phases. Anchoring would also occur during O&M and during biological monitoring efforts related to wind development. Anchoring may be minimized by use of dynamic positioning systems.

Anchoring impacts on finfish, invertebrates, and EFH may include degradation of sensitive habitat, mortality of finfish and invertebrates, and increased turbidity. Impacts of anchoring are expected to be greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish). Anchor and chain contact with the seafloor would result in direct impacts on habitat, including EFH, and benthic organisms but would be limited to an approximate area of 7,342 acres (2,971 hectares) within the geographic analysis area (Appendix D, Table D.A2-2). Direct disturbance of the seafloor would be limited to surficial sediments. Impacts on seafloor habitats may be permanent if they occur on hard bottom. Mortality of organisms may also occur, but studies have demonstrated the ability of benthic habitats and communities to recover following physical disturbances (Wilber and Clarke 2007). Indirect impacts include increased turbidity from resuspension of sediments and burial from redeposition. Dispersal distances of resuspended sediments depend on bottom currents. Dilution of sediments would increase with increasing dispersal distances. Mobile organisms may avoid burial by repositioning in the sediments or by avoiding sediment plumes. Burial of hard-bottom habitat is possible and potentially permanent. Recovery of non-permanent impacts is expected to be rapid. Anchoring impacts could be reduced if project vessels use dynamic positioning systems. All anchoring impacts would be localized. Impacts from increased turbidity would be short term and impacts from physical contact would be short term, whereas impacts from degradation of sensitive habitats could be long term. Given that the affected area is relatively much smaller than that of the geographic analysis area, BOEM anticipates that impacts on finfish, invertebrates, and EFH from planned offshore wind-related anchoring activity would be negligible to minor.

Cable emplacement and maintenance: Offshore wind development would place hundreds of miles of buried or armored cable along transmission corridors and interarray connections, disturbing more than 6,154 acres (2,490 hectares) of seafloor (Appendix D, Table D.A2-2). New cable emplacement and maintenance would disturb, displace, and injure or kill finfish and invertebrates, release sediment into the water column, and cause habitat alterations. The width of the disturbed bottom along cable routes, however, would be 33 feet (10 meters) or less (Appendix D, Table D.A2-1).

Cable installation would require trenching, laying, and burial. Trenching can be done using a cutting wheel in hard-bottom habitat or plowing or water jetting in soft-bottom habitat (Taormina et al. 2018). Each method would potentially resuspend sediments that may redeposit on other habitats. Plowing is designed to minimize resuspension of sediments by trenching, laying, and burying all in successive steps. Water jetting would entrain and possibly injure or kill small organisms, but this impact would be relatively small and localized.

Cable emplacement and maintenance activities (including dredging) would disturb sediments and cause sediment suspension, which could disturb, displace, and directly injure finfish species and EFH. Short-term disturbance of seafloor habitats could disturb, displace, and directly injure or result in mortality of invertebrates in the immediate vicinity of the cable emplacement activities. Sediment disturbance and resettlement could also affect eggs and larvae, particularly demersal eggs such as longfin squid eggs, which have high rates of mortality if egg masses are exposed to abrasion. When new cable emplacement and maintenance cause resuspension of sediments, increased turbidity could have an adverse impact on filter-feeding fauna such as bivalves. Depending on the substrate being disturbed, invertebrates could be exposed to contaminants via the water column or resuspended sediments, but effects would depend on the degree of exposure.

Mobile finfish and invertebrates are likely to move away from cable-laying equipment, but immobile or slow-moving demersal species and life stages (e.g., eggs, larvae) may be injured or killed by the equipment. Surfclams have been demonstrated to have high survival rates (99 percent) following mechanical disturbance by trawls (Sabatini 2007), suggesting that shelled mollusks may be similarly tolerant of other disturbances, including those from cable-laying equipment.

Burial of habitats and organisms from redeposition of sediments would occur during offshore wind activities, specifically during dredging and cable emplacement. When disturbed sediments are resuspended into the water column, they may drift or disperse to other locations before settling, including areas of complex bottom and EFH habitats. Dispersal distance and rate of suspended sediments depends on currents. As dispersal distance increases, dilution of suspended sediments may increase, reducing impacts from redeposition and burial. Redeposition of disturbed sediments may temporarily or permanently alter nearby complex hard-bottom habitats and organisms. Long-term, chronic increases in suspended sediment can cause physiological stress to sessile organisms; however, most fish and invertebrate organisms are able to mediate short-term turbidity plumes by expelling filtered sediments or reducing filtration rates (NYSERDA 2017; Bergstrom et al. 2013; Clarke and Wilber 2000). In response to moderate sediment deposition, infaunal organisms (e.g., marine worms) may reposition in the sediments to avoid smothering (Hinchey et al. 2006), while mobile organisms (e.g., fishes, crustaceans) are able to avoid areas. However, some demersal eggs and larvae (e.g., longfin squid, winter flounder, ocean pout) may be unable to avoid burial by redeposited sediments. Impacts from displacement and mortality on finfish, invertebrates, and EFH would be short term and localized to the emplacement corridor and are expected to vary based on the time of year during which sediment-disturbing activities occur.

Cable laying and burial may require dredging in some areas where jet plowing is insufficient to achieve target cable burial depths. This can alter habitats, including short-term alterations of sand waves that provide vertically structured habitat for finfish and invertebrates. Tidal and wind-forced bottom currents are expected to reform most sand wave areas within days to weeks following disturbance, as they are known to migrate at rates up to 21 to 66 feet (6.5 to 20 meters) per year (van Dijk and Kleinhans 2005). Although some sand waves may not recover to the same height and width as pre-disturbance, habitat function is expected to fully recover.

Hard-bottom habitat would only be introduced in areas where target burial depths are not achieved, and cable armoring is required for protection. Protective cable armoring would create hard-bottom habitat up to 16 feet (5 meters) wide along cable corridors. The continuous hard-bottom habitat may fragment soft-bottom habitat communities, especially infaunal communities, while presenting habitat opportunities for complex benthic communities (e.g., biofouling communities that include anemones and barnacles). Fish species associated with complex structure (e.g., black sea bass) would be attracted to cable armoring substrate (Harrison and Rousseau 2020; Stevens et al. 2019). Cable armoring impacts are likely to be permanent in most areas, but some re-sedimentation may occur and cover armoring material. Along cable routes, impacts on finfish, invertebrates, and EFH due to cable emplacement and maintenance would be moderate.

The resuspension of sediments may also release chemical and nutrient contaminants into the water column (Miro et al. 2022; Chen et al. 2020); however, impacts on biological communities may not be significant (Miro et al. 2022). The process of resuspension and transport of sediments that is discussed could disperse contaminated sediments in the water column and to other locations (Miro et al. 2022), especially when sediments are disturbed near potentially large coastal human population centers (Dong et al. 2012; Bay et al. 2003; Cearreta et al. 2000). Potential contaminants include heavy metals, hydrocarbons, and pesticides, which have been documented to affect survival, growth, metabolism, development, reproduction, immune response, and behavior of marine organisms (Austin 1999). Environmental contaminants may also increase vulnerability of aquatic organisms to disease (Austin 1999). Non-lethal impacts include concentration of contaminants in marine food webs (Pacheco 1988). Benthic organisms are particularly exposed to contaminants (Pacheco 1988). Contaminants then transfer into food webs as benthic organisms are typically prey to organisms higher on the food web. Suction dredging methods may significantly reduce the resuspension of contaminants compared to other dredging methods (Chen et al. 2022).

Cable emplacement and maintenance activities could result in short-term impacts and over time may result in long-term habitat alterations. The intensity of impacts would be dependent on multiple factors, including time of year, sediment type, and habitat type being affected where activities occur. For example, sand is the predominant sediment type within the New Jersey WEA (Guida et al. 2017), so disturbed sediments would be expected to settle out of the water column relatively quickly and travel shorter distances than if the seabed was dominated by finer sediments (mud).

BOEM expects localized adverse impacts from cable emplacement to be short term and moderate. Minor adverse impacts from cable maintenance activities could be long term but intermittent.

Discharges/intakes: Increases in vessel discharges would occur during construction and installation, O&M, and decommissioning of offshore wind development. Offshore permitted discharges include uncontaminated bilge water and treated liquid wastes. Increases would be greatest during construction and decommissioning of offshore wind projects. Discharge rates would be staggered according to project schedules and localized. Certain discharges are required to comply with permitting standards that are established to minimize potential impacts on the environment.

Entrainment and impingement of organisms would be likely at cooling water intakes for HVDC converters. Additionally, entrainment and impingement would occur at intakes for cable-laying equipment. Impacts on finfish, invertebrates, and EFH from entrainment and impingement at intakes are expected to be localized. Further, as discussed under the *Cable emplacement and maintenance* IPF, entrainment and impingement at cable-laying equipment intakes would be short term.

Impacts on finfish, invertebrates, and EFH from discharge volumes and intakes from offshore wind activities are expected to be negligible.

Electric and magnetic fields and cable heat: Up to 13,064 miles (21,025 kilometers) of export and interarray cables would be installed in offshore wind development planned in the geographic analysis area and would increase the presence of EMF in the geographic analysis area (Appendix D, Table D.A2-1). EMF strength rapidly decreases with distance from cables and would therefore mostly be confined to within a few meters of cable corridors. While burial increases the distance between cables and the exposed surficial sediments or water column, EMF is not eliminated or reduced when cables are buried or contained in a shield (Hutchison et al. 2021). EMF would persist continuously over the operating life of each project.

Many marine species are electromagnetic-sensitive and have been shown to respond to EMF from HVAC (Nyqvist et al. 2020; Gill et al. 2014, 2012). Although past studies have found mixed, and sometimes conflicting, results (Albert et al. 2020; Hutchison et al. 2020b), growing research on responses of marine animals to EMF have identified potential negative impacts of EMF (Klimley et al. 2021). Behavioral responses to EMF have been documented in decapods (e.g., lobsters and crabs) (Scott et al. 2018, 2021; Hutchison et al. 2018, 2020a; Ernst and Lohmann 2018) and finfish (Hutchison et al. 2020a; Scanlan et al. 2019), including migratory finfish (Minkoff et al. 2020; Klimley et al. 2017). Attraction to EMF exposed shelters was observed in the edible crab *Cancer pagurus* (Scott et al. 2018, 2021), while another decapod, the spiny lobster *Panulirus argus*, was observed to avoid EMF shelters (Ernst and Lohmann 2018). Other behavior impacts of EMF on decapods include changes in movement patterns and position above the seabed noted in a study on the American lobster *Homarus americanus* (Hutchison et al. 2020a). EMF impacts on behavior patterns of little skate have been observed (Hutchison et al. 2018), and other elasmobranchs potentially would have similar responses due to the group's sensitivity to EMFs (Hutchison et al. 2021; Gill et al. 2014). In other finfishes, results have been mixed or contradictory, even between species in the same genus (Gillson et al. 2022; Hutchison et al. 2020a; Scanlan et al. 2019; Öhman et al. 2007). For example, responses to magnetic fields were observed in migratory Atlantic salmon (Minkoff et al. 2020; Scanlan et al. 2019). However, mixed and contradictory responses in movements to EMF were observed in a similar species, Chinook salmon (*Oncorhynchus* *tshawytscha*) (Wyman et al. 2018). In a separate study, juvenile Chinook salmon migrations were not impeded by magnetic fields (Klimley et al. 2017). Migrations of green sturgeon (*Acipenser medirostris*) also have been found to not be impeded by magnetic fields (Klimley et al. 2017). EMFs were also not found to influence spatial distribution and behavior of lesser sandeel larvae (*Ammodytes marinus*) (Cresci et al. 2022). Further research and monitoring is needed to more fully understand the impacts of EMF on fish behavior (Klimley et al. 2021).

Recent studies have also identified physiological impacts of EMF on marine worms (Jakubowska et al. 2019; Stankevičiūtė et al. 2019), decapods (Scott et al. 2018), bivalves (Jakubowska et al. 2022; Stankevičiūtė et al. 2019), and finfish (Stankevičiūtė et al. 2019). Reduced rate of ammonia excretion in response to EMF was detected in the marine worm *Hediste diversicolor* (Jakubowska et al. 2019; Stankevičiūtė et al. 2019), the common bivalve *Cerastoderma glaucum* (Jakubowska et al. 2022), and the rainbow trout *Oncorhynchus mykiss* (Stankevičiūtė et al. 2019). Albert et al. (2022) did not observe EMF impairing feeding in blue mussel (*Mytilus edulis*), though the study did not explore ammonia excretion. Other physiological effects of EMF that have been observed include cytotoxicity in *H. diversicolor*, rainbow trout, and the Baltic clam *Limecola balthica* (Stankevičiūtė et al. 2019) and disruptions in the circadian rhythm of blood sugars associated with rest and activity in edible crab (Scott et al. 2018).

Future research is needed to explore the cumulative and population-level impacts of EMF on marine organisms (Hutchison et al. 2020b). A recent study found behavioral and developmental impacts of EMF on European lobster (*Homarus gammarus*) and edible crab that would potentially have population-level impacts (Harsanyi et al. 2022).

Offshore cables would emit heat along cable routes. Impacts on most finfish would be negligible considering that most cables from offshore wind development are expected to be buried, and heat from above-sediment cables would be cooled by water, limiting the heated area at short distances from cables (Taormina et al. 2018). Infaunal fishes (e.g., sand lances) and invertebrates, however, may be impacted by cable heat. Based on controlled experiments, Emeana et al. (2016) measured >10°C increases in sediment temperature at distances ranging from 16 inches (40 centimeters) to over 3.3 feet (1 meter) from cable sources that varied depending on sediment substrate and source temperature. Alternating current cables generate higher heat than direct current cables (Taormina et al. 2018).

Potential impacts of EMF on finfish, invertebrates, and EFH would not be minimized or eliminated by installing transmission cables with shielding or by burying them. However, cable burial depth could mitigate impacts of heat emission from cables. Minor to moderate adverse impacts on finfish, invertebrates, and EFH are expected from EMF and heat emission associated with cables from offshore wind development, though further research is needed to fully understand the impacts of EMF on finfish, invertebrates, and EFH.

Gear utilization: Biological monitoring information is required to be collected as part of wind energy development projects under 30 CFR Part 585 Subpart F. BOEM (2019b, 2019c) has outlined recommended approaches for developing benthic and fisheries biological monitoring programs. The purpose of the recommended monitoring programs is to establish pre-construction baselines and to assess changes/disturbances to resources in post-construction periods associated with operations. Monitoring during early operation periods may also serve to assess changes/disturbances that occurred due to construction activities.

Recommended gear types for biological monitoring include benthic grabs (e.g., Hamon grab, Van Veen grab, and benthic sled), otter trawls, underwater video imagery, and sediment profile imaging. Monitoring surveys that use underwater video imagery are not expected to produce any or noticeable impacts on habitats or benthic or fish resources (Beisiegel et al. 2017; Mallet and Pelletier 2014). Sediment profile imaging methods produce minimal disturbance to bottom habitats while providing data on habitat and biological fauna (Germano et al. 2011). However, trawling and benthic grab sampling gears are expected to have some level of measurable adverse impacts on benthic finfish and invertebrates and their benthic habitats (Jac et al. 2021; Kaiser 2019; Kaiser et al. 2002; Collie et al. 2000; Schwinghamer et al. 1996). Trawls and benthic grabs produce adverse impacts by removal of fauna and disturbance to bottom habitats (Jac et al. 2021; Collie et al. 2000; Kaiser et al. 2000; Clark 1999; Auster et al. 1996).

Active fishing gears such as trawls are known to reduce biomass and/or abundance of biological communities at the local spatial scale (i.e., within gear footprints) and at short, intermediate, or long-term time scales, with some changes potentially being permanent (Kaiser et al. 2000). This includes declines in biomass and/or abundance of targeted finfish or invertebrate species and epi- and infaunal communities impacted by habitat disturbances (Jennings et al. 2001, 2002; Collie et al. 2000; Kaiser et al. 2000). Declines in abundance or changes to community composition may also result in ecological community function with desired or targeted species being replaced with organisms not vulnerable to trawling (de Juan et al. 2007). Trawl gear, including otter trawls, leave behind notable tracks that are evidence of direct disturbance to bottom habitats (Smith et al. 2003; Auster et al. 1996; Schwinghamer et al. 1996). Sensitive habitats have been documented to be vulnerable to trawling activity (Clark 1999). Direct disturbance of soft-bottom habitats from trawling could also result in sediment plumes and resuspension of nutrients and/or contaminants with potential biogeochemical consequences (Breimann et al. 2022; Palanques et al. 2022; Paradis et al. 2021; Pilskaln et al. 1998; Jones 1992; Churchill 1989). Other potential impacts on communities from trawling could include declines in production processes and overall community size spectra in benthic habitats (Queiros et al. 2006; Jennings et al. 2001, 2002).

Future recommendations for biological monitoring include a combination of imagery surveys to supplement or limit the use of trawling methods, though imagery methods are not considered sufficient to replace trawling altogether (Jac et al. 2021; Trenkel et al. 2019; Beisiegel et al. 2017). Imagery approaches, however, have some advantages to other gears in some habitats (Beisiegel et al. 2018), and the combined approach is recommended in guidelines for offshore wind development biological monitoring programs (BOEM 2019b). Water samples for eDNA analysis is another suggested approach for biological monitoring programs that would have limited impacts on underwater fauna and habitats (Trenkel et al. 2019).

Lighting: Light emissions would increase in the geographic analysis area from offshore wind activities. Construction of up to 2,844 WTGs and 39 OSSs/ESPs and met towers are planned in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). According to regulatory guidelines, each offshore structure would have flashing navigational and hazard lights (BOEM 2019a). Artificial lights from offshore wind structures would persist during the operating life of each project. Light sources from these activities include vessels, buoys, towers, and WTG structures. Lights would be from above-water sources, but light easily propagates through air and transitions through water. Marine organisms are attracted to light, which may influence natural nighttime behavioral patterns and possibly biological diel patterns. Finfish and invertebrates that are attracted to light may be exposed to more harmful IPFs associated with marine projects (e.g., noise). Any behavioral responses to offshore lighting are expected to be localized and temporary (BOEM 2021a).

Nighttime operation of vessels requires the use of navigational lights, which would emit light during transit as well as during construction activities. Vessel activity during O&M and biological monitoring efforts, which may occur at night, would also be a source of light. Increases in light emissions would be highest during construction and decommissioning phases when vessel deck lights, and possibly spotlights, could be utilized. BOEM issued guidance for minimizing impacts from offshore wind-related artificial lights including minimizing the number of lights, using lower-intensity or strobe lighting, and avoiding white lights (Orr et al. 2013). Lights from offshore wind development could produce local, minor impacts on finfish, invertebrates, and EFH. Overall, impacts within the geographic analysis area would be negligible, given that affected areas are relatively small.

Noise: Noise is expected to increase in the geographic analysis area from offshore wind activities. Up to 2,844 WTGs and 39 OSSs/ESPs and met towers are expected to be constructed in offshore wind development between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2). Noise sources related to construction of these structures include aircraft, vessels, seismic G&G surveys, pile driving, WTG operation, and overall construction activities. A description of the physical qualities of these sound sources can be found in Appendix B, Section B.5, *Underwater Acoustics*.

Many fishes and invertebrates produce sounds for basic biological functions like attracting a mate and defending territory. A recent study revealed that sound production in fishes has evolved at least 33 times throughout evolutionary time, and that the majority of ray-finned fishes are likely capable of producing sounds (Rice et al. 2022). Fish may produce sounds through a variety of mechanisms, such as vibrating muscles near the swim bladder, rubbing parts of their skeleton together, or snapping their pectoral fin tendons (Rice et al. 2022; Ladich and Bass 2011). Similarly, many marine invertebrates produce sounds, ranging from the ubiquitous snapping shrimp “snaps” (Johnson et al. 1947) to spiny lobster “rasps” (Patek 2002) to mantis shrimp “rumbles” (Staaterman et al. 2011). Some sounds are also produced as a byproduct of other activities, such as the scraping sound of urchins feeding (Radford et al. 2008a) and even a “coughing” sound made when scallops open and close their shells (Di Iorio et al. 2012).

All fishes and invertebrates are capable of sensing the particle motion component of a sound wave (for information about particle motion see Appendix B, Section B.5). The inner ear of fishes is similar to that of all vertebrates. Each ear has three otolithic end organs, which contain a sensory epithelium lined with hair cells, as well as a dense structure called an otolith (Popper et al. 2022). As the back-and-forth particle motion moves the body of the fish (which has a density similar to seawater), the denser otoliths lag behind, creating a shearing force on the hair cells, which sends a signal to the brain via the auditory nerve (Fay and Popper 2000). Many invertebrates have structures called statocysts which, similar to fish ears, act like accelerometers: a dense statolith sits within a body of hair cells, and when the animal is moved by particle motion, it results in a shearing force on the hair cells (Budelmann 1992; Mooney et al. 2010). Some invertebrates also have sensory hairs on the exterior of their bodies, allowing them to sense changes in the particle motion field around them (Budelmann 1992), and the lateral line in fishes also plays a role in hearing (McCormick 2011). The research thus far shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper et al. 2022).

In addition to particle motion detection, which is shared across all fishes, some species are also capable of detecting acoustic pressure (Fay and Popper 2000); some sharks possibly detect both particle motion and acoustic pressure (Poppelier et al. 2022; van Den Berg and Schuijf 1983). Special adaptations of the swim bladder (e.g., anterior projections, additional gas bubbles, or bony parts) bring it in close proximity to the ear; as the swim bladder expands and contracts, pressure signals are radiated within the body of the fish, making their way to the ear in the form of particle motion (Popper et al. 2022). These species can typically detect a broader range of acoustic frequencies (up to 3–4 kHz) (Wiernicki et al. 2020) and are therefore considered to be more sensitive to underwater sound than those only detecting particle motion. Hearing sensitivity in fishes is generally considered to fall along a spectrum: the least-sensitive (sometimes called "hearing generalists") are those that do not possess a swim bladder and cannot detect sound above 1 kHz, while the most sensitive ("hearing specialists") possess specialized structures enabling pressure detection (Popper et al. 2022). A few species in the herring family can detect ultrasonic (> 20 kHz) sounds (Mann et al. 2001), but this is considered to be very rare among the bony fishes, as more fishes detect sound in the infrasound range (Enger et al. 1993) and most fishes in the audible range (Ladich and Fay 2013). Another important distinction for species that do possess swim bladders is whether it is "open" or "closed": species with open swim bladders can release pressure via a connection to the gut, while those with closed swim bladders can only release pressure very slowly, making them more prone to injury when experiencing rapid changes in pressure (Popper et al. 2019). It should also be noted that hearing sensitivity can change with age; in some species like black sea bass, the closer proximity between the ear and the swim bladder in smaller fish can mean that younger individuals are more sensitive to sound than older fish (Stanley et al. 2020). In other species, hearing sensitivity seems to improve with age (Enger and Mann 2005; Kenyon 1996).

As with marine mammals, fishes and invertebrates may experience a range of impacts from underwater sound depending on physical qualities of the sound source and the environment, as well as the physiological characteristics and the behavioral context of the species of interest (see Section 3.5.6, *Marine Mammals*). It is important to note that unlike mammals, whose hair cells do not regenerate, fishes are able to regrow hair cells that die or become damaged (Corwin 1981), making it extremely likely that they could experience PTS. However, fishes do experience TTS, and when very close to impulsive sound sources or explosions they could experience barotrauma, a term that refers to a class of injuries ranging from recoverable bruises to organ damage (which could ultimately lead to death) (Popper et al. 2014; Stephenson et al. 2010). When the air-filled swim bladder inside the body of the fish quickly expands and contracts due to a rapid change in pressure, it can cause internal injuries to the nearby tissues (Halvorsen et al. 2011). The greater the difference between the static pressure at the site of the fish and the positive/negative pressures associated with the sound source, the greater the risk of barotrauma. This means that impulsive sounds like those generated by impact pile driving may present a risk of injury due to the rapid changes in acoustic pressure (Hamernik and Hsueh 1991). Damage to invertebrate statocysts has been observed in response to sound exposure, but it is unclear whether the hair cells can regenerate, like they do in fishes (Solé et al. 2013, 2017). As with marine mammals, continuous, lower-level sources (e.g., vessel noise) are unlikely to result in auditory injury but could induce changes in behavior or acoustic masking. A discussion of hearing thresholds used in fishes can be found in Appendix B, Section B.5.

Offshore wind activities may include the use of helicopters for transporting workers to construction sites and structures. The most intense helicopter activity would occur during construction phases and mostly likely during shift changes. Aircraft noise, including noise from helicopters, is not likely to propagate efficiently as it transitions from through air into the water, diminishing impact levels. Near-surface pelagic organisms may detect decreased aircraft noise levels as they transition from through-air to through-water, but impacts are not expected (BOEM 2021a). Noise levels from aircraft would be greatly diminished when they reach benthic/demersal habitats and may be at least partially masked by ambient ocean noise.

Increased vessel noise from offshore wind activities would occur, especially during construction phases. A description of the physical qualities of vessel noise can be found in Appendix B, Section B.5. Most construction vessels produce noise while stationary as well as during transit. Transiting vessels generate continuous sound from their engines, propeller cavitation, onboard machinery, and hydrodynamics of water flows (Ross 1976). The actual radiated sound depends on several factors, including the type of machinery on the ship, the material conditions of the hull, how recently the hull has been cleaned, interactions with the sea surface, and shielding from the hull, which reduces sound levels in front of the ship.

In general, vessel noise increases with ship size, power, speed, propeller blade size, number of blades, and rotations per minute. Source levels for large container ships can range from 177 to 188 dB re 1 µPa-m (McKenna et al. 2013) with most energy below 1 kHz. Smaller vessels typically produce higher-frequency sound concentrated in the 1–5 kHz range. Kipple and Gabriele (2003) measured underwater sound from vessels ranging from 14 to 65 feet (4.3 to 19.8 meters) long (25 to 420 horsepower) and back-calculated source levels to be 157–181 dB re 1 µPa-m. Similar levels are reported by Jiménez-Arranz et al. (2020), who provide a review of measurements for support and crew vessels, tugs, inflatable RIHBs, icebreakers, cargo ships, oil tankers, and more.

During transit to and from shore bases, survey vessels typically travel at speeds that optimize efficiency, except in areas where transit speed is restricted. The vessel strike speed restrictions that are in place along the Atlantic OCS are expected to offer a secondary benefit of underwater noise reduction. For example, recordings from a speed reduction program in the Port of Vancouver (689- to 820-foot [210- to 250-meter] water depths) showed that reducing speeds to 11 knots reduced vessel source levels by

5.9 to 11.5 dB, depending on the vessel type (MacGillivray et al. 2019). Vessel noise is also expected to be lower during geological and geophysical surveys, as they typically travel around 5 knots when towing instruments.

Avoidance of vessels and vessel noise has been observed in several pelagic, schooling fishes, including Atlantic herring (Vabo et al. 2002), Atlantic cod (Handegard 2003), and others (reviewed in De Robertis and Handegard 2013). In response to vessels, fish may dive toward the seafloor, move horizontally out of the vessel's path, or disperse from their school (De Robertis and Handegard 2013; Misund and Aglen 1992). These responses in schooling behavior may increase individual-fish vulnerability to predation; however, population-level effects are unlikely. A body of recent work has documented other, more subtle behaviors in response to vessel noise, but has focused solely on tropical reef-dwelling fish. For example, predator avoidance responses in damselfish (Ferrari et al. 2018; Simpson et al. 2016) and boldness (Holmes et al. 2017) seem to decrease in the presence of vessel noise, while nest-guarding behaviors seem to increase (Nedelec et al. 2017). Habituation to extended exposure to vessel sound has been observed in the domino damselfish (Nedelec et al. 2016). After 2 days of exposure to vessel sound playback, domino damselfish increased hiding behavior and ventilation rates, but responses diminished after 1 to 2 weeks, indicating habituation (Nedelec et al. 2016).

Vessel noise may also induce physiological stress or acoustic masking in hearing abilities of fishes. Studies have shown an increase in cortisol, a stress hormone, after playbacks of vessel noise (Celi et al. 2016; Nichols et al. 2015; Wysocki et al. 2006). However, recent studies suggest that stress from handling during experiments is greater than stress from acoustic stimulus, possibly confounding the results from the earlier studies (Harding et al. 2020; Staaterman et al. 2020). The cavitation of vessel propellors produces low-frequency, nearly continuous sound that is audible by most fishes and invertebrates and could mask important auditory cues, including conspecific communication (Haver et al. 2021; Parsons et al. 2021). Stanley et al. (2017) demonstrated that the communication range of both haddock and cod (species with swim bladders but lacking connections to the ear) would be significantly reduced in the presence of vessel noise, which is frequent in their habitat in Cape Cod Bay. In general, fish species that are sensitive to acoustic pressure would experience masking at greater distances than those that are only sensitive to particle motion).

Limited research on invertebrate responses to vessel noise has yielded inconsistent findings. Some crustaceans seem to have physiological responses to vessel noise. For example, increases in oxygen consumption are apparent in crabs (Wale et al. 2013). Other physiological responses include increases in some hemolymph (an invertebrate analog to blood) biomarkers like glucose and heat-shock proteins in spiny lobsters, which are indicators of stress (Filiciotto et al. 2014). Changes in hemolymph biomarkers in response to vessel noise were not observed in other crustaceans, including American lobsters and blue crabs (Hudson et al. 2022). However, these species exhibited behavioral changes in response to vessel noise including decreases in food handling time, defending food, and initiating fights with competitors (Hudson et al. 2022). Note that the research discussed in this paragraph is limited to laboratory studies, and in most cases, did not consider particle motion as a relevant cue; therefore, it is difficult to draw conclusions from the limited breadth of this work.

The planktonic larvae of fishes and invertebrates may experience acoustic masking from continuous sound sources like vessels. Several studies have shown that larvae are sensitive to acoustic cues and may use these signals to navigate to suitable settlement habitat (Montgomery 2006; Simpson et al. 2005), initiate metamorphosis into the juvenile stage (Stanley et al. 2012), or to maintain group cohesion during their pelagic transport (Staaterman et al. 2014). However, given the short range of such biologically relevant signals for particle motion-sensitive animals (Kaplan and Mooney 2016), the spatial scale at which these cues are relevant is rather small. If vessel transit areas overlap with settlement habitat, it is possible that vessel noise could mask some biologically relevant sounds (e.g., Holles et al. 2013), but these effects are expected to be short term and would occur over a small spatial area.

Several offshore wind projects have proposed use of dynamic positioning to avoid anchoring impacts. Many studies have found that the measured sound levels of dynamic positioning alone are, counterintuitively, higher than those of dynamic positioning combined with the intended activities such as drilling (Jiménez-Arranz et al. 2020; Kyhn et al. 2011; Nedwell and Edwards 2004) and coring (Warner and McCrodan 2011). Nedwell and Edwards (2004) reported that dynamic positioning thrusters of the semi-submersible drill rig Jack Bates produced periodic noise (corresponding to the rate of the thruster blades) with most energy between 3 and 30 Hz. The received SPL measured at 328 feet (100 meters) from the vessel was 188 dB re 1 µPa. Warner and McCrodan (2011) found that most dynamic positioning related sounds from the self-propelled drill ship, *R/V Fugro Synergy* were in the 110–140 Hz range, with an estimated source level of 169 dB re 1 µPa-m. Sounds in this frequency range varied by 12 dB during dynamic positioning, while the broadband levels, which also included diesel generators and other equipment sounds, varied by only 5 dB over the same time period. Sound levels from dynamic positioning have high variability with time due in part to the intermittent usage and relatively slow rotation rates of thrusters. It is also difficult to provide a realistic range of source levels from the data thus far because most reports do not identify the direction from which sound was measured relative to the vessel, and dynamic positioning thrusters are highly directional systems.

The active acoustic positioning systems used in dynamic positioning also generate high frequency sound. These systems usually consist of a transducer mounted through the vessel's hull and one or more transponders affixed to the seabed. Kongsberg High Precision Acoustic Positioning systems produce pings in the 10–32 kHz frequency range. The hull-mounted transducers have source levels of 188–206 dB re 1 µPa-m depending on adjustable power settings (Kongsberg Maritime AS 2013). The fixed transponders have maximum source levels of 186–206 dB re 1 µPa-m depending on model and beam width settings from 15 to 90° (Jiménez-Arranz et al. 2020). These systems have high source levels, but beyond 1.2 miles (2 kilometers), they are generally quieter than other components of the sound from dynamic positioning vessels for various reasons, including their pulses are produced in narrowly directed beams, each individual pulse is very short, and their high frequency content leads to faster attenuation. Specific impacts from dynamic positioning thruster and transponder noise on finfish, invertebrates, and EFH have not been studied.

Impacts from vessel noise are expected to be localized, short term, and minor. Considering the relative size of affected areas compared to the geographic analysis area, overall impacts would be negligible.

Some offshore wind development projects may require G&G surveys, which introduces noise while active acoustic sources are in use. Project-specific G&G surveys would occur during site assessments. Where possible, existing survey information would be reprocessed for offshore wind development, possibly limiting G&G surveys at some WEAs (BOEM 2014). Of the sources that may be used in geophysical surveys for offshore wind, only a handful (e.g., boomers, sparkers, bubble guns, and some SBPs) emit sounds at frequencies that are within the hearing range of most fishes and invertebrates (see Appendix B, Section B.5 for more detail on these sources [Crocker and Fratantonio 2016; Ruppel et al. 2022]). This means that side-scan sonars, multibeam echosounders, and some SBPs would not be audible, and thus would not affect them. For the sources that are audible, it is important to consider other factors such as source level, beamwidth, and duty cycle (Ruppel et al. 2022). Boomers, sparkers, hull-mounted SBPs, and bubble guns have source levels close to the threshold for injury for pressure-sensitive fishes, so unless a fish was within a few meters of the source, injury is highly unlikely (Crocker and Fratantonio 2016; Popper et al. 2014). Behavioral impacts could occur over slightly larger spatial scales. For example, if one assumes an SPL threshold of 150 dB re 1 µPa for behavioral disturbance (GARFO 2020) and spherical spreading loss, sounds with source levels of 190 dB re µPa-m would fall below this threshold approximately 328 feet (100 meters) from the source (assuming cylindrical spreading, this would be approximately 0.6 mile [1 kilometer]). This means that the lowest-powered sparkers, boomers, and bubble guns would not result in behavioral disturbance beyond approximately 328 feet (100 meters) in a deep water oceanic environment (Crocker and Fratantonio 2016). Towed SBPs are generally lower in power than hull-mounted systems, so behavioral impacts are likely to occur over even smaller scales. It should be noted that these numbers are reported in terms of acoustic pressure because there are currently no behavioral disturbance thresholds for particle motion. It is expected that behavioral impact ranges would be even smaller for particle motion-sensitive species, including invertebrates. Because most HRG sources are typically "on" for short periods with silence in between, only a few "pings" emitted from a moving vessel towing an active acoustic source would reach fish or invertebrates below, so behavioral effects would be intermittent and temporary. Overall, the level of disturbance from G&G surveys is expected to be negligible for fishes and invertebrates due to the frequency range, the small spatial extent of sound propagation, and the short duration of exposure.

Low-frequency noise from WTG operation would persist during the operational life of each offshore wind project. A description of the physical qualities of vessel noise can be found in Appendix B, Section B.5. Elliot et al. (2019) compared field measurements during offshore wind operations from the BIWF to the published audiograms of a few fish species. They found that, even at 164 feet (50 meters) from an operating turbine, particle acceleration levels were below the hearing thresholds of several fish species, meaning that it would not be audible at this distance. Pressure-sensitive species may be able to detect operational noise at greater distances, though this will depend on other characteristics of the acoustic environment (e.g., sea state). Nonetheless, it is unlikely that operational noise will be audible to animals beyond those that live in close vicinity to the pile (i.e., those that have settled there due to the structure it provides), and even if it is audible, it may not be bothersome. Noise is also expected during maintenance (e.g., vessel noise, repairs) but would be infrequent. Impacts of noise from O&M would be localized (i.e., restricted to the general WEAs), and noise levels would be low to moderate. No studies have identified behavioral impacts of WTG operation on finfish, invertebrates, and EFH (Thomsen et al. 2015).

Impact and vibratory pile-driving noise is expected to occur as part of the construction and installation of each of the planned offshore wind projects in the geographic analysis area. A description of the physical qualities of pile-driving noise can be found in Appendix B, Section B.5. Impulsive, high-source-level noise, such as pile-driving noise, may injure, kill, or otherwise disrupt development in early life stages of fish and invertebrates (Weilgart 2018; Hawkins and Popper 2017). Closer investigations into the effects of the particle motion component of noise on fish have been recommended (Weilgart 2018; Hawkins and Popper 2017).

Dead fish observed within 32.8 feet (10 meters) of a bridge construction project were attributed to pile-driving activity, suggesting that pile-driving noise could cause fish mortality (Abbott and Reyff 2004). Only one other field study measured potential fish mortality near pile-driving operations (Debusschere et al. 2014). That study found no increase in mortality of juvenile European seabass (a species with a closed swim bladder) from pile-driving noise at received peak pressures of 210–211 dB re 1 µPa within 147.5 feet (45 meters) of a pile (Debusschere et al. 2014). Because little empirical work has examined the potential for non-recoverable injury (i.e., injuries that would lead to mortality), acoustic modeling can be combined with the given acoustic thresholds to predict potential effects. For example, Ainslie et al. (2020) used a damped cylindrical spreading model informed by empirical measurements from the North Sea (pile diameter ranging from 11.1 to 23 feet [3.4 to 7.0 meters]) to derive effect ranges for fishes based on Sound Exposure Guidelines outlined in Popper et al. (2014). Based on a model scenario of 7,000 strikes to drive a 19.7-foot (6-meter) diameter pile at a depth of 92 feet (28 meters) and 10 dB noise abatement, fish without a swim bladder could experience mortal injury up to 128 feet (39 meters) from a source and recoverable injury up to 253 feet (77 meters) from a source. For fish that have a swim bladder involved in hearing, mortal injury could occur within 0.33 mile (533 meters) from the source and recoverable injury could occur up to 0.75 mile (1.2 kilometers) from the source. In similar water depths of the Western Atlantic, modeling predictions for installing a 36-foot (11-meter) diameter monopile (assuming 2,202 strikes), using a 4,000-kJ hammer with 10 dB of attenuation yielded similar exposure ranges. Fish without a swim bladder could experience recoverable injury at 722 feet (220 meters), while fish with a swim bladder involved in hearing could experience recoverable injury up to 0.94 mile (1.52 kilometers) away (Ocean Wind 2022). It is generally safe to assume that fishes without a swim bladder, as well as invertebrates, could experience recoverable injury on the order of tens to hundreds of meters, while fishes with swim bladders involved in hearing may experience effects on the order of one to two kilometers; these distances assume 10 dB of attenuation at the source.

The estimates given above are based on acoustic modeling and are described in terms of acoustic pressure, which is relevant for fishes with swim bladders, but for other species, particle motion is the more appropriate cue. Field work by Amaral et al. (2018) measured particle acceleration during impact pile-driving of jacket foundations with 4.3-foot (1.3-meter) diameter piles. At 0.3 mile (500 meters) from the pile, in-water particle acceleration ranged from 30 to 65 dB re 1 µm/s2 in the 10–1000 Hz range, but closer to the seabed it was significantly higher, at 50–80 dB re 1 µm/s2. When comparing these received levels to the published hearing thresholds of several fish species, the authors surmised that in-water particle acceleration would be barely audible at this distance, while levels near the seabed would indeed be detectable (Amaral et al. 2018). These field measurements of particle motion are critical for putting other experimental research into context; most of the studies described have focused on acoustic pressure, which is relevant for only a sub-set of fishes. It also underscores the fact that species that lack hearing specializations are unlikely to experience significant effects from impact pile driving beyond a few hundred meters from the source, for similar-size piles and water depths.

A suite of empirical studies has examined other behavioral and physiological effects in fishes—beyond injury—and are described briefly here. Most of this work has focused on commercially important species like the European seabass, which lacks hearing specializations and has a closed swim bladder. Adult seabass generally dive deeper and increase swimming speed and group cohesion when exposed to intermittent and impulsive sounds like pile driving (Neo et al. 2014, 2018), but juveniles become less cohesive (Herbert-Read et al. 2017) and generally seem to be more sensitive to pile-driving noise than adults (Kastelein et al. 2017). There is also some evidence that respiration rates may be affected by pile-driving noise (Spiga et al. 2017). Importantly, a number of studies have shown that European seabass are likely to habituate to pile-driving sounds over repeated exposure (e.g., Bruintjes et al. 2016; Neo et al. 2016; Radford et al. 2016). Together, this research suggests that European seabass, and probably other species with similar hearing anatomy, are likely to exhibit short-term startle or physiological responses but would recover quickly once pile-driving is complete.

In field-based studies that can better represent the acoustic conditions that fish would experience near real pile-driving operations, Mueller-Blenkle et al. (2010) showed that free-swimming cod and sole both exhibited changes in swimming behavior in response to pile-driving sounds. Hawkins et al. (2014) found that schools of sprat were more likely to disperse, while mackerel were more likely to change water depth. Despite different hearing anatomies, both species exhibited behavioral responses 50 percent of the time to sound levels at 163 dB re 1 µPa Lpk-pk, which could be expected tens of kilometers from the source (Hawkins et al. 2014). Iafrate et al. (2016) did not observe significant displacement in tagged grey snapper, a species with high site fidelity, residing within hundreds of meters of real pile-driving operations, while Krebs et al. (2016) observed that Atlantic sturgeon seemed to avoid certain areas when pile driving was taking place, suggesting that they would not remain in the area long enough to experience detrimental physiological effects. These field studies indicate that fishes may be startled, temporarily displaced, or change their schooling behaviors during pile-driving noise, but that when the sound is over, they are likely to resume normal behaviors relatively quickly.

Overall, the research thus far indicates that fishes will exhibit short-term behavioral or physiological responses to impulsive sounds like impact pile driving. Species with more sensitive hearing would be more susceptible to TTS and behavioral disturbance, and at greater distances, than those with less sensitive hearing. Aside from hearing anatomy, impacts are likely to differ between species based on other contextual factors, such as time of year or time of day. For example, impacts from noise would be greater if it occurs during spawning periods or within spawning habitat, particularly for species that are known to aggregate in specific locations to spawn, use sound to communicate, or spawn only once in their lifetime. Fish that avoid an area during pile-driving are likely to return following completion of pile-driving activity.

Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not likely to experience barotrauma from pile driving. Very few studies have examined the effects of substrate vibrations from pile driving, yet many have recently acknowledged that this is a field of urgently needed research (Hawkins et al. 2021; Popper et al. 2022; Wale et al. 2021). Most of the research thus far has focused on water-borne particle motion, or even acoustic pressure, and is discussed briefly below.

Sessile marine invertebrates like bivalves are sensitive to substrate-borne vibrations and may be affected by pile driving noise (Day et al. 2017; Roberts et al. 2015; Spiga et al. 2016). A recent study by Jézéquel et al. (2022) exposed scallops to a real pile-driving event at distances of 26 to 164 feet (8 and 50 meters) from the pile. Measured peak particle acceleration was 110 dB re 1 µm/s^2 at the close site and 87 dB re 1 µm/s^2 at the farther site. Exposed scallops did not exhibit swimming behavior, an energetically expensive escape response. At the experimental site 26 feet (8 meters) from the pile, scallops increased valve closures during pile-driving noise and did not show any acclimatization to repeated sound exposure. However, they returned to their pre-exposure behaviors within 15 minutes after exposure. Increased time spent with closed valves could reduce feeding opportunities and thus have energetic consequences, though the biological consequences of this effect have not been studied.

Cephalopods can detect low-frequency sounds by sensing particle motion with their statocysts (Mooney et al. 2010), which, similar to the fish ear, act like three-dimensional accelerometers and could be injured from high sound exposures. Indeed, damage to cephalopod statocysts has been observed in several tank-based studies (André et al. 2011; Sole et al. 2022). Jones et al. (2020) observed alarm response behavior, such as inking and jetting, in longfin squid exposed to pile-driving noise at median peak particle velocities of 40 dB re 1 m/s within a tank. While their initial responses diminished quickly, after 24 hours, the squid were re-sensitized to the noise. A follow-up field study with small-scale pile driving looked at the behavior of the same species held in cages at different distances (26 and 164 feet [8 and 50 meters]) and found similar results: alarm behaviors occurred with the first acoustic stimulus, but diminished quickly (within ~4 seconds). Responses were only observed in squid at the near site, suggesting that at greater distances from pile driving there is unlikely to be any alarm response (Cones et al. 2022). Another tank experiment examined predatory feeding behavior of longfin squid (Jones et al. 2021). Within the tank, peak particle acceleration during the playbacks were 130 to 150 dB re 1 µm/s^2 (160–180 dB re 1 µPa Lpk), which the authors surmise is similar to field conditions within 0.3 mile (500 meters) of a 4.3-foot (1.3-meter) diameter steel pile. In the presence of pile-driving noise, there was a reduction in squid feeding success, and the introduction of pile-driving noise caused the squid to abandon predation attempts. Interestingly, additional work showed that interactions between males, and reproductive behaviors between males and females were unaffected by pile-driving noise, suggesting that the motivation to mate exceeds the potential stress that noise may introduce (BOEM-funded report, in press). This work underscores that squid (and likely all cephalopods) are sensitive to low-frequency sound but may recover quickly. When pile-driving noise co-occurs with feeding periods, it could negatively affect feeding, but is unlikely to affect reproductive success.

Like other marine invertebrates, crustaceans are capable of sensing low-frequency sound through particle motion in the water or in the substrate (Popper et al. 2001; Roberts and Breithaupt 2016).

Research on seismic airguns and crustaceans has not demonstrated any widespread mortality or major physiological harm (e.g., American lobsters: Payne et al. 2007, rock lobsters: Day et al. 2016, snow crabs: Christian et al. 2003; Cote et al. 2020; Morris et al. 2020), though some sub-lethal effects on hemolymph biochemistry have been observed, and the biological consequences of these effects have not been well-studied. Pile-driving sounds have been shown to affect certain behaviors in crustaceans, such as reducing locomotor activity (Norway lobster: Solan et al. 2016), decreasing feeding activity (crabs: Corbett 2018), or inhibiting attraction to chemical cues (hermit crabs: Roberts and Laidre 2019). The research thus far indicates that marine crustaceans may alter their natural behaviors in response to pile-driving sounds, but further work is required to understand the biological significance of these changes, and whether substrate-borne or water-borne particle motion has a greater influence on their behavior. Disentangling these effects is important for understanding the spatial scale at which they may be affected by pile-driving noise.

Pile-driving activities would largely be scheduled during summer when favorable weather conditions for construction are most likely (BOEM 2021b). Summer-spawning species would be vulnerable to impacts from pile-driving noise. In general, noise from pile-driving activities could cause moderate effects on finfish, invertebrates, and EFH; these effects would be short term and localized.

Cable laying from offshore wind activities would occur along up to 13,064 miles (21,025 kilometers) of export and interarray cable corridors (Appendix D, Table D.A2-1). Cable-laying activities that produce noise include trenching, jet plowing, backfilling, and cable protection installation. Noise levels from cable laying would be minor, and noise would be temporary and local. No impacts on finfish, invertebrates, and EFH from noise generated by cable-laying activities are expected (BOEM 2021b). Cable-laying activities would continuously move, and areas would be exposed to cable-laying noise for relatively short periods.

Adverse impacts on finfish, invertebrates, and EFH due to noise would be negligible to minor, localized, and mostly short term. Intermittent maintenance activities would occur over the long term but would be negligible.

Presence of structures: Construction of new underwater structures from offshore wind development presents a risk of entanglement and loss of fishing gear. Planned offshore structures include WTG foundations (e.g., monopiles, lattice, gravity-based) and their scour protection, meteorological towers, cable armoring, buoys, and pilings. Fishing gear potentially entangled or lost on these structures includes mesh from trawls or other similar nets, traps, and angling gear (e.g., fishing line, hooks, lures with hooks). Entangled nets and fishing line and lost traps may trap or ensnare marine organisms, leading to injury or mortality. Lost hooks, sometimes baited, and lures may be ingested by marine organisms, possibly causing harm. Impacts on finfish, invertebrates, and EFH from lost gear are considered short term and localized, but the risk of gear loss due to offshore wind structures would be long term, persisting during the operational life of the wind farm (BOEM 2021b).

Offshore wind development may construct up to 2,844 WTGs and 39 OSSs/ESPs and met towers in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). Hydrodynamics around offshore WEAs can be affected by modifications to wind-driven waves and currents, and there can be direct impacts on ocean currents from offshore wind structure foundations (van Berkel et al. 2020). Based on hydrodynamic modeling studies, the presence of offshore wind arrays could potentially disrupt water flow at a fine scale within the interarray area and immediately downstream, but flows would return to normal at short distances from the array (Miles et al. 2017; Cazenave et al. 2016). Increases in turbulent flow immediately around offshore wind structure foundations would combine with reductions in wind-driven mixing downstream of structures to dynamically affect the hydrodynamic field within the local periphery of wind farms (Christiansen et al. 2022; Dorrell et al. 2022; van Berkel et al. 2020; Carpenter et al. 2016). Disruptions to flow around foundation structures were modeled to extend from 65.6 to 164 feet (20 to 50 meters) downstream and are proportional to the diameter of the foundation (Miles et al. 2017; Cazenave et al. 2016). In a shelf-scale model based on offshore wind structures in the Irish Sea, a 5-percent reduction in peak water velocities was estimated for an array totaling 297 turbines (Cazenave et al. 2016). The reductions in peak velocities in that study were modeled to extend up to 0.5 nautical mile (1 kilometer) downstream of monopiles. Strong vertical mixing of the water column has been identified in studies on impacts of subsurface infrastructure on hydrodynamic flow (van Berkel et al. 2020). Variation in depth of the mixing layer may also impact distributions of larval assemblages in the water column (Chen et al. 2021). Altered hydrodynamics can also result in seabed scour and sediment suspension around structures, resulting in sediment plumes. Sediment plumes are typically observed in structures in shallow water and high-current velocity systems and are not expected to occur offshore. Impacts of offshore wind structures on hydrodynamics would be long term, persisting for the life of structures.

Hydrodynamic disturbances from offshore wind structures also may affect the mid-Atlantic cold pool, which is a seasonally present water mass that is an important hydrographic feature to the dispersal and survival of early life stages of many fish and invertebrates (BOEM 2021a). The cold pool has been described by Chen et al. (2018) and Lentz (2017), but its year-to-year dynamics are yet to be fully understood. Research on the potential disruptions to the cold pool from offshore wind structures is ongoing (BOEM 2021a). A modeling study investigating the impacts of offshore wind structures on large-scale stratification, the principal feature of the cold pool, in the North Sea did not find a significant reduction in stratification from small-scale installations (i.e., modeled wind farm length of 5 miles [8 kilometers]) (Carpenter et al. 2016). This study, however, found significant reductions in stratification from modeled large-sale installations (i.e., modeled wind farm length of 62 miles [100 kilometers]). Localized reductions in stratification were similarly found in a modeling study that scaled single foundation impacts on a realistic wind farm scenario in the Irish Sea (Cazenave et al. 2016). Miles et al. (2021) note that stratification used in the North Sea and Irish Sea studies is much weaker than summer cold pool stratification. The stratification level used in those studies is more representative of spring and fall cold pool stratification (Miles et al. 2021). Additionally, predicted warming sea temperatures in the geographic analysis area add to long-term uncertainty associated with the dynamics and presence of the mid-Atlantic cold pool (Miles et al. 2021).

The addition of offshore wind structures would convert soft-bottom habitat to complex structured habitat. This conversion would occur within the footprint of WTGs and along cable routes.

Approximately 5,405 acres (2,187 hectares) of hard scour protection would be installed around the foundations, and an additional 2,576 acres (1,043hectares) of hard protection would be installed around the export and interarray cables where target depths are not achieved (Appendix D, Table D.A2-2). While hard structures from offshore wind development may fragment or displace soft-bottom communities, particularly infaunal communities, soft-bottom habitat is the most extensive habitat in the Georges Bank, Southern New England, and Mid-Atlantic Bight subregions of the LME; therefore, the presence of offshore wind structures would not significantly reduce the availability of this habitat for finfish and invertebrates. Due to the low availability of complex structured habitat in the Southern New England and Mid-Atlantic Bight subregions of the LME, offshore wind structures and protective cable armoring would have an artificial reef effect by providing new habitat for communities associated with this habitat type (Glarou et al. 2020).

Once installed, offshore wind structures and associated armoring would be rapidly colonized by fouling communities (e.g., macroalgae, mussels, barnacles) and epifaunal succession would proceed (Degraer et al. 2020; Coolen et al. 2020; De Mesel et al. 2015). Aggregations of decapods, gobies (Gobiidae), and pelagic predators have been documented to follow the colonization of fouling communities at wind turbine foundations (Hutchison et al. 2020; Krone et al. 2017). The physical foundation structures would provide shelter and foraging opportunities for fishes (Mavraki et al. 2021; Degraer et al. 2020; Krone et al. 2017). Fish communities, especially species associated with complex habitat, such as black sea bass, would aggregate around offshore wind structures (Wilber et al. 2022b). Mid-water (i.e., pelagic) predators would also be attracted to the new structure provided by WTG foundations (Glarou et al. 2020), but evidence of predation on smaller fish aggregates may be lower at artificial complex habitat, including at WTG foundations, compared to natural complex habitat (Mavraki et al. 2021; Love et al. 2019). Lower predation pressure on artificial reefs could lead to higher production of prey species compared to natural reefs (Claisse et al. 2014).

Structures may cause a localized increase in overall biomass and diversity (Causon and Gill 2018), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). Fish abundance and biomass would also increase around WTG foundations and associated armoring (Wilber et al. 2022b; Mavraki et al. 2021; Reubens et al. 2014). The initial increase in fish abundance/biomass is presumably from attraction and thus, redistribution of existing nearby fish populations (Degraer et al. 2020; Hutchison et al. 2020; Reubens et al. 2014). Therefore, the initial local increases of fish abundance/biomass at WTG foundations are not a regional or population-level increase (Reubens et al. 2014). Reubens et al. (2014) discussed the system-scale theoretical outcomes of fish redistribution in relation to artificial reefs: (1) fish are redistributed leading to declines in fish at source locations; (2) fish move and show preference to artificial reef habitats where suboptimal growth and mortality conditions exist and there is a net system reduction in carrying capacity, and therefore, reduction in abundance/biomass; and (3) fish are initially redistributed from source locations to artificial reefs where enhanced growth and mortality conditions lead to a higher system carrying capacity and therefore higher regional/population-scale abundance/biomass. There is some evidence against theoretical outcome 2 for some demersal fish species from studies at the BIWF (Wilber et al. 2022a). Currently documented increases in fish abundance and/or biomass at artificial reefs and WTG foundations are considered local (Wilber et al. 2022b; Mavraki et al. 2021; Reubens et al. 2014) and further studies are needed to understand region-scale impacts (Mavraki et al. 2021; Hutchison et al. 2020). However, Stevens et al. (2019) have provided some evidence that, for some species, such as black sea bass, the addition of structures and associated complex habitat has the potential to increase regional carrying capacity, possibly supporting positive population-level outcomes.

Some invertebrate species may benefit from the addition of new hard substrate habitat introduced by offshore wind structures including cable armoring. As mentioned in this section, rapid colonization of fouling invertebrate organisms would occur at offshore wind structures. This colonization of early successional organisms may then be followed by colonization by later successional organisms (e.g., bivalves and cephalopods) that are commercially and/or ecologically important (Todd et al. 2020, 2021). Other commercially and/or ecologically important invertebrates such as crabs would also eventually colonize artificial structures (Page et al. 1999); however, such colonization would be from the redistribution of existing populations and could be considered a negative impact on the population level as explained in the previous paragraph.

Another element to consider regarding habitat change due to the presence of offshore wind structures is the risk of expanding structural habitat suitability for non-indigenous species (Kerckhof et al. 2011). Offshore wind structures have been documented to aid the spread of non-indigenous species in Europe and recently in the BIWF in the United States (De Mesel et al. 2015; Kerckhof et al. 2011). The idea that new habitat provided by offshore wind structures aids the spread of non-indigenous species, discussed by Kerckhof et al. (2011), has been described as a "stepping stone" effect, first mentioned by Reubens et al. (2014) then discussed in greater detail by De Mesel et al. (2015). Their studies, however, were focused on fouling invertebrate communities for which there are several examples of the "stepping-stone" effect. Offshore wind structures may also serve as "stepping stones" for the expansion of nonnative structure-oriented fish species (e.g., lionfish species). The distribution of invasive lionfishes in the U.S. Atlantic coastal waters has expanded from Florida to relatively recent observations in New England (Grieve et al. 2016). Much of the research regarding the expansion potential of lionfishes has focused on temperature habitat suitability and how cold temperatures at higher latitudes may be limiting northward expansion (Barker et al. 2018; Whitfield et al. 2014; Cerino et al. 2013; Kimball et al. 2004). While temperature tolerance limits may be slowing the northward expansion of lionfishes (Barker et al. 2018), the species is present at higher latitudes (Grieve et al. 2016). There is a clear spatial gap in lionfish distribution with few to no observations between the latitudes of the Chesapeake Bay mouth and Lower New York Bay (Grieve et al. 2016). Another factor possibly limiting the expansion of lionfishes is lack of suitable structural habitat (Bacheler et al. 2022). Bacheler et al. (2022) found that high-relief structure habitat is the most important factor influencing fish communities and abundance, including lionfishes. The coastal shelf habitat between the Chesapeake Bay mouth and Lower New York Bay lacks high-relief structure that would be introduced by offshore wind development, possibly allowing lionfishes to expand further. On shorter time scales, individual lionfish were found to range up to a maximum area of 0.15 square mile (0.38 square kilometers) (Green et al. 2021). Although the movement range of lionfish reported by Green et al. (2021) was higher than in previous reports by

Bacheler et al. (2015), the movement range is relatively small considering the planned distances between offshore wind structures within and between projects. However, larval dispersal potentially would allow lionfish to expand over greater distances.

Fish aggregations at offshore wind structures are viewed favorably by recreational anglers (Ferguson et al. 2021; Smythe et al. 2021). However, under theoretical hypotheses 1 and 2 discussed by Reubens et al. (2014) and summarized in the previous paragraph, fishing pressure at wind structures would have negative consequences on exploited fish populations. In those scenarios, fish populations would be more vulnerable to fishing pressure, as they are simply more concentrated at a particular location, rather than more abundant at the regional scale. As such, fish aggregations at WTG foundations may in some cases result in adverse impacts on some finfish species. Offshore wind structures would be constructed along migratory fish pathways including for striped bass and Atlantic sturgeon (Rothermel et al. 2020). It is too early to evaluate the effect of offshore wind structures on fish and invertebrate movements and migrations (Sparling et al. 2020); however, there is some evidence that offshore wind structures may create stopover locations for migratory fishes (Rothermel et al. 2020). Stopover locations may benefit migrating fish by providing feeding opportunities but may also disrupt or slow migrations (Rothermel et al. 2020). These behavioral effects may affect the migrations of individual fish, but they are not expected to have broad impacts on migration. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migrations (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018).

Cumulative impacts of habitat conversion from presence of structures on finfish and invertebrates are expected to be local and long term, continuing for the life of structures. Presence of structures from offshore wind development would have minor to moderate impacts on finfish, invertebrates, and EFH. Current evidence suggests that these impacts could mostly be localized.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and finfish, invertebrates, and EFH would continue to be affected by natural and human-caused IPFs including accidental releases and discharges, anchoring, cable emplacement and maintenance, EMF, anthropogenic lighting, noise, and presence of structures. Impacts of existing and ongoing activities would be **negligible** to **moderate**.

Cumulative Impacts of Alternative A – No Action. IPFs associated with ongoing and planned construction and installation, O&M, and decommissioning offshore wind development activities under the No Action Alternative would result in **negligible** to **moderate** adverse and **minor beneficial** impacts on finfish, invertebrates, and EFH. Impact determinations for each IPF are provided in the following paragraphs.

Negligible adverse impacts are expected from discharges/intakes of ongoing activities associated with the No Action Alternative. **Negligible** to **minor** adverse impacts of ongoing activities associated with the No Action Alternative include accidental releases, anchoring, lighting, and noise. Of these impacts, lighting would have long-term impacts while the others would be short term and localized. Introduction of invasive species from accidental releases could potentially be permanent.

Adverse impacts from EMF and cable heat, gear utilization, and presence of structures would be **minor** to **moderate**. Cable emplacement impacts would be localized and short term. Adverse impacts from EMF and cable heat, cable maintenance, and presence of structures would be localized and long term. Adverse impacts from gear utilization would be localized, occurring at time scales ranging from short term to potentially permanent. The presence of structures may also result in **minor beneficial** impacts on some invertebrate species, but not finfish species. Cable emplacement and maintenance would have **moderate** impacts on finfish, invertebrates, and EFH. These impacts are expected to be short term, occurring during construction.

BOEM anticipates that cumulative impacts on finfish, invertebrates, and EFH as a result of ongoing activities associated with the No Action Alternative would be **moderate**. BOEM anticipates that the cumulative adverse impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would be **moderate**.

3.5.5.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE, would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on finfish, invertebrates, and EFH:

- Number of WTGs, OSSs, and met tower (200 WTGs maximum combined number from Projects 1 and 2, up to 10 OSSs, and 1 met tower).
- Total length of export, interlink, and interarray cables (441 miles [710 kilometers]/37 miles [60 kilometers]/ 547 miles [880 kilometers]).
- The route of the interarray cables and offshore export cable, including the ability to reach target burial depth and the cable protection measures that are used when target burial depth is not achieved. The length and location of the cable route would determine the total amount of temporary habitat alteration resulting from installation of the cables and the total amount of long-term habitat alteration caused by the placement of cable protection.
- The time of year when construction activities occur in relation to migrations and spawning for finfish and invertebrates.

Below is a summary of potential variances in impacts based on the variability of the proposed Project design:

- WTG foundation number, type, and size: The number, type, and size of WTG foundations affects the magnitude of several of most impactful IPFs on finfish, invertebrates, and EFH, including pile-driving noise and the presence of structures. Variability in foundation types (piled, suction bucket, and gravity) would influence the magnitude of underwater noise impacts associated with pile driving. More WTG foundations would result in a longer duration of pile driving, and larger WTG foundations would result in a larger ensonified area. More WTG foundations would result in greater impacts associated with the presence of structures, including risk of entanglement of commercial fishing gear, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbance.

- The time of the year during which construction occurs: Migratory finfish and invertebrates exhibit seasonal variation in migration patterns, such that certain species and life stages are present in the Project area at certain times of the year. Time of year during which construction occurs may influence the magnitude of impacts (e.g., noise) on these species.

Although some variation is expected in the design parameters, the assessment of impacts on finfish, invertebrates, and EFH in this section considers the maximum-case scenario.

3.5.5.5 Impacts of Alternative B – Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

As described in Chapter 2, *Alternatives*, the Proposed Action includes the construction of up to 200 WTGs, 10 OSSs, and 1 met tower, and the installation of up to 547 miles (880 kilometers) of interarray cables, 37 miles (60 kilometers) of interlink cables, and 441 miles (710 kilometers) of export cables between 2025 and 2027. The Proposed Action also includes 30 years of O&M over a 30-year commercial lifespan and decommissioning activities at the end of commercial life. This section describes the primary IPFs of the Proposed Action that BOEM expects to affect finfish, invertebrates, and EFH.

Onshore Activities and Facilities

Onshore construction and installation, O&M, and decommissioning activities for the Proposed Action would not cause any IPFs for finfish, invertebrates, and EFH.

Offshore Activities and Facilities

Accidental releases: The construction and installation and decommissioning phases of the Proposed Action may increase the risk of accidental releases of fuels, fluids, hazardous materials, and invasive species from construction and installation activities. As described under the No Action Alternative, accidental releases of fuel, fluids, and hazardous materials can cause short-term, localized impacts on finfish, invertebrates, and EFH, including increased mortality, decreased fitness, and contamination of habitat. Furthermore, accidental releases during discharges of ballast water and bilge water from marine vessels can release invasive species into the aquatic environment, which may have permanent, widespread impacts on native finfish, invertebrates, and EFH (e.g., increased competition, habitat alteration) if invasive populations are able to establish. However, the incremental impacts of the Proposed Action from construction and installation activities would not increase the risk of accidental releases beyond that described under the No Action Alternative. The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste, further reducing the likelihood of an accidental release. Atlantic Shores has developed an OSRP (COP Volume I, Appendix 1-D; Atlantic Shores 2023) with measures to avoid accidental releases and a protocol to respond to such a release. Furthermore, Atlantic Shores would implement appropriate measures during HDD activities at export cable landfalls to minimize potential release of HDD fluid. Therefore, accidental releases are considered unlikely.

Operation and maintenance activities of the Proposed Action, including O&M vessels, may increase the risk of accidental releases of fuels, fluids, hazardous materials, and invasive species. Impacts on finfish, invertebrates, and EFH from accidental releases would be similar to those described for the construction and installation and decommissioning phases of the Proposed Action. Vessels used during O&M would likely be relatively smaller than the large installation vessels used during construction and installation, limiting the volume of discharges of ballast water and bilge water. As described for construction and installation, the Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste, and Project measures to avoid or limit accidental release would be adopted.

Anchoring: The Proposed Action would result in increased anchoring from construction and installation and decommissioning vessels. Anchored vessels associated with the Proposed Action would disturb approximately 714 acres (289 hectares) of seafloor (Appendix D, Table D.A2-2). As described under the No Action Alternative, anchoring would cause several impacts on finfish, invertebrates, and EFH, including increased turbidity levels, mortality of finfish and invertebrates from physical contact with anchors and chains, and damage to or degradation of sensitive habitat in areas where anchors and chains meet the seafloor. However, the extent of all anchoring impacts would be minimal and localized. Impacts from increased turbidity and mortality from physical contact would be short term, whereas impacts from damage to or degradation of sensitive habitats could be long term. Atlantic Shores would minimize anchoring impacts by establishing a seasonal work window that avoids installation and construction activities during periods when sensitive species and life stages would be present in the Project area, as feasible. Additionally, Atlantic Shores proposes to minimize construction anchoring impacts by use of dynamic positioning systems or anchoring to midline buoys, thereby limiting the use of anchors and jack-up features, where feasible (GEO-02, GEO-03, WAT-01, WAT-02, BEN-04, BEN-07; Appendix G, Table G-1).

Cable emplacement and maintenance: The Proposed Action would involve the emplacement of 988 miles (1,590 kilometers) of export, interlink, and interarray cables. The emplacement of the export and interarray cables would result in a 576-acre (233-hectare) area of seabed disturbance. As described under the No Action Alternative, cable emplacement and maintenance activities may disturb, displace, and injure or kill finfish and invertebrates; release sediment into the water column; and cause habitat alterations. Displacement may occur in mobile benthic species (e.g., American lobster, monkfish, winter flounder), whereas mortality may occur in immobile or slow-moving species and life stages (e.g., Atlantic surfclam, demersal eggs, squid egg mops). Array and offshore export cables would be installed by jet plow (GEO-02, WAT-02, BEN-04, FIN-04; Appendix G, Table G-1), where possible, with alternative methods to include plowing and trenching. The use of jet plow requires withdrawal water from the water column, which can entrain small numbers of finfish and invertebrate larvae.

Sediment disturbances from cable emplacement would cause increases in turbidity and sediment deposition along the interarray and export cable corridors. As described under the No Action Alternative, sediment deposition could have negative impacts on slow-moving and sessile species and early life stages (i.e., eggs and larvae) of finfish and invertebrates. Slow-moving species (e.g., horseshoe crabs, Jonah crabs, scallops, whelks) may not be able to escape the area of sediment deposition but are expected to uncover themselves during and after sedimentation. Sessile species are the most vulnerable to sediment deposition because of their inability to avoid affected areas, but these species often possess adaptations to high turbidity levels and sedimentation events, which occur periodically in soft-bottom habitats (Wilber et al. 2005). Sediment deposition may bury demersal eggs (e.g., Atlantic wolffish eggs, longfin squid egg mops, winter flounder eggs) and newly settled bivalve spat (e.g., American oyster spat), thereby causing sub-lethal effects or mortality.

Sediment transport and deposition modeling was conducted in the WTA and offshore export cable corridor for construction and installation activities (COP Volume II, Appendix II-J3; Atlantic Shores 2023). The models demonstrated that TSS concentrations would be influenced by bottom currents. For the Atlantic and Monmouth ECC pit excavations, sediment depositions would exceed 0.04 inch (1 millimeter) at distances up to 1,572 and 656 feet (479 and 200 meters), respectively. Modeled TSS concentrations from interarray and export cable corridors remained relatively close to corridor centerlines, constrained to the bottom water column, and short-lived with water column concentrations substantially dissipating within 2 to 4 hours and fully dissipating in less than 6 hours. Modeled maximum distances to the 0.04- and 0.4-inch (1- and 10-millimeter) thickness contours were 2,805 and 538 feet (855 and 164 meters), respectively. Based on the relatively small area over which sediment would be deposited and the small amount of affected soft-bottom habitat relative to that available regionally, sediment deposition is expected to have a localized, short-term impact on finfish, invertebrates, and EFH, with affected populations completely recovering following construction and installation activities.

The Proposed Action would require the removal of some sand bedforms via “pre-sweeping” or dredging in 20 percent of export cable corridors and 10 percent of interarray cable corridors. These activities would create narrow troughs or flats in fields of sand waves, altering the seabed profile and potentially causing localized, short-term impacts on finfish, invertebrates, and EFH. As described under the No Action Alternative, sand ripples provide vertically structured habitat for finfish and invertebrates in an otherwise flat seascape. Sand ripples that are dredged would likely be redeposited in areas of similar sediment composition, and tidal and wind-forced bottom currents are expected to reform most ripple areas within days to weeks following disturbance. Although some sand ripples may not recover to the same height and width as pre-disturbance, the habitat function is expected to fully recover post-disturbance. Therefore, BOEM expects that the impacts of seabed profile alterations on finfish, invertebrates, and EFH would be localized and short term, dissipating over time as mobile sand waves fill in the altered seabed profile.

All impacts from cable emplacement would be localized to the emplacement corridor. Impacts on finfish and invertebrates from turbidity and from displacement and mortality would be short term. Impacts from habitat alteration would be long term only in areas where cables are armored. Atlantic Shores has sited offshore export cable routes that would minimize overlap with sensitive benthic habitats, and cables would be further micro-sited along those routes to avoid boulders and other hard-bottom habitat to the extent feasible. Cable emplacement impacts would be further minimized by seasonal work window restrictions that avoid construction during periods when sensitive species and life stages would be present in the Project area, as feasible; by using cable installation tools that minimize the area and duration of sediment suspension, as feasible; and by using HDD at the export cable landfall sites to minimize physical disturbance of coastal habitats. Given these avoidance and conservation measures, the probability of adverse interactions of cables with sensitive finfish, invertebrate, and EFH resources is low.

A temporary offshore platform may be placed on benthic habitat at landfall sites to a support HDD rig for installation of export cables. Installation of export cables at landfall sites would also require up to four 98.4- by 26.2-foot (30- by 8-meter) temporary cofferdams. Installation of cofferdams would result in direct disturbance to sandy bottom sediments. After initial injury, mortality, and/or displacement of organisms within the cofferdam footprint, the seabed and communities are expected to recover.

Maintenance of the export, interlink, and interarray cables could potentially disturb seafloor habitat. Seafloor disturbance during maintenance would be relatively minimal compared to disturbances from cable emplacement during construction and installation. Furthermore, cable maintenance would also be infrequent. Therefore, seafloor disturbances during maintenance would be considerably minimal compared to those during construction and installation.

Discharges/intakes: Increases in Project vessel discharges would occur during construction and installation, O&M, and decommissioning. As described under the No Action Alternative, certain discharges are required to comply with permitting standards that are established to minimize potential impacts on the environment. Discharge volumes from Project-related vessel activities would be relatively minimal considering that the Project would contribute 211 of the 3,226 planned offshore wind structures (7 percent) and 998 of 13,554miles (7 percent) of planned cables (Appendix D, Tables D.A2-1 and D.A2-2).

Entrainment and impingement of finfish and invertebrates would not occur under either transmission option considered in the PDE. HVAC would not use non-contact cooling water. Atlantic Shores has indicated that if HVDC is used, only a closed loop cooling system would be utilized, negating any need for a cooling water intake (FIN-12, Appendix G, Table G-1). Entrainment and impingement of organisms may also occur during operation of cable-laying equipment along cable corridors during installation. Impacts from entrainment and impingement of finfish and invertebrates would be mostly confined to cable centerlines and would be short term.

Electric and magnetic fields and cable heat: The interarray and export cables that would be installed as part of the Proposed Action would generate EMF in the surrounding waters for the duration of the operational period. The Proposed Action would install up to 441 miles (710 kilometers) of 23–275 kV HVAC or 320–525 kV HVDC offshore export cables. Additionally, 547 miles (880 kilometers) of 66–150 kV HVAC interarray cables would be installed. Up to eight export cables would be required under the HVAC cable option while only two cables would be required under the HVDC cable option; five cables would be required if a mixture of cable options are used between Projects 1 and 2. As described under the No Action Alternative, adverse impacts of EMF on finfish and invertebrates have been documented in scientific literature. Behavioral and physiological impacts of EMF have been documented in benthic epifaunal and infaunal invertebrates and finfishes (Scott et al. 2018, 2021; Hutchison et al. 2018, 2020a, 2021; Scanlan et al. 2019; Ernst and Lohmann 2018). However, finfish responses to EMF have been mixed and contradictory, even within species (Minkoff et al. 2020; Scanlan et al. 2019). Further research is needed to understand the mechanisms of EMF impacts and the large-scale or population-scale consequences of EMF (Hutchison et al. 2020b).

Heat emission would occur along the planned 1,025 miles (1,650 kilometers) of Project cables. Heat emission from above-sediment cables would be minimized by cooling from bottom water and mitigated by cable sheathing or armoring, or both. However, heat from buried cables may radiate at considerable distances relative to burial depths, depending on cable source heat and sediment substrate (Emeana et al. 2016). Based on controlled experiments, cable emitted heat radiated less than 6.6 feet (2 meters) for cable heat 66°F (19°C) or less above ambient temperature (Emeana et al. 2016). At source heat 109°F (43°C) and higher, radiation distances approach 6.6 feet (2 meters) (Emeana et al. 2016). Alternating current cables emit higher heat than direct current cables (Taormina et al. 2018). Project cables would be buried to a target depth of 5 to 6.6 feet (1.5 to 2.0 meters) (GEO-07, OCE-05, FIN-03, REC-10, COM-08, NAV-14; Appendix G, Table G-1) where possible, providing some measure of mitigation depending on actual cable temperatures. Additionally, Atlantic Shores would institute a cable monitoring system that would monitor if buried cable depth is sufficient and include acoustic sensing and monitoring of distributed temperature and discharge (OCE-06, PUB-13; Appendix G, Table G-1).

Gear utilization: Atlantic Shores would implement benthic monitoring surveys in the Offshore Project area to establish pre-construction baselines, measure Project-related impacts, and monitor recovery of habitats and biological communities (COP Volume II, Appendix II-H; Atlantic Shores 2023). Atlantic Shores has also proposed to implement fisheries monitoring surveys (COP Volume II, Appendix II-K; Atlantic Shores 2023). Benthic survey gear types include benthic grab samplers, multibeam echosounders, and underwater video cameras. Proposed fisheries survey gear types include clam dredges, demersal fish trawls, and fish pots.

As discussed in Section 3.5.5.3, *Impacts of Alternative A – No Action on Finfish, Invertebrates, and Essential Fish Habitat,* underwater video surveys are not expected to produce significant, if any, adverse impacts on finfish and invertebrates or their habitats (Beisiegel et al. 2017; Mallet and Pelletier 2014). Multibeam echosounders may produce sound in frequency ranges detectable by fish, but studies on their impacts are lacking (Mooney et al. 2020). As discussed in Section 3.5.5.3, noticeable impacts on benthic fish and invertebrates and their benthic habitats are expected from use of benthic grab and towed (otter trawls and clam dredges) gears surveys during Project biological monitoring. The Atlantic Shores benthic grab survey program plans to collect 378 samples per year in the WTA and ECC area using a 0.43-square-foot (0.04-square-meter) standard sampler (e.g., Van Veen, Day, or Ponar) (COP Volume II, Appendix II-H; Atlantic Shores 2023). The proposed fish monitoring program currently under development by Atlantic Shores in coordination with state and federal agencies, would include use of otter trawls, hydraulic clam dredges, and fish trap, or “pot,” surveys in the WTA only (COP Volume II,

Appendix II-K; Atlantic Shores 2023). As discussed in Section 3.5.5.3, towed gears, such as otter trawls and dredges, would produce adverse impacts by removing benthic fauna and disturbing benthic habitats (Jennings et al. 2001, 2002; Collie et al. 2000; Kaiser et al. 2000). Adverse impacts are expected from use of fish traps due to removal of fauna. Fish traps also directly disturb benthic habitats and epifauna (Schweitzer et al. 2018). Indirect impacts would also occur from resuspension of sediments during gear deployment and retrieval (Breimann et al. 2022; Palanques et al. 2022; Paradis et al. 2021; Pilskaln et al. 1998; Jones 1992; Churchill 1989).

Lighting: Vessel activity associated with construction and installation and decommissioning of the Proposed Action would increase nighttime ambient light in the Project area. Project vessels operating at night would be equipped with deck and safety lighting. The incremental contribution associated with the concurrent operation of up to 16 Project vessels during construction and installation represents a small fraction of the lighting expected under the No Action Alternative. As described under the No Action Alternative, artificial lighting could elicit temporary attraction, avoidance, or other behavioral responses in some finfish and invertebrates, potentially affecting distributions near the light source. Artificial lighting may also cause short-term disruptions of biological functions that are triggered by changes in daily and seasonal daylight cycles (e.g., spawning).

Maintenance vessels and operation of offshore structures associated with the Proposed Action would increase artificial light at night during the O&M phase. The incremental contribution associated with the Proposed Action would be lighting up to 200 WTGs, 10 OSSs, and 1 met tower during the operation period. Atlantic Shores would use lighting on the WTGs and OSSs that complies with FAA and USCG standards and would follow BOEM best practices to minimize illumination of the water surface. Furthermore, Atlantic Shores has proposed the use of an ADLS to minimize the time that FAA-required lighting is illuminated on the offshore structures (BIR-05, BAT-03, VIS-05, CUL-05; Appendix G, Table G-1). Therefore, light generated by O&M activities of the Proposed Action is expected to have a negligible impact on finfish, invertebrates, and EFH.

Noise: Underwater sources of anthropogenic noise associated with construction and installation and decommissioning of the Proposed Action would include aircraft, G&G surveys, pile driving during construction, cable emplacement, and vessel operations. As described under the No Action Alternative, these noise sources may affect finfish and invertebrates by causing behavioral changes, PTS or TTS, injury, and mortality. Extended exposure to mid-level noise or brief exposure to extremely loud sound can cause a PTS, which leads to long-term loss of hearing sensitivity. Less-intense noise may cause a TTS, resulting in short-term, reversible loss of hearing acuity (Buehler et al. 2015). The potential impacts associated with each noise source are discussed separately in the following paragraphs.

Helicopters may be used to transport workers during construction and installation of the Proposed Action. Noise from helicopters may cause behavioral changes in finfish and invertebrates in the immediate vicinity of the noise source. However, helicopters transiting to and from the Project area would fly at sufficient altitudes to avoid behavioral effects except during take-off and landing. Any behavioral responses that occur during low-altitude flight would be temporary, dissipating once the aircraft leave the area, and are not expected to be biologically significant.

HRG surveys, a type of G&G survey, would be conducted prior to construction to support final engineering design and after cable emplacement to confirm burial of submarine export and interarray cables. The frequency range of the multibeam echosounder for these surveys has yet to be determined by Atlantic Shores (COP Volume II, Appendix II-H; Atlantic Shores 2023). As described under the No Action Alternative, G&G survey noise can disturb finfish and invertebrates in the immediate vicinity of the survey and can cause temporary behavioral changes. However, multibeam echosounders produce sound frequencies outside of the hearing range of ESA-listed fish (Baker and Howson 2021). Based on analyses in the Atlantic OCS, impacts from HRG survey multibeam echosounders are not likely to adversely affect fish species, including ESA-listed fish species such as Atlantic sturgeon (Baker and Howson 2021).

The most substantial source of underwater noise associated with the Proposed Action would be impact pile driving during construction and installation. A total of 211 foundations are expected to be installed under the Proposed Action, each requiring a maximum of 7 to 9 hours of pile driving, which would occur over a maximum-case scenario of a total of 420 days (2 days per foundation assuming a single operating vessel and no daylight restrictions) over 3 years. As described under the No Action Alternative, the intense and impulsive noise generated by pile driving can cause injury or mortality to finfish and invertebrates over a small area around each pile and can cause temporary stress and behavioral changes over a larger area. The presence of potentially injurious noise would render EFH unavailable or unsuitable for the duration of the noise. Pile-driving noise could also result in reduced reproductive success while pile driving is occurring, particularly in species that spawn in aggregate. Fish with a swim bladder involved in hearing (e.g., herrings, gadids) are most susceptible to pile-driving noise while those without swim bladders (e.g., flatfish, rays, sharks) are least susceptible (Popper et al. 2014). An individual fish would be injured by pile-driving noise only if it remained near the pile during installation (NOAA Fisheries 2015). Early life stages of finfish (i.e., eggs, larvae) and sessile invertebrates (i.e., longfin squid egg mops, ocean quahog, scallops, surfclam) are less sensitive to pile-driving noise but are more vulnerable because they are unable to move to avoid the noise. Surfclam, ocean quahog, and scallops would likely respond to the vibration and sound of the impact hammer by closing their valves or “flinching,” which prevents feeding (Charifi et al. 2017; Day et al. 2017). The loss of foraging opportunity resulting from closed valves would be a short-term, reversible, adverse impact on these species; once the disturbance ended, the bivalves would resume feeding.

As detailed in the Atlantic Shores Hydroacoustic Modeling Report (COP Volume II, Appendix II-L; Atlantic Shores 2023), modeled unmitigated impact pile-driving noise during installation of 50-foot (15-meter) monopile foundations were estimated to produce injurious and behavioral impacts over the greatest range; therefore, impacts in this section are reported under this scenario (COP Volume II, Appendix II-L, Table 29; Atlantic Shores 2023). Acoustic radial distances ($R_{95\%}$) are the 95th percentile of ranges (based on modeling) at which the thresholds were expected to be exceeded. Based on unweighted sound pressure during modeled pile driving with a 4,400-kilojoule hammer, the maximum $R_{95\%}$ where behavioral impact thresholds were exceeded for any fish was 6.9 miles (11.2 kilometers) at the deep modeled location and 6.4 miles (10.2 kilometers) at the shallow modeled location. The maximum $R_{95\%}$ where injurious sound thresholds were exceeded for any fish was 0.27 mile (0.43 kilometer) at the deep modeled location and 0.31 mile (0.50 kilometer) at the shallow modeled location. Because of the relatively small footprint and short duration of injurious sound and the ability of most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause population-level impacts on fish. Impacts of pile-driving noise on invertebrates, which are generally less sensitive to sound than fish, are expected to occur within a closer distance from the sound source.

Noise impacts from vibratory pile driving are expected at the Monmouth and Atlantic cable landing sites. Sound source levels from vibratory pile driving are expected to be comparatively lower than impact pile driving and therefore vibratory pile driving noise impacts are expected to be at a lower level.

Atlantic Shores would implement measures to avoid, minimize, and mitigate impacts of pile-driving noise on finfish and invertebrates, including using soft-start procedures and noise abatement systems, implementing time-of-day restrictions unless effective reduced-visibility monitoring equipment is available, and implementing seasonal work windows that avoid construction during periods when sensitive species and life stages would be present in the Project area. With these measures in place, injuries to fish and invertebrates are expected to be minimal. While some fish and invertebrates are expected to experience behavioral effects within the ensonified area, these effects would be temporary, as behavior is expected to return to preconstruction levels following the completion of pile driving (Jones et al. 2020; Shelledy et al. 2018). Impacts from injurious sound are expected to be short term and localized.

Noise-producing activities associated with emplacement of 1,025 miles (1,650 kilometers) of export, interlink, and interarray cables as part of the Proposed Action may include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. Impact range distances to received noise levels that would induce 100 percent avoidance behavior in four species of fish (cod, dab, herring, and salmon) were modeled. These distances varied among the four species ranging up to 3 feet (≤1 meter) for trenching, from less than 3 to 26 feet (<1 to 8 meters) for cable laying, less than 3 to 20 feet (<1 to 6 meters) for cable protection installation, and from less than 3 to 7 feet (<1 to 2 meters) for cable-laying vessel noise (Nedwell et al. 2012). With regards to received noise levels that would generate a behavioral reaction in about 85 percent of fish, modeled ranges for the four species varied from 3 to 217 feet (1 to 66 meters) for cable laying, from less than 3 to 89 feet (<1 to 27 meters) for trenching, from 13 to 203 feet (4 to 62 meters) for cable protection installation, and from 3 to 118 feet (1 to 36 meters) for cable-laying vessel noise (Nedwell et al. 2012). These modeled noise level metrics do not indicate injurious consequences, but Nedwell et al. (2007) note that prolonged exposure to noise levels that would induce 100 percent avoidance may cause injury. Because the cable-laying vessel and equipment would be continually moving and the ensonified area would move with it, a given area would not be ensonified for more than a few hours. Therefore, any behavioral responses to cable-laying noise are expected to be short term and localized.

As many as 16 vessels would be in operation during construction and installation of the Proposed Action. Vessels generate low-frequency (mostly 10 to 500 Hz) (MMS 2007), non-impulsive noise that could cause temporary startle and stress responses in finfish and invertebrates. In an analysis conducted for the Cape Wind EIS (MMS 2009), the maximum perceived sound for finfish, based on information from earlier studies, was evaluated at 3 meters (10 feet) from source sound levels for tugboats and barges reported by Malme et al. (1989). This analysis calculated maximum received sound for finfish, including Atlantic salmon, “bass,” “cod,” and tautog, at 3 meters (10 feet) from the source to be well below harassment and injury thresholds used at the time and may be just above the avoidance thresholds. Therefore, potential Project vessel sound levels would not be expected to cause harassment or physical harm to finfish but would cause avoidance (MMS 2009). Vessel-related noise would most likely affect hearing in sensitive, pelagic species, such as Atlantic herring and Atlantic mackerel, but these highly mobile species are capable of swimming away from the noise source. Vessel noise may result in brief periods of exposure near the surface of the water column but is not expected to cause injury, hearing impairment, or long-term masking of biologically relevant cues in finfish and invertebrates. Consistent with this, BOEM determined that there would not likely be an adverse impact on finfish and invertebrates from noise generated by vessel transit and operations (BOEM 2018).

Noise during the O&M period of the Proposed Action would occur during maintenance activities and operation of WTGs. Behavioral and physical impacts of noise on finfish and invertebrates would be similar to what was identified for construction and installation and decommissioning.

Helicopter and vessel transport of personnel to offshore structures from the Proposed Action would be necessary for inspections and maintenance. Impacts from helicopter- and vessel-related noise on finfish and invertebrates would be similar to what was identified for construction and installation and decommissioning. Helicopter and vessel transportation would be greatly reduced and infrequent during the O&M period, however.

Operating WTGs generate non-impulsive, underwater noise that is audible to some finfish and invertebrates. Available measurements of operational noise from WTGs of sizes ranging from 0.2 to 6.15 MW were evaluated in a study by Tougaard et al. (2020). Normalizing these measurements to 328 feet (100 meters) from WTGs and to a wind speed of 33 feet (10 meters) per second, produced estimated root-mean-square SPL below 120 dB re 1 micropascal in the 25 to 1,000 Hz frequency band for a single operating turbine generating 6.15 MW or less (Tougaard et al. 2020). I proposed 10 MW WTG installations are larger than the largest included in the calculations by Tougaard et al. (2020). Noise levels associated with operating WTGs are expected to decrease to ambient levels within a relatively short distance from the turbine foundations (Thomsen et al. 2015). At BIWF, operational turbine noise reaches ambient noise levels within 164 feet (50 meters) of the turbine foundations (Miller and Potty 2017). Based on the studies in this discussion, expected sound levels from the Proposed Action that are potentially harmful to finfish would be restricted to a very small area around each monopile. Sensitivity thresholds have not been established for most species of invertebrates, but their lack of a gas-filled structure associated with hearing suggests that their sensitivity to noise may be similar to that of fish without swim bladders. As the best available data indicate noise levels produced by operating WTGs would be below fish behavior and injury thresholds, noise from operating WTGs is not expected to produce impacts on finfish and invertebrates. However, if the larger WTGs installed for the Proposed Action produce sound levels that exceed these thresholds, WTG noise may result in minor impacts on finfish and invertebrates.

Presence of structures: The Proposed Action would include construction of up to 200 WTGs, 10 OSSs, and 1 met tower that would include installation of up to 289 acres (117 hectares) of hard scour protection around the foundations and up to 595 acres (241 hectares) of hard cable protection around the export and interarray cables (Appendix D, Table D.A2-2). As described under the No Action Alternative, the presence of structures can affect finfish, invertebrates, and EFH through entanglement of fishing gear, resulting in lost gear, hydrodynamic disturbance, fish aggregation, habitat conversion, and increased migration disturbances. Each of these potential impacts is addressed separately in the following paragraphs.

The Proposed Action would install up to 289 acres (117 hectares) of hard scour protection around the WTG foundations, OSSs, and met tower. Additional hard structure may be installed for cable protection where cable burial is not feasible. For example, cable burial target depth may not be achievable where Project cables intersect existing cable near the Atlantic City, New Jersey, landfall site. Project cables at these intersections may not be buried and would require above-seafloor cable protection (Section 2.1.2.1 in Chapter 2). Commercial and recreational fishing vessels that deploy gear over these structures, particularly trawls and dredges, would be at risk of entanglement and loss of fishing gear. As described under the No Action Alternative, lost fishing gear, carried by ocean currents, can result in the ensnarement, injury, or mortality of finfish and invertebrates and can result in the short-term alteration of benthic habitat. Impacts of lost gear on finfish, invertebrates, and EFH are expected be short term and localized, but the increased risk of gear loss would be long term, persisting as long as the structures remain.

The tall, vertical foundations that would be installed for each of the 200 WTGs as part of the Proposed Action would cause continuous, fine-scale hydrodynamic disturbances. As described under the No Action Alternative, the placement of offshore WTG foundations can alter downstream flows and resulting larval dispersal patterns (Chen et al. 2016), but flows are expected to return to background levels 8 to 10 pile diameters downstream of the foundation (Miles et al. 2017). This indicates that background conditions would exist 394 to 492 feet (120 to 150 meters) downstream of the largest monopile foundations that are being considered as part of the Proposed Action. Given the small scale at which hydrological changes from the Proposed Action would occur, impacts on finfish and invertebrates are expected to be negligible. As described under the No Action Alternative, hydrodynamic disturbances from offshore wind structures may also affect the mid-Atlantic cold pool, a region of seasonally stratified water that is important to the dispersal and survival of early life stages of many fish and invertebrates (BOEM 2021a). Offshore wind structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). Changes in cold pool dynamics resulting from the Proposed Action could potentially cause changes in habitat suitability and fish community structure, but the extent of these potential impacts is uncertain. Any impacts from hydrodynamic disturbances would be long term, persisting as long as the WTG foundations are in place.

The installation of WTG foundations, OSSs, met tower, scour protection, and cable protection as part of the Proposed Action would create 504.3 acres (204.1 hectares) of structurally complex, hard-bottom habitat in an otherwise flat and sandy seascape, including sand wave and ridge and swale sensitive habitats. Because hard-bottom and three-dimensional structures in the Project area are currently limited to shipwrecks and artificial reefs, some structure-oriented finfish and invertebrates are expected to aggregate around this new hard-bottom habitat (Guida et al. 2017). Artificial reefs in New Jersey and New York coastal waters have been observed to attract numerous species of finfish and invertebrates, including American lobster, Atlantic cod, black sea bass, scup, summer flounder, tautog, and several species of crab (Wilber et al. 2022b; Hutchison et al. 2020; NJDEP 2019); these same species are expected to be attracted to the hard-bottom habitat created as part of the Proposed Action. A recent meta-analysis of the effect of wind farms on fish abundance concluded that effects are positive, indicating that more fish occur within wind farms than at nearby reference locations (Methratta and Dardick 2019). However, based on the discussion for the No Action Alternative, higher abundance or biomass at wind farms does not indicate increases in overall system or population-level abundance or biomass. The redistribution of fish to wind farms may have an overall negative effect on a system or fish population under some hypothesized scenarios discussed in Section 3.5.5.3 (Reubens et al. 2014). As discussed for the No Action Alternative, there is some evidence to support that the addition of complex habitat to mid-Atlantic shelf waters would potentially increase the carrying capacity of an area for some species such as black sea bass (Stevens et al. 2019). Further studies are needed to evaluate if offshore wind structures could be beneficial at the regional or population level (Mavraki et al. 2021; Hutchison et al. 2020). The effects of fish aggregation near structures would be localized and long term and may be adverse or neutral on finfish and invertebrate populations, as the dynamics of predation and fishing would vary by location.

The Proposed Action would result in the conversion of approximately 504.3 acres (204.1 hectares) of primarily soft-bottom habitat to hard-bottom habitat. Although conversion of soft-bottom habitat would result in the displacement of soft-bottom species (e.g., Atlantic surfclam, squid, winter flounder), soft-bottom habitat is the dominant habitat type in the geographic analysis area, and species that rely on this habitat would not likely experience population-level impacts from habitat conversion (Guida et al. 2017; Greene et al. 2010). Underwater portions of foundations would be colonized by encrusting and attaching organisms, creating an array of biogenic artificial reefs (Mavraki et al. 2021; Degraer et al. 2020; Degraer et al. 2018; Hooper et al. 2017a, 2017b; Griffin et al. 2016; Fayram and de Risi 2007). The assemblage of species that colonizes each WTG, OSS, or met tower foundation would be influenced not only by the amount of surface area but also by the seasonal availability of larval recruits immediately following installation. Therefore, the pattern of colonization and succession would vary throughout the Project area, especially during the early years (Krone et al. 2013, 2017). The area surrounding each WTG foundation would accumulate remains of attached organisms, which may provide essential habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Krone et al. 2017; Coates et al. 2014; Goddard and Love 2008). The colonization of these structures may cause a localized increase in biomass and diversity (Causon and Gill 2018; Reubens et al. 2014; Krone et al. 2013), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by fewer species (Kerckhof et al. 2019). As mentioned for the No Action Alternative, some invertebrate species may benefit from the presence of structures (Todd et al. 2021; Page et al. 1999). Colonizing organisms, including fishes, may include non-indigenous species (Kerckhof et al. 2011). Impacts of habitat conversion on finfish and invertebrates are expected to be localized and long term, continuing as long as the structures remain. Colonization by non-indigenous species may be permanent.

The 504.3 acres (204.1 hectares) of hard-bottom habitat created by the WTG foundations, OSSs, met tower, scour protection around foundations, and cable protection as part of the Proposed Action may provide forage and refuge for some migratory finfish and shellfish, such as black sea bass, longfin squid, monkfish, and summer flounder. The WTG foundations may also attract highly migratory fishes (NOAA Fisheries 2017); mahi-mahi and some tuna (e.g., yellowfin, bigeye) and sharks (e.g., dusky, whitetip, shortfin mako, common thresher) may be attracted by the abundant prey (Itano and Holland 2000; Wilhelmsson and Langhamer 2014) or use the structures as navigational landmarks (Taormina et al. 2018). These behavioral effects may affect the migrations of individual fish, but the consequences are not yet known. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migrations (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018).

Impacts of Alternative B – Proposed Action on ESA-Listed Species

The Proposed Action would have similar impacts on Atlantic sturgeon as other non-ESA species. Presence of structures, emplacement and maintenance of cables, and EMFs are IPFs that may impact migrating Atlantic sturgeon. To a lesser extent, shortnose sturgeon may be impacted by nearshore cable emplacement and maintenance and EMFs during infrequent ventures outside of estuaries. Other ESA-listed species in the LME are not likely to be impacted by IPFs from the Proposed Action.

In addition to impacts from the IPFs discussed in this section, both sturgeon species and giant manta ray would be at risk to vessel strikes from Project-related vessel activity. Up to 20 round trips to the Portsmouth Marine Terminal in Norfolk, Virginia, near the mouth of the James River, are planned during the construction phase and one trip per year is planned during operation. Atlantic sturgeon are known to occur or transit this vessel route (Balazik et al. 2020). Both sturgeon species occur in the Delaware Estuary where up to 1,390 round trips are planned during construction and up to 35 are planned during operation (see Section 3.6.6, *Navigation and Vessel Traffic*). Vessel-related injuries and mortalities of sturgeon have been documented in the Delaware and Chesapeake Estuaries (Balazik et al. 2012; Brown and Murphy 2010); therefore, Project-related vessel traffic would slightly increase vessel strike risk compared to existing vessel traffic. Giant manta ray occur offshore in shelf waters and may occur in the vicinity of the Offshore Project area during warmer months (Farmer et al. 2022) where they could be at risk to vessel strikes including from Project vessels. Vessel strike injuries have been documented to occur on manta rays (Pate and Marshall 2020; McGregor et al. 2019).

Impacts of the Connected Action

As described in Chapter 2, improvements to the existing marine infrastructure within an approximate 20.6-acre (8.3-hectare) site at the Atlantic City, New Jersey, Inlet Marina are planned in connection with construction of the O&M facility of the Proposed Action. The connected action includes construction of a new 356-foot (109-meter) bulkhead composed of steel or composite vinyl sheet piles to replace the existing and deteriorating 250-foot (76-meter) bulkhead. Additionally, the connected action would include maintenance dredging at Farley's Marina Fuel and Clam Creek and would co-occur with maintenance dredging for Atlantic City in portions of the Federal Channel leading into the Inlet Marina and most of the inlet area to reestablish a channel depth of 15 feet (4.6 meters) below the plane of Mean Low Water plus 1.0 foot (0.3 meter) of allowable overdredge. The estimated dredge volumes would be up to 20,113 cubic yards (15,378 cubic meters) at Farley's Marina Fuel and up to 122,710 cubic yards (93,818 cubic meters) from Clam Creek. Dredging would be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. The volume of dredge material from the connected action would be combined with dredge material from Atlantic City's complete maintenance dredging project. The combined volume of dredge material is estimated at 597,761 cubic yards (457,021 cubic meters) and would be disposed at three proposed locations: (1) DH #86 site, a 14.4-acre (5.8-hectare) subaqueous borrow pit restoration site within Beach Thorofare and owned by the New Jersey Department of Transportation Office of Maritime Resources; (2) Tuckahoe Turf Farm upland site in Estell Manor, New Jersey; and 3) Kinsley's Landfill upland site in Sewell, New Jersey. Placement of the dredged material at the proposed DH #86 site is contingent on a use agreement between the City of Atlantic City and the Office of Maritime Resources. Atlantic Shores is proposing to implement the construction of the new bulkhead and the City of Atlantic City would complete the maintenance dredging at the site.

BOEM expects the connected action to affect finfish, invertebrates, and EFH through the following primary IPFs.

Accidental releases: Risks of accidental release of fuels/fluids/hazardous materials, and trash and debris are possible during construction and installation and O&M activities associated with the connected action. BOEM assumes that construction vessels would comply with laws and regulations to properly dispose of marine debris and minimize accidental releases of fuels/fluids/hazardous materials. The relative contribution of the risks of accidental releases associated with the connected action is minimal compared to risks under the No Action and Proposed Action alternatives.

Anchoring: Activities associated with the connected action may require vessels to anchor near the Inlet Marina or within Beach Thoroughfare. Anchor/chain disturbances to bottom sediments could injure or kill invertebrates and early life stages or fish, damage habitats, and resuspend sediments. Damage to bottom habitats would be temporary if they occur to soft-bottom habitats and long term if complex hard habitat is damaged. Losses of organisms due to mortality would be limited to the area that is contacted by anchors/chains. Such loss would be relatively minimal compared to the amount of available habitat to organisms. Resuspended sediments would be dispersed via tidal currents and could bury benthic organisms or eggs.

Discharges/intakes: At least three vessels (dredge vessel, tug, and scow) would be required to conduct dredging activities associated with the connected action. Vessel traffic associated with construction activities for the connected action would not be permanent. Furthermore, use of Inlet Marina following construction would not result in a net increase in commercial vessel traffic and is not expected to exceed an increase of two non-commercial vessels. All vessels associated with the connected action are expected to comply with environmental permitting standards for discharged materials.

Noise: Activities associated with the connected action would generate noise from the operation of construction vessels and pile driving. Construction vessels would include at least three vessel types (dredge vessel, tug, and scow) during a temporary construction window.

Installation of sheet piles for construction of the new bulkhead would include impact and vibratory pile-driving activities generating noise that potentially affects finfish and invertebrates by causing behavioral changes, PTS or TTS, injury, and mortality.

Construction vessel activity would also generate noise during connected action activities. Vessels associated with the connected action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in finfish and invertebrates. Impacts of vessel noise on individual finfish and invertebrates are expected to be temporary and localized. The volume of construction vessel traffic is expected to be small and occur during a limited number of days.

Presence of structures: Minimal impacts on finfish and invertebrates are expected due to presence of structures from construction of the new bulkhead in the connected action. The existing bulkhead already provides hard substrate that provides habitat for associated finfish and invertebrate communities (e.g., oysters and crabs).

Port utilization: Dredging and dredge material management from the connected action may affect finfish, invertebrates, and EFH through mortality, direct disturbance and modification of bottom habitat, and sediment suspension and deposition. Demersal and pelagic fish and invertebrates would likely avoid the dredge, but benthic invertebrates and fish with benthic life stages (e.g., eggs, larvae) may be captured by the dredge, possibly resulting in mortality. The potential loss of individual fish and invertebrates due to mortality from dredging is not expected to cause population-level effects on any species. BOEM expects that permit requirements for dredging activities would adhere to restrictions and regulations intended to minimize disturbances or protect species of concern; however, critical habitats for spawning, overwintering, or areas of dense aggregations are not present within the connected action area.

Dredging activity associated with the connected action would disturb sediments releasing them into the water column. Resuspended sediments would drift or disperse to other locations before resettling, including areas of complex-bottom structure and EFH habitats. Resuspended sediments may contain chemical contaminants. Mechanical dredging could resuspend sediments at concentrations up to 445 mg/L above ambient concentrations (NMFS 2022). Elevated suspended sediments would be temporary, and most fish and invertebrates are capable of mediating temporary increases in suspended sediment by expelling filtered sediments or reducing filtration rates (Bergstrom et al. 2013; Clarke and Wilber 2000). Further, the use of cofferdams or turbidity curtains to minimize the dispersal of sediments is proposed. Redeposition of disturbed sediments may temporarily or permanently alter nearby complex hard-bottom habitats and may bury organisms. In response to moderate sediment deposition, mobile fishes and crustaceans may actively avoid areas of deposition. However, some demersal eggs and larvae could be buried by suspended sediment that settles following dredging.

Habitat disturbance and modification associated with dredging could result in short-term habitat disturbance and modification within the dredge footprint. Benthic communities typically recover from dredging disturbances within 1 year (Wilber and Clarke 2007). Dredging is not expected to alter the existing sediment composition. Given this, subsequent changes in benthic community composition are not expected. However, dredging may expose underlying chemical contaminants, which may affect recolonization by benthic invertebrates. Impacts from habitat disturbance and modification on finfish, invertebrates, and EFH would be short term and localized.

Resuspension of sediments would also occur from pile-driving activity associated with the connected action. Pile driving could resuspend sediments at concentrations of 5 to 10 mg/L above ambient concentrations within 300 feet (91 meters) of a pile (FHWA 2012). Impacts due to resuspension of sediments from pile driving are expected to be relatively lower than from dredging.

Approximately 334,069 cubic yards (255,414 cubic meters) of combined dredge material associated with dredging Atlantic City's maintenance dredging and for the connected action is proposed to be disposed in-water at DH #86, a 14.0-acre (5.7-hectare) human-made subaqueous borrow pit. The dredge material would be mechanically and hydraulically placed and would temporarily release suspended sediments. The vast majority of the placed dredge material is expected to settle within the borrow pit. Organisms within the immediate 14.0-acre (5.7-hectare) area would likely be killed from burial; however, only seven invertebrate taxa were identified at depths greater than 15 feet (4.6 meters) and numbers of fish decreased at depths greater than 25 feet (7.6 meters) based on a study that sampled within and around DH #86 (McKenna et al. 2018). The benthic invertebrate community within the borrow pit, and in the vicinity, is mostly composed of crustaceans (67 percent) and polychaetes (25 percent), while bivalves account for 5 percent of the benthic invertebrate community and the overall total number of taxa was 46 (McKenna et al. 2018). Only seven taxa represent the benthic invertebrate community at depths greater than 15 feet (4.6 meters), including three polychaete, three crustacean, and one bivalve taxa/taxon (McKenna et al. 2018). Fish surveys conducted within and in the vicinity of the borrow pit found that fish abundance decreases at depths greater than 25 feet (7.6 meters) while identifying the presence of summer flounder and blue crab within the boundaries of the borrow pit (McKenna et al. 2018). In the study done to characterize the biological community at the site, dissolved oxygen concentrations were found to be unsuitable for most organisms (< 2 mg/L) at depths greater than 29.5 feet (9 meters) in May and at depths greater than 23.0 feet (7 meters) in August (McKenna et al. 2018).

Geotechnical boring samples were taken within the dredge footprint area of the connected action during four sampling events in June and August 2020 and April and May 2021 (ACT Engineers, Inc. 2021). Out of 28 boring samples, 12 were found to exceed NJDEP Residential Direct Contact Criteria for Benzo(a)pyrene, arsenic, and lead. Dredging at these locations could potentially release contaminants in resuspended sediments and/or result in contaminated dredge materials.

Proposed dredging activities falling under the *Port utilization* IPF are likely to have minor impacts on finfish, invertebrates, and EFH.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned activities include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications, tidal energy projects, marine minerals use and ocean-dredge material disposal, military use, marine transportation, fisheries use and management, oil and gas activities, regulated fishing effort, global climate change, and planned offshore wind development.

Accidental releases: The incremental contributions of the Proposed Action to the cumulative impacts of accidental releases from ongoing and planned activities on finfish, invertebrates, and EFH would be negligible considering that the volume of vessel activities from construction and installation, O&M, and decommissioning of the Proposed Action would contribute a relatively small amount of increased vessel traffic from overseas ports.

Anchoring: The incremental contributions of the Proposed Action to the cumulative impacts of anchoring from ongoing and planned activities on finfish, invertebrates, and EFH would be undetectable. The negligible to minor cumulative impacts from ongoing and planned activities determined for the No Action Alternative would therefore remain unchanged considering contributions from the Proposed Action. Overall, anchoring impacts are expected to be localized and short term.

Cable emplacement and maintenance: The incremental contributions of the Proposed Action to the cumulative impacts of cable emplacement and maintenance from ongoing and planned activities on finfish, invertebrates, and EFH would be negligible. The short-term and localized direct habitat disturbance and indirect impacts from resuspension and redeposition of sediments due to cable emplacement activities of wind development projects, including the Proposed Action, would occur on staggered construction schedules and may not be cumulative.

Discharges/intakes: The Proposed Action would contribute negligible impacts from discharges/intakes to the cumulative impacts from ongoing and planned activities on finfish, invertebrates, and EFH. The negligible impact determination of discharges/intakes from ongoing and planned activities would therefore remain unchanged with incremental contributions from the Proposed Action.

Electric and magnetic fields and cable heat: The incremental contributions of the Proposed Action to the cumulative impacts of EMF and cable heat from ongoing and planned activities on finfish, invertebrates, and EFH would be minor to moderate. EMF and cable heat from ongoing and planned activities and the Proposed Action would be fully cumulative because the cables that generate them would be operational in the long term. However, the impact determinations of EMF and cable heat from ongoing and planned activities are not expected to be elevated with incremental contributions from the Proposed Action.

Gear utilization: The incremental contributions of the Proposed Action to the cumulative impacts of gear utilization from ongoing and planned activities on finfish, invertebrates, and EFH would be minor to moderate. Gear utilization from monitoring surveys of the Proposed Action would have localized impacts. Although survey programs would be planned to occur in the long term, monitoring surveys would occur intermittently, allowing some level of recovery in between disturbances. Some existing scientific monitoring surveys would be impacted by offshore wind development thereby lessening cumulative impacts. Gear utilization during biological monitoring may be temporarily synergistic with short-term impacts from cable emplacement. However, the cumulative and synergistic effects are not expected to have population-level impacts.

Lighting: The incremental contributions of the Proposed Action to the cumulative impacts of lighting from ongoing and planned activities on finfish, invertebrates, and EFH would be negligible. Lighting from the Proposed Action would occur temporarily (e.g., construction vessel lighting) and over the long term (e.g., offshore wind structure lighting). The staggered construction schedules of planned offshore wind projects including the Proposed Action may reduce cumulative impacts from vessel lighting. The relative contribution of lighting impacts from vessel activity by the Proposed Action is negligible to the lighting from ongoing and planned vessel activity. Impacts from offshore wind structure lighting of ongoing and planned activities including the Proposed Action would be long term but localized.

Noise: The incremental contributions of the Proposed Action to the cumulative impacts of noise from ongoing and planned activities on finfish, invertebrates, and EFH would be minor to moderate. Noise impacts from construction of the Proposed Action may not be fully cumulative considering that construction of other planned activities would be on a staggered schedule. Operational noise impacts, however, would be cumulative.

Presence of structures: The incremental contributions of the Proposed Action to the cumulative impacts of presence of structures from ongoing and planned activities on finfish, invertebrates, and EFH would be minor to moderate. Impacts of presence of structures would be long term and cumulative within the geographic analysis area. Potential cumulative impacts include all those that are discussed under the No Action Alternative.

Conclusions

Impacts of Alternative B – Proposed Action. Individual IPFs associated with construction and installation, O&M, and decommissioning of the Proposed Action would result in **negligible** to **moderate** adverse and **minor beneficial** impacts on finfish, invertebrates, and EFH. The most consequential adverse impacts would result from the disturbance of seafloor during cable emplacement and the presence of structures. Impact determinations for each IPF are provided in the following paragraphs.

Adverse impacts from accidental releases, anchoring, discharges/intakes, and lighting would be **negligible**. These impacts would be localized to within or near the Project periphery. Anchoring impacts would be short term while the risk of accidental releases and lighting would be long term. Noise impacts on finfish, invertebrates, and EFH would be **negligible** to **minor**. Impacts of pile-driving noise would be short term, occurring during construction. Operational WTG noise may also have **minor** impacts if the larger WTGs associated with the Proposed Action produce sound levels that exceed regulatory thresholds for finfish.

Adverse impacts on finfish, invertebrates, and EFH from presence of EMF and structures and gear utilization would be **minor** to **moderate**. EMF, cable maintenance, and WTG noise impacts would be long term, and EMF, cable maintenance, and WTG would potentially have regional or population level impacts. Some invertebrate species could experience **minor beneficial** impacts, but not finfish species. **Moderate** adverse impacts are expected from cable emplacement and presence of structures. The impacts from cable emplacement would be short term while impacts from presence of structures would be long term.

BOEM expects that the connected action alone would have **negligible** to **minor** impacts on finfish, invertebrates, and EFH resulting from accidental releases, noise, presence of structures, and port utilization. These impacts are expected to be localized and temporary or short term.

Cumulative Impacts of Alternative B – Proposed Action. Cumulative impacts resulting from individual IPFs from ongoing and planned activities, including the Proposed Action, would range from **negligible** to **moderate** adverse and **minor beneficial**. Considering all IPFs together, BOEM anticipates that the impacts from ongoing and planned activities, including the Proposed Action, would result in **moderate** impacts on finfish, invertebrates, and EFH in the geographic analysis area. This impact rating is mostly driven by the presence of structures associated with the Project and planned offshore wind projects. The Proposed Action would contribute to the overall impact rating primarily through long-term impacts associated with the presence of structures and short-term impacts from seafloor disturbances during cable emplacement. The combined overall impacts on finfish, invertebrates, and EFH would be **moderate,** driven by long-term impacts of the presence of structures.

3.5.5.6 Impacts of Alternative C on Finfish, Invertebrates, and Essential Fish Habitat

Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) intends to minimize impacts on habitat areas that are important to fish communities by adjusting the layout or the maximum number of WTGs and OSSs. Under Alternative C1, up to 16 WTGs, 1 OSS, and associated cables within the “Lobster Hole” designated area would be removed. The “Lobster Hole” broad swale depression is a known productive fishing area. Alternative C2 would remove up to 13 WTGs and associated interarray cables within the NMFS-identified sand ridge complex. A combination of Alternatives C1 and C2 would be considered. The combined alternatives would allow for the removal of up to 29 WTGs, 1 OSS, and associated interarray cables from both the AOC 1 and AOC 2 areas. The combined Alternatives C1 and C2 would minimize impacts on sensitive habitats. Alternative C3 would remove up to 6 WTGs and associated interarray cables within 1,000 feet (305 meters) of the sand ridge complex area identified by NMFS and demarcated using of NOAA’s Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores. Sand ridge habitat is important to demersal fishes that utilize it as shelter and where important predator-prey relationships occur (Auster et al. 2003; Gerstner 1998). Alternative C4 would microsite 29 WTGs, 1 OSS and associated interarray cables outside of 1,000-foot (305-meter) buffers of ridges and swales within AOC 1 and AOC 2.

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternative C would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.5.5).

Offshore Activities and Facilities

The potential reduction of facilities from options under Alternative C would reduce impacts of EMFs, noise, and the presence of structures. Presence of structures under the Proposed Action include moderate adverse and moderate beneficial impacts on finfish and invertebrates, which would be reduced under Alternative C. These minor differences in interarray and export cable locations would avoid or create a 1,000-foot (305-meter) buffer around sensitive sand wave and ridge and swale habitat areas. Alternative C would result in a reduction of impacts on sensitive habitats due to habitat conversion from presence of structures, noise, and sediment resuspension and redeposition.

Impacts of Alternative C on ESA-Listed Species

Impacts of Alternative C on ESA-listed species would be the same as those described under the Proposed Action.

Cumulative Impacts of Alternative C

Although Alternative C would slightly reduce adverse impacts on finfish, invertebrates, and EFH compared to the Proposed Action, the relative reduction of impacts may not be noticeable in the context of cumulative impacts with ongoing activities and planned offshore wind development.

Conclusions

Impacts of Alternative C. Impacts of Alternative C would not be measurably different from the impacts of the Proposed Action. Therefore, construction and installation, O&M, and decommissioning of Alternative C would likewise result in **negligible** to **moderate** adverse and **minor beneficial** impacts on finfish, invertebrates, and EFH. **Moderate** adverse impacts would be due to presence of structures that would persist for the life of the Project. Cable emplacement activities during the construction phase are expected to result in temporary and localized moderate adverse impacts.

Cumulative Impacts of Alternative C. Cumulative impacts on finfish, invertebrates and EFH from ongoing and planned activities, including Alternative C, would range from **negligible** to **moderate** adverse with **minor beneficial** impacts. Considering all IPFs together, BOEM anticipates that the overall impacts associated with all ongoing and planned activities, including Alternative C, would result in **moderate** impacts on finfish, invertebrates, and EFH, driven by long-term impacts due to the presence of structures.

3.5.5.7 Impacts of Alternatives D and E on Finfish, Invertebrates, and Essential Fish Habitat

Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) is intended to minimize visual impacts by altering the WTG layout and possibly reducing the number of WTGs. Alternative D1 would remove turbines up to 12 miles (19.3 kilometers) from shore. This would result in the removal of up to 21 WTGs from Project 1. The height of the remaining turbines in Project 1 would be restricted to a maximum blade tip height of 932 feet (284 meters) ASML. Alternative D2 would remove up to 31 turbines up to 12.75 miles (20.5 kilometers) from shore. The height of the remaining turbines under Alternative D2 would be restricted to a maximum blade tip height of 932 feet (284 meters) ASML.

Under Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), impacts on existing ocean uses would be minimized by modifying the WTG layout. Proposed modifications under Alternative E include creating a setback between Atlantic Shores South and Ocean Wind 1 (OCS-A 0498). The setback range under Alternatives E would be from 0.81 nautical mile (1,500 meters) to 1.08 nautical miles (2,000 meters).

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternatives D and E would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.5.5).

Offshore Activities and Facilities

Alternatives D and E would slightly reduce offshore impacts on finfish, invertebrates, and EFH from those under the Proposed Action. The potential reduction of the number of WTGs in each of these alternatives would slightly reduce impacts due to presence of structures. Under Alternative D, up to 31 WTGs may be removed. Under Alternative E, up to 4 to 5 WTGs may be removed or microsited. Any reduction in the number of WTGs may also reduce the length of the interarray cable. Alternatives D and E would consider a 2 to 16 percent reduction in the number of WTGs, and a reduction in the length of interarray cable, would reduce cable emplacement and noise, benefiting some finfish and invertebrate species. However, BOEM anticipates that reductions of construction and installation impacts on finfish, invertebrates, and EFH under Alternatives D and E would not be measurably different from those anticipated under the Proposed Action.

Impacts of Alternatives D and E on ESA-Listed Species

Alternatives D and E may lead to slightly reduced impacts due to presence of structures on Atlantic sturgeon that may migrate through the Offshore Project area. Impacts of Alternatives D and F on other ESA-listed species would not differ from those under the Proposed Action.

Cumulative Impacts of Alternatives D and E

The slight reduction of adverse impacts under Alternatives D and E on finfish, invertebrates, and EFH is not expected to be noticeable in the context of cumulative impacts with ongoing activities and planned offshore wind development.

Conclusions

Impacts of Alternatives D and E. Impacts of Alternatives D and E would not be measurably different from the impacts of the Proposed Action. Therefore, construction and installation, O&M, and decommissioning of Alternatives D and E would result in **negligible** to **moderate** adverse and **minor beneficial** impacts on finfish, invertebrates, and EFH. **Moderate** adverse impacts would be due to presence of structures that would persist for the life of the Project. Cable emplacement activities during the construction phase are expected to result in temporary and localized **moderate** adverse impacts.

Cumulative Impacts of Alternatives D and E. Cumulative impacts on finfish, invertebrates, and EFH from ongoing and planned activities, including Alternative D or E, would range from **negligible** to **moderate** adverse with **minor beneficial** impacts. Considering all IPFs together, BOEM anticipates that the overall impacts associated with all ongoing and planned activities, including Alternatives D or E, would result in **moderate** impacts on finfish, invertebrates, and EFH, driven by long-term impacts due to the presence of structures.

3.5.5.8 Impacts of Alternative F on Finfish, Invertebrates, and Essential Fish Habitat

Under Alternative F (Foundation Structures), construction and installation, O&M, and decommissioning would occur within a range of design parameters, including a range of foundation types, all of which are evaluated under the Proposed Action (Section 3.5.5.5). Departing from the Proposed Action, Alternatives F1 to F3 would evaluate impacts associated with specific foundation types. Under Alternative F1, monopiles and piled jacked foundations would be used for up to 200 WTG foundations, 1 permanent met tower (Project 1), and up to 10 small OSSs (monopile or piled jacket), up to 5 medium OSSs (piled jacket), or 4 large OSSs (piled jacket) for Project 1 and Project 2. Under Alternative F2, mono-bucket, suction bucket jacket, and suction bucket tetrahedron base foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and either up to 10 small OSSs (mono-bucket or suction bucket jacket), up to 5 medium OSSs (suction bucket jacket), or 4 large OSSs (suction bucket jacket), for Project 1 and Project 2. Under Alternative F3, gravity-pad tetrahedron and GBS foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and either up to 10 small OSSs, up to 5 medium OSSs, or 4 large OSSs, with GBS for Project 1 and Project 2.

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternative F would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.5.5).

Offshore Activities and Facilities

Though all potential offshore activities under Alternative F were evaluated under the Proposed Action, sub-alternatives of Alternative F may exclude some activities evaluated under the Proposed Action. Activities would not differ between the Proposed Action and Alternative F1. Under Alternatives F2 and F3, no impact pile driving would be conducted, eliminating impacts due to underwater noise. Absent the potential impacts on finfish and invertebrates from pile-driving noise, the overall construction and installation impacts on finfish and invertebrates would be reduced under Alternatives F2 and F3 compared to the Proposed Action. Noise impacts on finfish, invertebrates, and EFH would be eliminated under Alternatives F2 and F3 compared to those described under the Proposed Action.

Alternatives F1 and F3 would result in a reduction in the installation of scour protection compared to the Proposed Action and Alternative F2. Reductions in scour protection would reduce O&M impacts due to the presence of structures. Specifically, the loss of soft-bottom habitat would be reduced. This would benefit the existing benthic, surficial, and infaunal fish and invertebrate communities. Alternatives F1 and F3 would also result in a decreased artificial reef effect. As discussed under the No Action Alternative and the Proposed Action, the artificial reef effect from scour protection may increase overall abundance and diversity of finfish and invertebrates. The reduction in scour protection under Alternative F3 would also reduce the risk of lost recreational fishing gear. Impacts on finfish, invertebrates, and EFH due to presence of structures in Alternatives F1 and F3 would be slightly reduced compared to in the Proposed Action.

Impacts of Alternative F on ESA-Listed Species

Alternative F may slightly reduce presence of structures impacts on Atlantic sturgeon that may migrate through the Offshore Project area. Impacts on other ESA-listed species would be similar to those under the Proposed Action.

Cumulative Impacts of Alternative F

Alternative F is expected to result in slight reductions in adverse impacts due to noise and presence of structures. However, the slight reduction of adverse impacts may not be noticeable in the context of cumulative impacts with ongoing activities and planned offshore wind development.

Conclusions

Impacts of Alternative F. Impacts of Alternative F2 would not be measurably different than the impacts of the Proposed Action. The reduction of noise impacts would not have measurable differences compared to the Proposed Action. Therefore, construction, O&M, and decommissioning of Alternative F1 would result in **negligible** to **moderate** adverse and **minor beneficial** impacts on finfish, invertebrates, and EFH. **Moderate** adverse impacts would be due to presence of structures that would persist for the life of the Project. Cable emplacement activities during the construction phase are expected to result in temporary and localized **moderate** adverse impacts.

Impacts of Alternatives F1 and F3 also would not be measurably different from the impacts of the Proposed Action. As explained in the O&M subsection for Alternative F, Alternatives F1 and F3 would result in the reduction of both adverse and beneficial impacts on finfish and invertebrates. Therefore, construction, O&M, and decommissioning of Alternatives F2 and F3 would still result in **negligible** to **moderate** adverse and **minor beneficial** impacts on finfish, invertebrates, and EFH.

Cumulative Impacts of Alternative F. Cumulative impacts on finfish, invertebrates, and EFH from ongoing and planned activities, including Alternative F1, F2, or F3, would range from **negligible** to **moderate** adverse with **minor beneficial** impacts. Considering all IPFs together, BOEM anticipates that the overall impacts associated with all ongoing and planned activities, including Alternative F, would be **moderate** on finfish, invertebrates, and EFH, driven by long-term impacts due to the presence of structures.

3.5.5.9 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed in Table 3.5.5-2 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.5.5-2. Proposed mitigation measures – finfish, invertebrates, and EFH

Measure	Description	Effect
Marine debris awareness training	Vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP must complete marine trash and debris awareness training annually. Atlantic Shores must submit an annual report describing its marine trash and debris awareness training process and certify that the training process was followed for the previous calendar year.	Marine debris and trash awareness training would minimize the risk of finfish ingestion of or entanglement in marine debris. While adoption of this measure would decrease risk to finfish under the Proposed Action, it would not alter the impact determination of negligible for accidental spills and releases.
Sampling gear	All sampling gear must be hauled at least once every 30 days, and all gear must be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	The regular hauling of sampling gear would reduce risk of entanglement or effects of entanglement in fisheries survey gear. While adoption of this measure would reduce risk under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in Project surveys must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long (0.9-meter-long) strip of black and white duct tape within 2 fathoms of a buoy attachment. In addition, three additional marks must be placed on the top, middle, and bottom of the line using black and white paint or duct tape.	Gear identification would improve accountability in the case of gear loss. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Lost survey gear	All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost survey gear must be reported to NMFS and BSEE.	Lost survey gear would improve accountability in the case of gear loss. While adoption of this measure would improve accountability under the Proposed

Measure	Description	Effect
		Action, it would not alter the impact determination of negligible for gear utilization.
Survey training	For any vessel trips where gear is set or hauled for trawl or ventless trap surveys, at least one of the survey staff onboard must have completed Northeast Fisheries Observer Program observer training within the last 5 years or completed other equivalent training in protected species identification and safe handling. Appropriate reference materials must be on board each survey vessel. Atlantic Shores must prepare a training plan that addresses how these survey requirements will be met.	Survey staff training would reduce risk of entanglement or effects of entanglement in fisheries survey gear. While adoption of this measure would reduce risk under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Atlantic sturgeon identification and data collection	Any Atlantic sturgeon caught or retrieved in any fisheries survey gear must first be identified to species or species group. Each ESA-listed species caught or retrieved must then be documented using appropriate equipment and data collection forms. Live, uninjured animals must be returned to the water as quickly as possible after completing the required handling and documentation.	Atlantic sturgeon identification and data collection would improve accountability for documenting take associated with fisheries surveys. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Atlantic sturgeon handling and resuscitation guidelines	Any Atlantic sturgeon caught and retrieved in gear used in fisheries surveys must be handled and resuscitated (if unresponsive) according to established protocols provided at-sea conditions are safe for those handling and resuscitating the animal(s) to do so.	Atlantic sturgeon handling and resuscitation guidelines would reduce effects of entanglement in fisheries survey gear. While adoption of this measure would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Take notification	The Greater Atlantic Regional Fisheries Office Protected Resources Division must be notified as soon as possible of all observed takes of Atlantic sturgeon occurring as a result of any fisheries survey.	Atlantic sturgeon take notification would improve accountability for documenting take associated with fisheries surveys. While adoption of this measure would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Monthly/annual reporting requirements	To document the amount or extent of take that occurs during all phases of the Proposed Action, Atlantic Shores must submit monthly reports during the construction phase and during the first year of operation and must submit annual reports beginning in year 2 of operation.	Reporting requirements to document take would improve accountability for documenting Atlantic sturgeon take associated with the Proposed Action. While adoption of this measure would improve accountability, it would not alter the overall impact

Measure	Description	Effect
		determination of minor for the Proposed Action.
Data collection BA BMPs	All Project Design Criteria and Best Management Practices incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) will be applied to activities associated with the construction, maintenance, and operations of the Atlantic Shores Wind project as applicable.	Compliance with Project Design Criteria and Best Management Practices for Protected Species would minimize risk to finfish during HRG surveys. While adoption of this measure would decrease risk to Atlantic sturgeon under the Proposed Action, it would not alter the impact determination of negligible for HRG activities.
Periodic underwater surveys, reporting of monofilament and other fishing gear around WTG foundations	Atlantic Shores must monitor potential loss of fishing gear in the vicinity of WTG foundations by surveying at least 10 different WTGs in each Project 1 and Project 2 area annually. Survey design and effort may be modified based upon previous survey results after review and concurrence by BOEM. Atlantic Shores must conduct surveys by remotely operated vehicles, divers, or other means to determine the locations and amounts of marine debris.	Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. While adoption of this measure would reduce risk to finfish under the Proposed Action, it would not alter the impact determination of minor associated with the presence of structures.
Artificial reef buffer for turbines	Atlantic Shores must remove a single turbine approximately 150–200 feet (31 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site).	This measure would reduce impacts on EFH by removing the footprint of one foundation. While adoption of this measure would reduce risk to EFH under the Proposed Action, it would not alter the impact determination of minor associated with the presence of structures.
Cable maintenance	In conjunction with cable monitoring, Atlantic Shores will develop and implement a Cable Maintenance Plan that requires prompt remedial burial of exposed and shallow-buried cable segments, will review to address repeat exposures, and will develop a process for identifying when cable burial depths reach unacceptable risk levels.	This measure would reduce the risk of EMF exposure to organisms by ensuring proper burial depth. While adoption of this measure would reduce risk to finfish and invertebrates under the Proposed Action, it would not alter the impact determination of minor associated with EMF.

3.5.5.10 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives C, D, E, and F would have the same negligible to moderate adverse impacts and minor beneficial impacts on finfish, invertebrates, and EFH as described under the Proposed Action. Alternative C would result in slightly reduced impacts on finfish and invertebrates due to the avoidance and minimization of impacts on sensitive habitats and the potential removal of up to 29 WTGs, 1 OSS, and associated interarray cables, slightly reducing impacts due to presence of structures and cable emplacement. Alternatives D and E would also result in slightly reduced structure-related impacts on finfish, invertebrates, and EFH due to the potential removal of up to 31 WTGs and associated interarray cables, or removal or micrositing of up to5 WTGs and associated interarray cables, respectively. Any reductions in offshore wind structures under Alternatives C, D, or E would result in slight reductions of both adverse and beneficial impacts, but these reductions would not change the overall impact determination made under the Proposed Action. Alternatives F2 and F3 would result in the absence of impacts due to pile-driving noise on finfish and invertebrates, but those reductions would not be measurable.

3.5.6 Marine Mammals

This section discusses potential impacts on marine mammal resources from the proposed Project, alternatives, and ongoing and planned activities in the marine mammal geographic analysis area. The marine mammal geographic analysis area, as shown in Figure 3.5.6-1, includes the Canadian Scotian Shelf, Northeast Shelf, Southeast Shelf, and Gulf of Mexico LMEs. This area is intended to capture the majority of the movement range for most marine mammal species that could be affected by the Project. The geographic analysis area includes the Gulf of Mexico LME because vessel transits between the Lease Area and Corpus Christi, Texas, may affect species in the Gulf of Mexico.

The analysis of IPFs of the Proposed Action in this assessment focuses on marine mammals that would likely occur near the Offshore Project area. The Offshore Project area includes the Atlantic Shores South Lease Area (OCS-A-0499) and the offshore export cable route study area shown on Figure 1-1 (Section 1.2, *Purpose of and Need for the Proposed Action*). Table D.A1-12 in Appendix D, *Ongoing and Planned Activities Scenario,* summarizes baseline conditions and impacts, based on IPFs assessed, of ongoing non-offshore wind activities, planned non-offshore wind activities, and offshore wind activities.

3.5.6.1 Description of the Affected Environment and Future Baseline Conditions

Fifty species of marine mammals are known to occur or could occur in U.S. waters of the northwest Atlantic Ocean, which includes the Northeast Shelf LME and is where almost all Project activities would occur: 6 mysticete species (i.e., baleen whales), 39 odontocete species (i.e., toothed whales, dolphins, and porpoises), 4 pinniped species (i.e., seals and sea lions), and 1 sirenian species (i.e., manatees and dugongs) (CSA Ocean Sciences 2020; BOEM 2021c). No additional species are expected to occur in the Southeast Shelf LME, which Project vessels would transit through on their way to and from ports in the Gulf of Mexico. Three additional species occur in the Gulf of Mexico that are not expected to occur in the Canadian Scotian Shelf, Northeast Shelf, or Southeast Shelf LMEs.[1] As some Project vessels are expected to transit to and from the Gulf of Mexico area during construction, there is the potential for vessel-related impacts on these species. However, only 20 round trips from the Gulf of Mexico are expected for the Project. Accidental releases from Project vessels are unlikely (Section 3.5.6.5, *Impacts of Alternative B*). Vessel noise would be temporary and localized, and noise effects of 20 round trips would be insignificant. The increased risk of a vessel strike associated with 20 round trips would be discountable, and this risk would be further reduced by vessel speed restrictions and collision avoidance measures in the Project's Incidental Take Regulations and associated LOA. Therefore, Project impacts in the Gulf of Mexico are unlikely and species unique to the Gulf of Mexico are not considered further in this Draft EIS. All 50 marine mammal species that occur in the northwest Atlantic OCS are protected under the MMPA, and six are listed under the ESA. The blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), North Atlantic right whale (NARW) (*Eubalaena glacialis*), sei whale (*B. borealis*), and sperm whale (*Physeter macrocephalus*) are listed as endangered. The West Indian manatee (*Trichechus*

[1] Additional species that may occur in the Gulf of Mexico include the ESA-listed Rice's whale (*B. ricei*), melon-headed whale (*Peponocephala electra*), and Fraser's dolphin (*Lagenodelphis hosei*). These species may be affected by vessel transits between the Lease Area and Corpus Christi, Texas.

manatus) is listed as threatened. Critical habitat has been designated for NARW and West Indian manatee. However, critical habitat for these species is not within or in the vicinity of the Atlantic Shores Offshore Project area. Unit 1 of NARW critical habitat is located approximately 249 miles (400 kilometers) northeast of the Lease Area, and Unit 2 is located approximately 424 miles (683 kilometers) south of the Lease Area. Manatee critical habitat is located within inland tributaries and along nearshore habitats of the coast of Florida. The BA for Atlantic Shores South provides a detailed discussion of ESA-listed species and potential impacts on these species as a result of the Project. A preliminary draft of the BA found that the Proposed Action *may affect, is likely to adversely affect* ESA-listed marine mammal species (i.e., fin whale, NARW, sei whale, and sperm whale) but is expected to have no effect on critical habitat designated for NARW. Consultation with NMFS pursuant to Section 7 of the ESA is ongoing, and results of the consultation will be presented in the Final EIS.

The Offshore Project area lies south of a seasonal management area for NARW and overlaps a biologically important area for NARW migration (December to February) (Figure 3.5.6-2). Though outside of the Offshore Project area, Project vessels may transit through the seasonal management area, which is in effect from November through April; during this period, vessels 65 feet (19.8 meters) or longer cannot exceed 10 knots (18.5 kilometers per hour) during transit.

Of the 50 species that are known to occur or could occur in the northwest Atlantic OCS, 35 have documented ranges that include the Offshore Project area (Table 3.5.6-1). For the purposes of the description of the affected environment in this Draft EIS, the focus is on the 9 species of marine mammals that would be likely to have regular or common occurrence in the Offshore Project area, as well as two additional ESA-listed species expected to experience acoustic effects of the Proposed Action (i.e., sei whale and sperm whale). Other marine mammal species are not described further in this subsection but are included in the impact assessments below. Additional information on these species can be found in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a) and the Project's application for MMPA rulemaking and LOA (Atlantic Shores 2022, 2023b).

Marine mammals use the North Atlantic OCS to rest, forage, mate, give birth, and migrate (Madsen et al. 2006; Weilgart 2007). Seasonal migrations between foraging and nursery areas are generally determined by prey abundance and availability. Some marine mammal species are highly migratory, traveling long distances between foraging and nursery areas, whereas other species migrate on a regional scale. Migratory patterns vary among species and are discussed in greater detail in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Prey distribution can influence the distribution of marine mammals and is highly dependent on oceanographic properties and processes. Therefore, impacts on prey items must also be considered when assessing impacts on marine mammals. Section 3.5.5 of the EIS summarizes the effects on fish, invertebrates, and EFH. Impacts on prey items are also assessed under the *Presence of structures* IPF in this subsection.

Marine Mammals Geographic Analysis Area
Atlantic Shores South Lease Area (OCS-A 0499)
Other BOEM Lease Areas

Source: BOEM 2023.

N

0 100 200 Miles

1:23,000,000

Figure 3.5.6-1. Marine mammals geographic analysis area

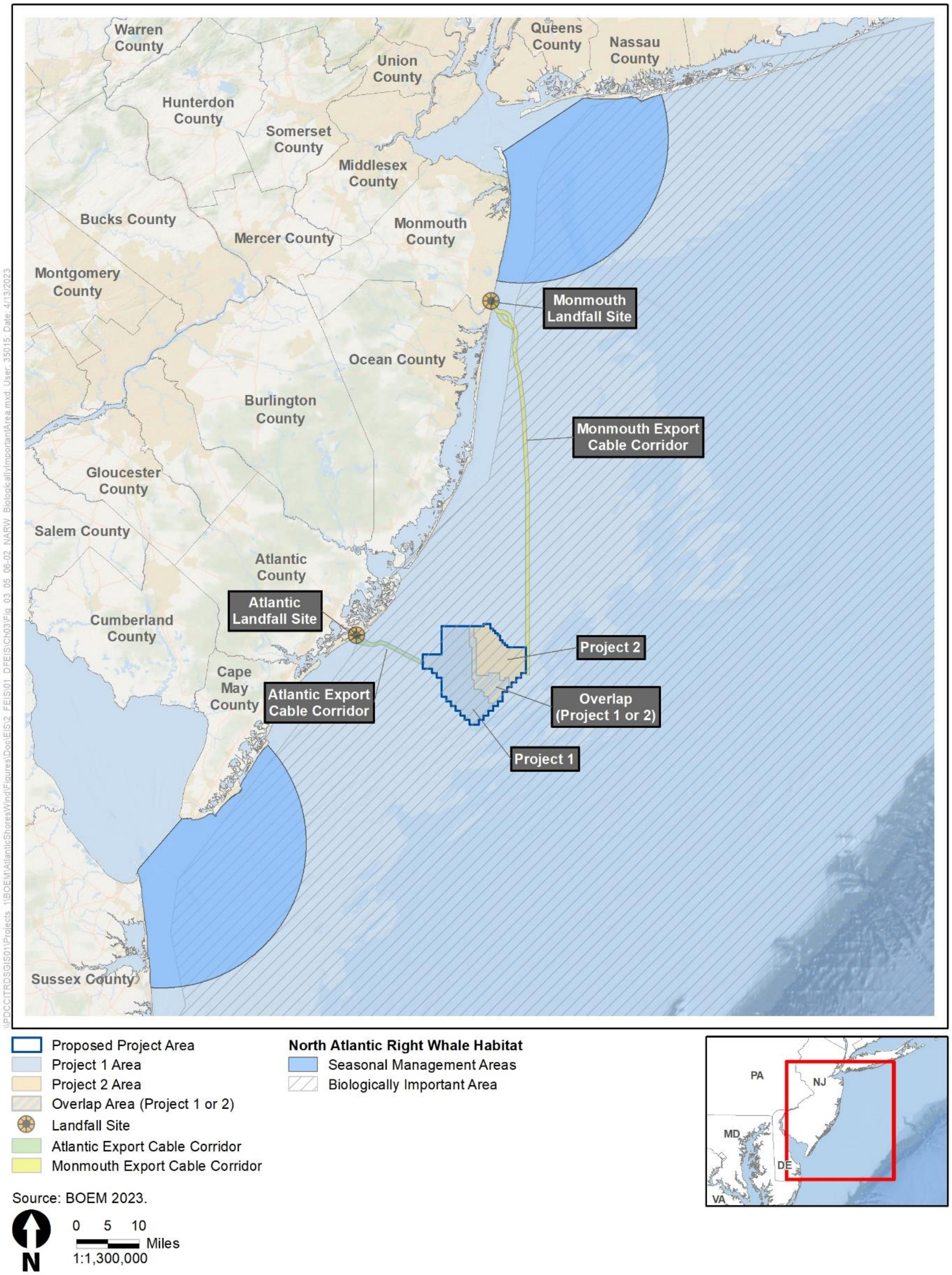


Figure 3.5.6-2. North Atlantic right whale Seasonal Management Areas and biologically important area

The best available information on marine mammal occurrence and distribution in the Offshore Project area is provided by a combination of visual sighting data from aerial and vessel surveys, which are routinely conducted near the Offshore Project area, as well as other available data, including passive acoustic monitoring data, habitat-based modeling efforts that utilize multiple years of visual survey data, technical reports, and academic publications, including the following:

- Marine mammal stock assessment reports (Hayes et al. 2017, 2018a, 2019, 2020, 2021, 2022a; NMFS 2023d): NMFS prepares marine mammal stock assessment reports each year presenting the most current description of the geographic range, minimum population estimate, population trend, net productivity rates, potential biological removals, status, estimate of human-caused mortality and serious injury by source, and descriptions of other factors contributing to population decline or inhibiting population recovery for each assessed stock. Though stock assessments are conducted each year, individual marine mammal stocks that are not designated as “strategic” are reviewed at least every 3 years (i.e., may not be reviewed in each annual assessment). These stock assessments are peer reviewed and subject to a public comment period.

- Ecological baseline studies conducted for NJDEP (Geo-Marine 2010): NJDEP funded the New Jersey Ecological Baseline Studies from January 2008 through December 2009 and used visual line-transect (shipboard and aerial) methods and passive acoustic monitoring to estimate the abundance and density of marine mammals from the shoreline to around 20 nautical miles (37 kilometers) off the coast of New Jersey between Stone Harbor and Seaside Park. Shipboard surveys were conducted once per month between January 2008 and December 2009. Aerial surveys were conducted once per month following the shipboard surveys between February and May 2008, and twice monthly (when possible) between January and June 2009.

- Sighting and density data from the Ocean Biodiversity Information System, which includes data from a habitat-based cetacean density model for the U.S. Exclusive Economic Zone of the East Coast and Gulf of Mexico developed by the Duke University Marine Geospatial Ecology Laboratory in 2016 and updated to include more recently available data in 2017, 2018, 2019, 2020, and 2022 (Roberts et al. 2015, 2016a, 2016b, 2017, 2018, 2020, 2022): The habitat-based cetacean density model was recently updated in June 2022 (Roberts et al. 2022) and serves as a complete replacement for the Roberts et al. (2016a) model and subsequent updates and is based primarily on a collection of Roberts et al. (2016b, 2017, 2018, 2020, 2021a, 2021b) density estimates. Collectively, these estimates are considered the best information currently available for marine mammal densities in the U.S. Atlantic. Marine mammal density estimates used in this analysis are derived from the habitat-based cetacean density model and are provided in the species descriptions below.

- Data from NMFS’s Atlantic Marine Assessment Program for Protected Species surveys (NEFSC and SEFSC 2015, 2016, 2018, 2019, 2020, 2022; Palka et al. 2017), which coordinates data collection and analysis to assess the abundance, distribution, ecology, and behavior of marine mammals in the U.S. Atlantic: These surveys include both ship and aerial surveys conducted between 2011 and 2019. Although the majority of survey effort has been focused on offshore areas outside the Offshore Project area, a portion were relevant to the assessment of the Proposed Action.

These data are summarized in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Marine mammal occurrence by species is summarized in Table 3.5.6-1 and described in the following paragraphs. Mean monthly densities within a 27-nautical-mile (50-kilometer) buffer around the WTA and ECCs are provided in Table 3.5.6-2. Abundance estimates are provided in Table 3.5.6-3. The four ESA-listed species likely to have regular or common occurrence in the Project area and/or expected to experience acoustic effects of the Proposed Action are addressed separately. The remaining eight species are grouped by taxon (i.e., mysticetes, odontocetes, and pinnipeds).

Threatened and Endangered Marine Mammals

The ESA (16 USC 1531 et seq.) classifies certain species as threatened or endangered based on their overall population status and health. Four marine mammals that are likely to occur in the Project area or are expected to experience acoustic effects are classified as endangered: fin whale, NARW, sei whale, and sperm whale. Of the marine mammal species listed under the ESA, critical habitat has only been designated for the NARW (NMFS 2016b). Critical habitat for the NARW within the marine mammal geographic analysis area comprises the feeding areas in Cape Cod Bay, Stellwagen Bank, and the Great South Channel, as well as the calving grounds that stretch from off Cape Canaveral, Florida, to Cape Fear, North Carolina (Hayes et al. 2021). The closest designated NARW critical habitat area is approximately 270 miles (435 kilometers) north of the Offshore Project area. Though these critical habitat areas do not overlap with the Project area, the general region is an important migratory corridor for a number of ESA-listed large whales, including NARW (Hayes et al. 2020, 2021). Biologically Important Areas (BIAs) [2] for NARW migration overlap with the Project area and surrounding waters for the months of March–April and November–December (Van Parjis et al. 2015). No other BIAs have been identified near the Project area. BIAs for fin whale feeding have been identified to the north of the Project area, off Rhode Island Sound between March and October, and year-round for Georges Bank, Cape Cod Bay, and the Gulf of Maine (Van Parjis et al. 2015). BIAs for NARW feeding have also been identified near Georges Bank, Cape Cod Bay, and the Gulf of Maine between the months of April and July (Van Parjis et al. 2015). BIAs for sei whale feeding have been identified north of the Project area, stretching from the Gulf of Maine to the continental shelf off Georges Bank between the months of March and November (Van Parjis et al. 2015).

Fin whale: Fin whales found in the Offshore Project area belong to the Western North Atlantic stock. This species inhabits deep offshore waters of every major ocean and is most common in temperate to polar latitudes (NMFS 2021c). In the U.S. Atlantic, fin whales are common in shelf waters north of Cape Hatteras, North Carolina, and are found in this region year-round (Edwards et al. 2015; Hayes et al. 2020). This species most commonly occupies waters along the 328-foot (100-meter) isobath but may be found in both shallower and deeper waters (Kenney and Winn 1986). Primary prey species for fin whales include sand lance, herring, squid, krill, and copepods (Kenney and Vigness-Raposa 2010), and

[2] Biologically important areas identify areas and times within which cetacean species or populations are known to concentrate for specific behaviors, or be range-limited, and consist of reproductive areas, feeding areas, migratory corridors, and small and resident populations. NOAA' Biologically Important Areas Map is available at https://cetsound.noaa.gov/biologically-important-area-map.

distribution of these species likely influences fin whale movements. Fin whale migratory patterns are complex, although the species generally exhibits a southward movement pattern in the fall from the Labrador/Newfoundland region to the West Indies (NMFS 2021c). Fin whales may occur in the Offshore Project area year-round; densities are expected to be highest in the winter and summer months. Monthly density of fin whales is provided on Figure 4.7-1 in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Mean monthly densities for this species are shown in Table 3.5.6-2, and range from 0.028 animal per 39 square miles (100 square kilometers) in August to 0.178 animal per 39 square miles (100 square kilometers) in January. The best abundance estimate for the Western North Atlantic stock is 6,802 individuals (Hayes et al. 2022a) (Table 3.5.6-3. There are currently insufficient data to determine a population trend for this species (Hayes et al. 2022a). A detailed species description for fin whales is provided in COP Volume II, Section 4.7.1.2 (Atlantic Shores 2023a).

North Atlantic right whale: NARWs found in the Offshore Project area belong to the Western North Atlantic stock. This species is found primarily in coastal waters although it is also found in deep waters offshore (NMFS 2021d). In the U.S. Atlantic, the NARW range extends from Florida to Maine. This species feeds primarily on copepods belonging to the *Calanus* and *Pseudocalanus* genera (McKinstry et al. 2013). NARWs exhibit strong migratory patterns between high-latitude summer feeding grounds and low-latitude winter calving and breeding grounds. Species densities are expected to be highest in the winter, but NARW could be found in the Offshore Project area throughout the year. Monthly density of NARW is provided on Figure 4.7-5 in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Mean monthly densities for this species are provided in Table 3.5.6-2, and range from 0.001 animal per 39 square miles (100 square kilometers) in July and August to 0.074 animal per 39 square miles (100 square kilometers in February. The best abundance estimate for the Western North Atlantic stock is 338 individuals (NMFS 2023d) (Table 3.5.6-3). The species is considered critically endangered, and the Western North Atlantic stock experienced a decline in abundance between 2011 and 2020 with an overall decline of 29.7 percent (NMFS 2023d). NARW has been experiencing an unusual mortality event since 2017 attributed to vessel strikes and entanglement in fisheries gear (NMFS 2021a). In 2017, a total of 31 mortalities, serious injuries, and morbidities were documented. Between 2017 and April 2023, a total of 98 mortalities, serious injuries, and morbidities (sublethal injury and illness) of NARW were documented (NMFS 2023c). The whales affected by the unusual mortality event (UME) represent more than 20 percent of the population. A detailed species description for NARWs is provided in COP Volume II, Section 4.7.1.2 (Atlantic Shores 2023a).

Sei whale: Sei whales found in the Offshore Project area belong to the Nova Scotia stock. This species inhabits deep offshore waters in subtropical, temperature, and subpolar latitudes (NMFS 2022a). Sei whale distribution is unpredictable, but this species is commonly found in the Gulf of Maine and on Georges and Stellwagen Banks in the summer (NMFS 2022a). Primary prey species for sei whales include plankton, small schooling fish, and cephalopods (NMFS 2022a). Sei whales are uncommon in the Mid-Atlantic Bight. Monthly density of this species is provided on Figure 4.7-6 in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Mean monthly densities for this species range from 0.001 animal per 39 square miles (100 square kilometers) in July and August to 0.074 animal per 39 square miles (100 square kilometers) in April. The best abundance estimate for the Nova Scotia stock is 6,292 individuals (Hayes et al. 2022a). A trend analysis has not been conducted for this species due to low statistical power (Hayes et al. 2022a). A detailed species description for sei whales is provided in COP Volume II, Section 4.7.1.2 (Atlantic Shores 2023a).

Sperm whale: Sperm whales found in the Offshore Project area belong to the North Atlantic stock. This species occurs in every ocean around the globe (NMFS 2022b). Compared to other large whales (i.e., mysticetes), sperm whale migrations are relatively unpredictable and poorly understood. In some populations, females remain in tropical waters with their young year-round while males undergo long migrations to higher latitudes (NMFS 2022b). Primary prey species for this species include squid, sharks, skates, and deep-water fish (NMFS 2022b). Sperm whales are expected to occur year-round in deeper waters near the shelf break (Tetra Tech and Smultea Sciences 2018; Tetra Tech and LGL 2019, 2020). Monthly density of this species is provided on Figure 4.7-6 in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Mean monthly densities for this species range from 0.000 animal per 39 square miles (100 square kilometers) in August through October to 0.010 animal per 39 square miles (100 square kilometers) in May. The best abundance estimate for the North Atlantic stock is 4,349 individuals (Hayes et al. 2020). A trend analysis has not been conducted for this species due to low statistical power (Hayes et al. 2020). A detailed species description for sperm whales is provided in COP Volume II, Section 4.7.1.2 (Atlantic Shores 2023a).

Non-Endangered Marine Mammals

As noted above, all marine mammals are protected pursuant to the MMPA (16 USC 1361 et seq.), and their populations are monitored by NMFS and USFWS.[3] Mysticetes that are not endangered or threatened and commonly or regularly occur in the Project area include the humpback whale (*Megaptera novaeangliae*) and minke whale (*B. acutorostrata*). Odontocetes that are not listed under the ESA and commonly or regularly occur in the Project area include bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), and harbor porpoise (*Phocoena phocoena*). Four additional odontocete taxa—Atlantic spotted dolphin, Atlantic white-sided dolphin, pilot whales, and Risso's dolphin—are expected to experience acoustic effects of the Proposed Action. Pinnipeds that are not endangered or threatened and commonly or regularly occur in the Project area include gray seal (*Halichoerus grypus*) and harbor seal (*Phoca vitulina*). BIAs for humpback whale feeding have been identified well north of the Project area near Georges Bank, Cape Cod Bay, and the Gulf of Maine between the months of March and December (Van Parjis et al. 2015).

Humpback whale: Humpback whales could be found in the Project area year-round. Monthly density of humpback whales is provided on Figure 4.7-2 in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Mean monthly densities for this species are provided in Table 3.5.6-2 and range from 0.006 animal per 39 square miles (100 square kilometers) in August to 0.121 animal per 39 square miles (100 square kilometers) in December. Humpback whales found in the Project area belong to the Gulf of Maine stock. The best abundance estimate for this stock is 1,396 individuals (Hayes et al. 2020) (Table 3.5.6-3). The Gulf of Maine stock is currently exhibiting an increasing trend (Hayes et al. 2020), although humpback

[3] Marine mammals under USFWS jurisdiction are not expected to occur in the Offshore Project area.

whales in the Atlantic have been experiencing an unusual mortality event since 2016 (NMFS 2021a). since then, 28 humpback whales have stranded off New Jersey, with 191 coastwide (NMFS 2023a). The suspected cause of this event is vessel strikes. However, more research is necessary to be definitive.

Minke whale: Minke whales could be found in the Project area throughout the year. Monthly density of minke whales is provided on Figure 4.7-3 in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Mean monthly densities for this species are provided in Table 3.5.6-2 and range from 0.015 animal per 39 square miles (100 square kilometers) in September to 0.810 animal per 39 square miles (100 square kilometers) in May. Minke whales in the Project area belong to the Canadian East Coast stock. The best abundance estimate for this stock is 21,968 individuals (Hayes et al. 2022a) (Table 3.5.6-3); a trend analysis has not been conducted for this stock. Minke whales in the Atlantic have been experiencing an unusual mortality event since 2017 (NMFS 2021a). A total of 142 individuals have stranded from Maine to South Carolina. The suspected cause of this event is entanglement and disease based on preliminary necropsy results. However, these results are not conclusive (NMFS 2023b). Detailed species descriptions for these mysticetes are provided in COP Volume II, Section 4.7.1.2 (Atlantic Shores 2023a).

Bottlenose dolphin: Bottlenose dolphins could be found in the Project area throughout the year. Bottlenose dolphins in the Project area belong to either the Western North Atlantic – Offshore stock or the Western North Atlantic – Northern Coastal Migratory stock. Monthly density of bottlenose dolphins is provided on Figure 4.7-8 in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Mean monthly densities for bottlenose dolphin are provided in Table 3.5.6-2 and range from 1.024 animal per 39 square miles (100 square kilometers) in February to 32.096 animals per 39 square miles (100 square kilometers) in September for the coastal stock and 0.489 animal per 39 square miles (100 square kilometers) in February to 9.485 animals per 39 square miles (100 square kilometers) in August for the offshore stock. The best abundance estimate for the offshore stock is 62,851 individuals (Hayes et al. 2020) (Table 3.5.6-3); this stock is not currently exhibiting any population trend. The best abundance estimate for the coastal migratory stock is 6,639 individuals (Hayes et al. 2018) (Table 3.5.6-2). As of 2017, there were no statistically significant trends detected for this stock.

Common dolphin: Common dolphins found in the Project area belong to the Western North Atlantic stock. This species could be found in the Project area year-round. Monthly density of common dolphins is provided on Figure 4.7-11 in COP Volume II, Section 4.7.1 (Atlantic Shores 2023a). Mean monthly densities for common dolphin are provided in Table 3.5.6-2 and range from 0.085 animals per 39 square miles (100 square kilometers) in September to 5.876 animals per 39 square miles (100 square kilometers) in December. The best abundance estimate for this stock is 172,974 individuals (Hayes et al. 2022a) (Table 3.5.6-3). A trend analysis has not been conducted for this stock.

Harbor porpoise: Harbor porpoises in the Project area belong to the Gulf of Maine/Bay of Fundy stock. This species could be present in the Project area year-round, with peak abundances in winter. Monthly density of harbor porpoises is provided on Figure 4.7-13 in COP Volume II, Section 4.7 (Atlantic Shores 2023a). Mean monthly densities for harbor porpoise are provided in Table 3.5.6-2 and range from 0.003 animal per 39 square miles (100 square kilometers) in September to 4.161 animals per 39 square miles (100 square kilometers) in April. The best abundance estimate for this stock is 95,543 individuals (Hayes et al. 2022a) (Table 3.5.6-3). A trend analysis has not been conducted for this stock.

Detailed species descriptions for these odontocetes and the four additional taxa expected to experience acoustic effects are provided in COP Volume II, Section 4.7.1.3 (Atlantic Shores 2023a) and in *Atlantic Shores Offshore Wind Application for Marine Mammal Protection Act (MMPA) Rulemaking and Letter of Authorization*, Section 4.2 (Atlantic Shores 2022).

Pinnipeds: Gray seal and harbor seal could occur in the Project area year-round. There are three major harbor seal haul-out sites in New Jersey: (1) Great Bay, which is the largest haul-out south of Long Island, New York, (2) Barnegat Inlet/Barnegat Lighthouse, and (3) Sandy Hook (CWF 2023; NJDEP 2010; Slocum et al. 2005). Mean monthly densities for seals are provided in Table 3.5.6-2 and range from 0.054 animal per 39 square miles (100 square kilometers) in August to 4.881 animals per 39 square miles (100 square kilometers) in January for gray seals and from 0.122 animal per 39 square miles (100 square kilometers) in August to 10.967 animals per 39 square miles (100 square kilometers) in January for harbor seals. Gray seals in the Project area belong to the Western North Atlantic stock. The best abundance estimate for this stock in U.S. waters is 27,300 individuals (Hayes et al. 2022b) (Table 3.5.6-3). In the U.S., pupping rates increased at most pupping locations between 1988 and 2019 (Hayes et al. 2022b citing Wood et al. 2020), indicating that seals may be recruiting to the U.S. breeding colonies from colonies in Canada (Hayes et al. 2022b). Harbor seals found in the Project area belong to the Western North Atlantic stock. The best abundance estimate for this stock in U.S. waters is 61,336 individuals (Hayes et al. 2022b) (Table 3.5.6-3). This stock is not currently exhibiting statistically significant population trends. Since July 2018, increased numbers of gray seal and harbor seal mortalities have been recorded across Maine, New Hampshire, and Massachusetts (Hayes et al. 2021). This event has been declared a UME by NMFS and encompasses 3,152 seal strandings from Maine to Virginia (Hayes et al. 2021). Off New Jersey, 172 seals stranded between July 2018 and March 2020 (NOAA Fisheries 2020). The pathogen phocine distemper virus was found in the majority of deceased seals and has therefore been identified as the cause of the UME. This 2018–2022 UME is non-active with closure pending. Since June 2022, another UME for harbor and gray seals has been declared by NMFS off the southern and central coast of Maine, with 322 seal strandings between June and December 18, 2022 (NOAA Fisheries 2023). Preliminary testing has found some of the harbor and gray seals affected by the June 2022 UME to be positive for highly pathogenic avian influenza H5N1. Detailed species descriptions for these pinnipeds are provided in COP Volume II, Section 4.7.1.4 (Atlantic Shores 2023a).

Table 3.5.6-1. Marine mammals occurring in the Project area

Common Name	Scientific Name	ESA/ MMPA Status[1]	Relative Occurrence in the Project Area[2]	Seasonal Occurrence in the Project Area
Mysticetes				
Blue whale	*Balaenoptera musculus*	E/D	Rare	Rare
Fin whale	*Balaenoptera physalus*	E/D	Regular	Year-round, peak in winter and summer
Humpback whale	*Megaptera novaeangliae*	None/N	Common	Year-round, peak in spring and fall
Minke whale	*Balaenoptera acutorostrata*	None/N	Regular	Year-round, peak spring-early summer
North Atlantic right whale	*Eubalaena glacialis*	E/D	Regular	Year-round, peak in winter
Sei whale	*Balaenoptera borealis*	E/D	Uncommon	Spring
Odontocetes				
Atlantic spotted dolphin	*Stenella frontalis*	None/N	Rare	Rare
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	None/N	Uncommon	Fall-spring
Blainville's beaked whale	*Mesoplodon densirostris*	None/N	Rare	Rare
Bottlenose dolphin	*Tursiops truncatus*	None/D, N	Common	Year-round
Common dolphin	*Delphinus delphis*	None/N	Common	Year-round
Cuvier's beaked whale	*Ziphius cavirostris*	None/N	Rare	Rare
Dwarf sperm whale	*Kogia sima*	None/N	Rare	Rare
False killer whale	*Pseudorca crassidens*	None/N	Rare	Rare
Fraser's dolphin	*Lagenodelphis hosei*	None/N	Rare	Rare
Gervais' beaked whale	*Mesoplodon europaeus*	None/N	Rare	Rare
Harbor porpoise	*Phocoena phocoena*	None/N	Common	Year-round, peak in winter
Killer whale	*Orcinus orca*	None/N	Rare	Rare
Long-finned pilot whale	*Globicephala melas*	None/N	Uncommon	Year-round
Pantropical spotted dolphin	*Stenella attenuata*	None/N	Rare	Rare
Pygmy sperm whale	*Kogia breviceps*	None/N	Rare	Rare
Risso's dolphin	*Grampus griseus*	None/N	Uncommon	Year-round
Rough-toothed dolphin	*Steno bredanensis*	None/N	Rare	Rare
Short-finned pilot whale	*Globicephala macrorhynchus*	None/N	Rare	Rare
Sowerby's beaked whale	*Mesoplodon bidens*	None/N	Rare	Rare
Sperm whale	*Physeter macrocephalus*	E/D	Uncommon	Year-round, peak in summer
Spinner dolphin	*Stenella longirostris*	None/N	Rare	Rare
Striped dolphin	*Stenella coeruleoalba*	None/N	Rare	Rare
True's beaked whale	*Mesoplodon mirus*	None/N	Rare	Rare
White-beaked dolphin	*Lagenorhynchus albirostris*	None/N	Rare	Rare
Pinnipeds				
Gray seal	*Halichoerus grypus*	None/N	Regular	Year-round

Common Name	Scientific Name	ESA/ MMPA Status[1]	Relative Occurrence in the Project Area[2]	Seasonal Occurrence in the Project Area
Harbor seal	*Phoca vitulina*	None/N	Regular	Year-round, peak fall-spring
Harp seal	*Cystophora cristata*	None/N	Rare	Rare
Hooded seal	*Phoca groenlandica*	None/N	Rare	Rare
Sirenians				
West Indian manatee	*Trichechus manatus*	T/D	Rare	Rare

[1] E = endangered; T = threatened; D = depleted; N = non-strategic.
[2] Rare – limited sightings for some years; uncommon – occurring in low numbers or on an irregular basis; regular – occurring in low to moderate numbers on a regular basis or seasonally; common – occurring consistently in moderate to large numbers.

Table 3.5.6-2. Marine mammal density estimates for marine mammals likely to occur in the Project area

Species	Mean Monthly Density Estimates for Species Animals/39 Square Miles (100 Square Kilometers)[1, 2]												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean
ESA-Listed Species													
Fin whale	0.178	0.123	0.098	0.099	0.088	0.075	0.047	0.028	0.029	0.031	0.038	0.141	0.081
North Atlantic right whale	0.069	0.074	0.062	0.046	0.010	0.003	0.001	0.001	0.002	0.004	0.010	0.042	0.027
Other Mysticetes													
Humpback whale	0.093	0.065	0.084	0.101	0.091	0.058	0.011	0.006	0.020	0.065	0.086	0.121	0.067
Minke whale	0.051	0.049	0.049	0.737	0.810	0.202	0.054	0.026	0.015	0.066	0.016	0.042	0.176
Odontocetes													
Bottlenose dolphin (northern coastal stock)	2. 917	1.024	2.053	8.290	20.869	27.429	29.272	31.415	32.096	29.744	30.414	16.667	19.349
Bottlenose dolphin (offshore stock)	1.409	0.489	0.732	2.460	6.311	8.449	9.350	9.485	8.613	8.335	9.468	5.944	5.920
Common dolphin	2.754	1.139	1.347	2.751	3.431	1.695	0.939	0.507	0.085	1.006	5.315	5.876	2.237
Harbor porpoise	3.968	3.756	3.091	4.161	1.025	0.033	0.023	0.016	0.003	0.007	0.029	2.891	1.584
Pinnipeds													
Gray seal	4.881	3.521	2.352	2.866	4.508	0.492	0.080	0.054	0.120	0.639	1.731	4.588	2.153
Harbor seal	10.967	7.911	5.285	6.439	10.127	1.106	0.180	0.122	0.271	1.437	3.889	10.308	4.837

Source: Section 6.1.1.1, Table 13; Atlantic Shores 2023b.

[1] Based on Lease Area OCS-A 0499 with a 2.4-mile (3.9-kilometer) buffer.

[2] Density estimates are from habitat-based density modeling of the entire U.S. Atlantic EEZ from Roberts et al. (2016a, 2016b, 2022).

Table 3.5.6-3. Population information for marine mammals likely to occur in the Project area

Common name	Stock	Population Estimate	Population Trend	Annual Human-Caused Mortality[1]	Reference
Fin whale	Western North Atlantic	6,802	Unavailable	1.8	Hayes et al. 2022a
Humpback whale	Gulf of Maine	1,396	Increasing	12.15	Hayes et al. 2020
Minke whale	Canadian East Coast	21,968	Unavailable	10.6	Hayes et al. 2022a
North Atlantic right whale	Western North Atlantic	338	Decreasing	8.1	NMFS 2023d
Bottlenose dolphin	Western North Atlantic – Offshore	62,851	None	28	Hayes et al. 2020
	Western North Atlantic – Northern Coastal Migratory	6,639	None	12.2–21.5	Hayes et al. 2018
Common dolphin	Western North Atlantic	172,974	Unavailable	390	Hayes et al. 2022a
Harbor porpoise	Gulf of Maine/Bay of Fundy	95,543	Unavailable	164	Hayes et al. 2022a
Gray seal	Western North Atlantic	27,300 (U.S. waters)	Unavailable	4,453	Hayes et al. 2022a
Harbor seal	Western North Atlantic	61,336 (U.S. waters)	None	339	Hayes et al. 2022a

[1] Annual human-caused mortality is mean annual figure for the period 2015–2019.

NMFS lists the long-term changes in climate as a threat for almost all marine mammal species (Hayes et al. 2020, 2021). Climate change is known to increase temperatures, alter ocean acidity, raise sea levels, and increase numbers and intensity of storms. Increased temperatures can alter habitat, modify species' use of existing habitats, change precipitation patterns, and increase storm intensity (Love et al. 2013; NASA 2023; USEPA 2022). Increase of the ocean's acidity has numerous effects on ecosystems, including reducing available carbon that organisms use to build shells and causing a shift in food webs offshore (Love et al. 2013; NASA 2023; USEPA 2022). This has the potential to affect the distribution and abundance of marine mammal prey. For example, between 1982 and 2018 the average center of biomass for 140 marine fish and invertebrate species along U.S. coasts shifted approximately 20 miles (32 kilometers) north. These species also migrated an average of 21 feet (6 meters) deeper (USEPA 2016). Shifts in abundance of their zooplankton prey will affect mysticetes who travel over large distances to feed (Hayes et al. 2020). The extent of these impacts is unknown; however, it is likely that marine mammal populations already stressed by other factors (e.g., NARWs) will likely be the most affected by the repercussions of climate change.

All marine mammal species in the geographic analysis area are also subject to ongoing anthropogenic threats. The primary threats to mysticetes include entanglement, vessel strike, and underwater noise. Habitat loss and degradation, pollution, and bycatch can also affect these species. Vessel strike, habitat loss and degradation, pollution, and fisheries interactions, including bycatch, are the primary threats to odontocetes. Additional threats include entanglement and underwater noise. Primary threats for pinnipeds include entanglement and fisheries interactions.

Overview of Sound and Marine Mammal Hearing

Underwater noise can be described through a source-path-receiver model. An acoustic source emits sound energy that radiates outward and travels through the water and the seafloor as pressure waves; pressure is the most relevant component of sound to marine mammals. The sound level decreases with increasing distance from the acoustic source as the sound pressure waves spread out under the influence of the surrounding environment. The amount by which the sound levels decrease between a source and receiver (e.g., a whale) is called transmission loss (Richardson et al. 1995). The amount of transmission loss that occurs depends on the distance between the source and the receiver, the frequency of the sound, properties of the water column, and properties of the seafloor layers. Underwater sound levels are expressed in decibels, which is a logarithmic ratio relative to a fixed reference pressure of 1 micropascal (μPa). A brief overview of acoustic units and the propagation of underwater sound can be found in Section B.5 of Appendix B, *Supplemental Information and Additional Figures and Tables*.

Underwater sound can be produced by biological and physical oceanographic sources, as well as anthropogenic (i.e., human-introduced) sources. Biological sounds include sounds made by animals, including marine mammals. Physical oceanographic sounds include wind and wave activity, rain, sea ice, and undersea earthquakes. Anthropogenic sounds include, but are not limited to, shipping and other vessel traffic, military activities, marine construction, and oil and gas exploration. Some natural and anthropogenic sounds are present everywhere in the ocean all of the time; therefore, background sound in the ocean is commonly referred to as “ambient noise” (DOSITS 2019).

Underwater noise is a particular concern for marine mammals. Marine mammals rely heavily on acoustic cues for extracting information from their environment. Sound travels faster and farther in water (approximately 4,921 feet [1,500 meters] per second) than it does in air (approximately 1,148 feet [350 meters] per second), making this a reliable mode of information transfer across large distances and in dark environments where visual cues are limited. Acoustic communication is used in a variety of contexts, such as attracting mates, communicating to young, or conveying other relevant information (Bradbury and Vehrencamp 1998). Marine mammals can also glean information about their environment by listening to acoustic cues, like ambient sounds from a reef, the sound of an approaching storm, or the call from a nearby predator. Finally, toothed whales produce and listen to echolocation clicks to locate food and to navigate (Madsen and Surlykke 2013).

Anthropogenic underwater noise can often be detected by marine mammals many kilometers from the source. Potential acoustic effects of anthropogenic underwater noise on marine mammals include mortality, non-auditory injury, permanent or temporary hearing loss, behavioral changes, and acoustic masking, with the severity of the effect increasing with decreasing distance from the sound source. These potential effects are described in greater detail in the noise impact analysis in Section 3.5.6.3.

Marine mammals are acoustically diverse, with wide variations in ear anatomy, hearing frequency range, and amplitude sensitivity (Ketten 1991). An animal's sensitivity to sound likely depends on the presence and level of sound in certain frequency bands and the range of frequencies to which the animal is most sensitive (Richardson et al. 1995). In general, larger species, such as baleen whales, are believed to hear better at lower frequency ranges than smaller species, such as porpoises and dolphins. Hearing abilities are generally only well understood for smaller species for which audiograms (i.e., plots of hearing threshold at different sound frequencies) have been developed based on captive behavioral studies, which rely on captive animals to react to sounds, and electrophysiological experiments, which measure auditory evoked potentials on captive or stranded animals (Erbe et al. 2012). Audiograms have been obtained in some odontocetes and pinniped species (Finneran 2015; Southall et al. 2007), while direct measurements of mysticetes hearing are lacking (Ridgway and Carder 2001). Baleen whale hearing sensitivities have therefore been estimated based on anatomy, modeling, vocalizations, taxonomy, and behavioral response studies (Au and Hastings 2008; Cranford and Krysl 2015; Dahlheim and Ljungblad 1990; Houser et al. 2001; Reichmuth 2007; Richardson et al. 1995; Southall et al. 2019 citing Ketten and Mountain 2011, 2014; Wartzok and Ketten 1999). Marine mammal species have been classified into functional hearing groups based on similar anatomical auditory structures and frequency-specific hearing sensitivity obtained from hearing tests on a subset of species (Finneran 2016; NMFS 2018a; Southall et al. 2019). For those species for which empirical measurements have not been made, the grouping of phylogenetic and ecologically similar species is used for categorization. This concept of marine mammal functional hearing groups was first described by Southall et al. (2007) and included five groups: low-, mid-, and high-frequency cetaceans (LFC, MFC, and HFC, respectively), pinnipeds in water, and pinnipeds in air. These were further modified by NMFS in their underwater acoustic guidance document (NMFS 2018a), mainly to separate phocid pinnipeds (i.e., earless seals) from otariid pinnipeds (i.e., fur seals and sea lions), and updated again by Southall et al. (2019). Though the science (Southall et al. 2019) now supports the need for at least eight functional hearing groups (i.e., LFC, HFC, very high frequency cetaceans, sirenians, phocids in air, phocids in water, other marine carnivores in air, and other marine carnivores in water, described in Southall et al. 2019), current regulatory practice is still based on the NMFS 2018 guidance. NMFS has the regulatory authority over the protection of cetaceans and most pinnipeds species, whereas USFWS oversees the protection of sirenia, walrus, and other marine carnivores (i.e., polar bears and sea otters).

Generalized hearing ranges and taxonomic groups for each of the functional hearing groups are provided in Table 3.5.6-4.

Table 3.5.6-4. Marine mammal hearing ranges for functional hearing groups that may occur in the Project area

Functional Hearing Group	Taxonomic Group	Generalized Hearing Range
Low-Frequency Cetaceans	Baleen whales (e.g., humpback whale, blue whale)	7 Hz to 35 kHz
Mid-Frequency Cetaceans	Most dolphin species, beaked whales, sperm whale	150 Hz to 160 kHz
High-Frequency Cetaceans	True porpoise, river dolphins, Cephalorhynchus dolphins)	275 Hz to 160 kHz
Phocid Pinnipeds	Phocid or true seals (e.g., harbor seal)	50 Hz to 86 kHz

Source: NMFS 2018a.
Hz = hertz; kHz = kilohertz

3.5.6.2 Impact Level Definitions for Marine Mammals

As described in Section 3.3, *Definition of Impact Levels,* this Draft EIS uses a four-level classification scheme (Table 3.5.6-5) to characterize potential impacts of alternatives, including the Proposed Action. Criteria used to define impact levels for marine mammals are provided in Table 3.5.6-6.

Table 3.5.6-5. Impact level definitions for marine mammals

Impact Level	Impact Type	Definition
Negligible	Adverse	The impacts on individual marine mammals or their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.
	Beneficial	Impacts on species or habitat would be beneficial but so small as to be unmeasurable.
Minor	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; however, they would be of low intensity, short term, and localized. Impacts on individuals or their habitat would not lead to population-level effects.
	Beneficial	If beneficial impacts occur, they may result in a benefit to some individuals and would be temporary to short term in nature.
Moderate	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of medium intensity, can be short term or long term, and can be localized or extensive. Impacts on individuals or their habitat could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat remains functional to maintain the viability of the species both locally and throughout their range.
	Beneficial	Beneficial impacts on species would not result in population-level effects. Beneficial impacts on habitat may be short term, long term, or permanent but would not result in population-level benefits to species that rely on them.
Major	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of severe intensity, can be long lasting or permanent, and would be extensive. Impacts on individuals and their habitat would have severe population-level effects and compromise the viability of the species.
	Beneficial	Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them.

Table 3.5.6-6. Criteria used to characterize impact level definitions for marine mammals

Criteria	Description	Classification	Definition
Intensity	Expected size or severity of the impact	Low	Project is likely to result in one or more of the following: Localized alteration of habitat, including exceedances of underwater noise Level B harassment (behavioral) thresholds; and/or Temporary disruption of critical activities (e.g., foraging, breeding, or nursing) or localized damage to sensitive or critical habitats.
		Medium	Project is likely to result in one or more of the following: Localized alteration of habitat, including exceedances of underwater noise Level A harassment (PTS) thresholds and non-auditory injury thresholds for explosions; One or more death or injury of a non-listed population; and/or Regular disruption of critical activities (e.g., foraging, breeding, or nursing) or localized damage to sensitive or critical habitats.
		Severe	Project is likely to result in one or more of the following: Widespread degradation of habitat in excess of underwater noise thresholds (both Level A and Level B harassment) as well as non-auditory mortality thresholds for explosions; One or more death or injury of a species at risk; and/or Extensive disruption of critical activities (e.g., foraging, breeding, or nursing) or damage to sensitive or critical habitats.
Geographic extent	Spatial scale over which the impact is expected to occur	Localized	Effect confined to the Offshore Project area (i.e., WTGs and their foundations, OSSs and their foundations, scour protection for foundations, interarray and substation interconnection cables, and offshore export cables) and vessel transit routes.
		Extensive	Effect extends beyond the localized area and into the greater geographic analysis area.
Frequency	How often the activity causing the effect is expected to occur	Infrequent	Effect occurs once or rarely (i.e., less than once per year) over the specified duration of the Project.
		Frequent	Effect occurs repeatedly (i.e., monthly to yearly) over the specified duration of the Project.
		Continuous	Effect occurs continuously (i.e., weekly or more frequently) over the specified duration of the Project.
Likelihood	The probability of the effect caused by the impacts to occur	Low	Past experience and professional judgment indicate that the effect is unlikely but could occur.
		Moderate	Past experience and professional judgment indicate that there is a moderate likelihood that the effect could occur.
		High	Past experience and professional judgment indicate that the effect is likely to occur.

3.5.6.3 Impacts of Alternative A – No Action on Marine Mammals

When analyzing the impacts of the No Action Alternative on marine mammals, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for marine mammals. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix D.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for marine mammals described in Section 3.5.6.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities.

Global climate change is an ongoing risk for marine mammal species in the geographic analysis area. Warming and sea level rise could affect marine mammals through increased storm frequency and severity, altered habitat/ecology, altered migration patterns, increased disease incidence, and increased erosion and sediment deposition. Increased storm severity or frequency may result in increased energetic costs, particularly for young life stages, reducing individual fitness (Kovacs et al. 2011; Wingfield 2013). Altered habitat/ecology associated with warming has resulted in northward distribution shifts for some prey species (Hayes et al. 2021), and marine mammals are altering their behavior and distribution in response to these alterations (Davis et al. 2017, 2020; Hayes et al. 2020, 2021). Warming is expected to influence the frequency of marine mammal diseases, particularly for pinnipeds. Ocean acidification may affect some marine mammals through negative effects on zooplankton (PMEL 2020). Warming and sea level rise, with their associated consequences, and ocean acidification could lead to long-term, high-consequence impacts on marine mammals.

Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals are generally associated with coastal and offshore development, marine transportation, fisheries use, and climate change. Coastal and offshore development, marine transport, and fisheries use and associated impacts are expected to continue at current trends and have the potential to affect marine mammals through accidental releases, which can have physiological effects on marine mammals; electric and magnetic fields and cable heat, which may result in behavioral changes in marine mammals; cable emplacement and maintenance and port utilization, which can disturb benthic habitats and affect water quality; noise, which can have physiological and behavioral effects on marine mammals; the presence of structures, which can result in behavioral changes in marine mammals, effects on prey species, which can affect prey availability for, and distribution of, marine mammals, and increased risk of interactions with fishing gear; and vessel traffic, which increases risk of vessel collision. See Appendix D, Table D.A1-12 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for marine mammals.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include:

- Continued O&M of the BIWF (5 WTGs) installed in state waters;
- Continued O&M of the CVOW pilot project (2 WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

The effects of approved projects have been evaluated through previous NEPA review and are incorporated by reference. Ongoing O&M of the BIWF and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect marine mammals through the primary IPFs of noise, presence of structures, and vessel traffic. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and vessel traffic described in detail below, under *Cumulative Impacts of Alternative A – No Action*, for planned offshore wind activities but the impacts would be of lower intensity.

Potential impacts associated with ongoing activities by IPF for marine mammals are described below and summarized in Appendix D, Table D.A1-12.

Accidental releases and discharges: Marine mammals are particularly susceptible to the effects of contaminants from pollution and discharges as they accumulate through the food chain or are ingested with garbage. PCBs and chlorinated pesticides (e.g., DDT, DDE, dieldrin) are of most concern and can cause long-term chronic impacts. These contaminants can lead to issues in reproduction and survivorship, and other health concerns (e.g., Hall et al. 2018; Jepson et al. 2016; Murphy et al. 2018; Pierce et al. 2008); however, the population-level effects of these and other contaminants are unknown. Research on contaminant levels for many marine mammal species is lacking. Some information has been gathered from necropsies conducted from bycatch and therefore focus on smaller whale species and seals. Moderate levels of these contaminants have been found in pilot whale blubber (Muir et al. 1988; Taruski et al. 1975; Weisbrod et al. 2000). Weisbrod et al. (2000) examined PCBs and chlorinated pesticide concentrations in bycaught and stranded pilot whales in the western North Atlantic. Contaminant levels were similar to or lower than levels found in other toothed whales in the western North Atlantic, perhaps because they are feeding farther offshore than other species (Weisbrod et al. 2000). Dam and Bloch (2000) found very high PCB levels in long-finned pilot whales in the Faroe Islands. Also, high levels of toxic metals (e.g., mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Islands drive fishery (Nielsen et al. 2000).

Impacts from accidental releases and discharges from ongoing non-offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds and are unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable, except for the NARW. Impacts from accidental releases and discharges from ongoing non-offshore wind activities would likely be major for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

Impacts from accidental releases and discharges associated with the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible (BOEM 2021a, 2021b). Offshore wind projects will comply with their OSRP and USCG requirements for the prevention and control of oil and fuel spills.

Cable emplacement and maintenance: Impacts from cable emplacement and maintenance from the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible (BOEM 2021a, 2021b). Sediment resuspension during cable emplacement and maintenance will be short term and localized, and individual marine mammals, if present, would be expected to successfully forage in nearby areas not affected by increased turbidity.

Electric and magnetic fields and cable heat: There are four in-service and six out-of-service submarine telecommunication cables present in the offshore export cable corridor and in the vicinity of the Offshore Project area. The four in-service cables would presumably continue to operate and generate EMF effects under the No Action Alternative. While the type and capacity of those cables is not specified, the associated baseline EMF effects can be inferred from available literature. Electrical telecommunications cables are likely to induce a weak EMF on the order of 1 to 6.3 microvolts per meter within 3.3 feet (1 meter) of the cable path (Gill et al. 2005). Fiber-optic communications cables with optical repeaters would not produce EMF effects. EMF effects on marine mammals from non-offshore wind activities would vary in extent and magnitude depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). However, measurable EMF effects are generally limited to within tens of feet of cable corridors. BOEM would require these future submarine cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation.

Impacts from EMF from ongoing non-offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds, of the lowest level of detection, and barely measurable, with no perceptible consequences to individuals or the population.

Impacts from EMF from the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible due to estimated low EMF levels, the localized nature of EMF along the cables near the seafloor, and appropriate shielding and burial depth (BOEM 2021a, 2021b).

Gear utilization: Global demand for fish as a food source will likely increase; however, output of seafood from wild fish capture has plateaued (Costello et al. 2020). Although traditional fisheries' gear utilization may not increase, there is potential for more aquaculture gear utilization to meet the growing demand (Costello et al. 2020). Fisheries interactions can have adverse effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands of individuals each year (Read et al. 2006). Marine mammals can ingest or become entangled in marine debris (e.g., ropes, plastic) that is lost from fishing vessels and other offshore activities. The majority of recorded marine megafauna entanglements are directly or indirectly attributable to ropes and lines associated with fishing gear (Benjamins et al. 2014; Harnois et al. 2015; McIntosh et al. 2015).

Entanglement is listed as a threat to large and small cetaceans and seals (Hayes et al. 2020, 2021). There is limited information regarding entanglements of blue, fin, sei, and minke whales; however, evidence of fishery interactions causing injury or mortality has been noted for each of these species in the Greater Atlantic Regional Fisheries Office entanglement/stranding database (Hayes et al. 2021). Of the available information, there are considerable data on the potential for entanglement of humpback whales and NARWs. A study of 134 individual humpback whales in the Gulf of Maine suggested that between 48 and 65 percent of the whales experienced entanglements (Robbins and Mattila 2001) and that 12 to 16 percent encounter gear annually (Robbins 2012). Along with vessel collisions, entanglement of humpback whales could be limiting the recovery of the population (Hayes et al. 2020). Entanglement in fishing gear has also been identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species' recovery (Knowlton et al. 2012). Limited information is available for sperm whale entanglement mortalities; however, from 1993 to 1998 there were three documented sperm whale entanglements, two of which were in the North Atlantic Ocean. Three additional sperm whale mortalities from entanglement were documented in 2009–2010 in a similar region (Waring et al. 2015).

Dolphins common to the Project area include common dolphin and bottlenose dolphin and are also susceptible to fishery interactions. Although limited data were found on entanglement in the North Atlantic, case reports of lethal fishing hook and line entanglement have been documented. Blowholes are susceptible to unattached fishing hooks, and plastic lines can cause asphyxiation and, if ingested, can lead to septic complications (Byard et al. 2020).

Pinnipeds, including harbor seals and gray seals, are also at risk for entanglements (Hayes et al. 2020, 2021). Drowning or asphyxiation in gear, chronic secondary complications of injuries, and feeding impairment are all associated with entanglement mortalities in seals (Moore et al. 2013). A 2014 unoccupied aerial system survey of large populations of gray and harbor seals was used to assess the prevalence of entanglement within haul-out locations in the North Atlantic. The mean prevalence of entanglement within the haul-outs varied between 0.83 percent and 3.70 percent (Waring et al. 2015). However, observed serious injury rates are lower than would be expected from the anecdotally observed numbers of gray seals living with ongoing entanglements, as gray seals entangled in netting are common at haul-out sites in the Gulf of Maine and southeastern Massachusetts. This may be because the majority of observed animals are dead when they come aboard the vessel as bycatch (Josephson et al. 2021); therefore, rates do not reflect the number of live animals that may have broken free of the gear and are living with entanglements. Martins et al. (2019) estimated the mean prevalence of live entangled gray seals at haul-out sites in Massachusetts and Isle of Shoals to be between 1 and 4 percent.

Bycatch occurs in various commercial, recreational, and subsistence fisheries with hotspots driven by marine mammal density and fishing intensity (Lewiston et al. 2014). Small cetaceans and seals are at most risk of being caught as bycatch due to their small body size that allows them to be taken up in fishing gear. Of the species considered in this assessment, Risso's dolphins, short-finned pilot whales, harbor porpoises, white-sided dolphins, harbor seals, and gray seals have been documented in several fisheries' bycatch data. The ones that most commonly report bycatch are pelagic longlining, bottom trawling, and sink gillnetting (Hayes et al. 2020, 2021). Purse seine fisheries, Atlantic blue crab trap/pot, North Carolina roe mullet stop net, and hook and line (rod and reel) have also noted instances of marine mammal bycatch.

Stranding data indicate that other marine mammal species may be affected by entanglements or bycatch; however, the contribution of fishery-related mortalities and serious injuries to these strandings is often difficult to determine. This is because not all of the marine mammals that die or are seriously injured wash ashore, and not all will show signs of entanglement or other fishery interaction (Hayes et al. 2020, 2021). As a result, the contribution of fisheries interactions to the annual mortality and injury of marine mammal species in the geographic analysis area and beyond is likely underestimated (Hayes et al. 2020, 2021). Although the duration of increased gear utilization is long term, the frequency of individual gear in any one location throughout the geographic analysis area is short term and localized. The impacts of gear utilization on mysticetes, odontocetes, and pinnipeds from ongoing non-offshore wind activities would be moderate because it is likely to result in long-term consequences to individuals or populations that are detectable and measurable, with the exception of NARW. Impacts on individual mysticetes, odontocetes, and pinnipeds could have population-level effects, but the population should sufficiently recover. Gear utilization from ongoing non-offshore wind activities would likely result in major impacts for NARW because impacts on individual NARWs could have severe population-level effects and compromise the viability of the species.

BOEM does not anticipate that mysticete, odontocete, or pinniped entanglement in gear used for biological monitoring for ongoing offshore wind projects would occur. There are no documented entanglement cases associated with biological monitoring for BIWF, the CVOW pilot project, or the Vineyard Wind 1 project. There are 13 documented seal deaths from South Fork Wind Farm biological monitoring; however, these occurred during gillnet surveys, and South Fork Wind Farm has since ceased gillnet surveys. While impacts from gear utilization associated with biological monitoring on individual marine mammals could occur, monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts so as to not result in population-level effects. Accordingly, impacts are expected to be minor to moderate (BOEM 2021a, 2021b).

Noise: As described in Section 3.5.6.1, marine mammals rely heavily on sound for essential biological functions, including communication, mating, foraging, predator avoidance, and navigation (Madsen et al. 2006; Weilgart 2007). Underwater sound is a pervasive issue throughout the world's oceans and can adversely affect marine mammals. Depending on the level of exposure, the context, and the type of sound, potential impacts of underwater sound on marine mammals may include non-auditory injury, permanent or temporary hearing loss, behavioral changes, acoustic masking, or increases in physiological stress (Götz et al. 2009). These potential effects are discussed below.

Non-auditory injury: Non-auditory physiological impacts are possible for very intense sounds or blasts, such as explosions. This kind of impact is not expected for most of the activities associated with offshore wind development; it is only possible during detonation of unexploded ordnances or if explosives are used in decommissioning. Although many marine mammals can adapt to changes in pressure during their deep foraging dives, the shock waves produced by explosives expose the animal to rapid changes in pressure, which in turn causes a rapid expansion of air-filled cavities (e.g., the lungs). This forces the surrounding tissue or bone to move beyond its limits, which may lead to tears, breaks, bleeding, or hemorrhaging. The extent and severity to which such injury will occur depends on several factors including the size of these air-filled cavities, the ambient pressure, the animal's proximity to the blast, and the size of the blast (Finneran et al. 2017). In extreme cases, this can lead to severe lung damage, which can directly kill the animal; a less severe lung injury may indirectly lead to death due to an increased vulnerability to predation or the inability to complete foraging dives.

Permanent or temporary hearing loss: An animal's auditory sensitivity to a sound depends on the spectral, temporal, and amplitude characteristics of the sound (Richardson et al. 1995). When exposed to sounds of significant duration and amplitude (typically within close range of a source), marine mammals may experience noise-induced threshold shifts. PTS is an irreversible loss of hearing due to hair cell loss or other structural damage to auditory tissues (Henderson et al. 2008; Saunders et al. 1985). TTS is a relatively short-term (e.g., lasting several hours or days), reversible loss of hearing following noise exposure (Finneran 2015; Southall et al. 2007), often resulting from hair cell fatigue (Saunders et al. 1985; Yost 2007). While experiencing TTS, the hearing threshold rises, meaning that a sound must be louder in order to be detected. Prolonged or repeated exposure to sounds at levels that are sufficient to induce TTS, without adequate recovery time, can lead to PTS (Finneran 2015; Southall et al. 2007).

Behavioral impacts: Farther away from a source and at lower received levels, marine mammals may show varying levels of behavioral disturbance ranging from no observable response to overt behavioral changes. They may flee from an area to avoid the noise source, exhibit changes in vocal activity, stop foraging, or change their typical dive behavior, among other responses (NRC 2003). When exposed to the same sound repeatedly, it is possible that marine mammals may become either habituated (i.e., show a reduced response) or sensitized (i.e., show an increased response) (Bejder et al. 2009). A number of contextual factors play a role in whether an animal exhibits a response to a sound source, including those intrinsic to the animal and those related to the sound source. Some of these factors include: (1) the exposure context (e.g., behavioral state of the animal, habitat characteristics), (2) the biological relevance of the signal (e.g., whether the signal is audible, whether the signal sounds like a predator), (3) the life stage of the animal (e.g., juvenile, mother and calf), (4) prior experience of the animal (e.g., novelty of sound source), (5) sound properties (e.g., duration of sound exposure, sound pressure level, sound type, mobility/directionality of the source), and (6) acoustic properties of the medium (e.g., bathymetry, temperature, salinity) (Southall et al. 2021a). Due to these many factors, behavioral impacts are challenging to both predict and measure, and this remains an ongoing field of study within the field of marine mammal bioacoustics. Furthermore, the implications of behavioral disturbance can range from temporary displacement of an individual to long-term consequences on a population if there is a demonstrable reduction in fitness (e.g., due to a reduction in foraging success).

Auditory masking: Auditory masking may occur over larger spatial scales than noise-induced threshold shift or behavioral disturbance. Masking occurs when a noise source overlaps in time, space, and frequency as a signal that the animal is either producing or trying to extract from its environment (Clark et al. 2009; Richardson et al. 1995). Masking can reduce an individual's communication space (i.e., the range at which it can effectively transmit and receive acoustic cues from conspecifics) or listening space (i.e., the range at which it can detect relevant acoustic cues from the environment). A growing body of research is focused on the risk of masking from anthropogenic sources, the ecological significance of masking, and what anti-masking strategies may be used by marine animals. This understanding is essential before masking can be properly incorporated into regulation or mitigation approaches (Erbe et al. 2016). As a result, most assessments only consider the overlap in frequency between the sound source and the hearing range of marine mammals.

Physiological stress: The presence of anthropogenic noise, even at low levels, can increase physiological stress in a range of taxa (Kight and Swaddle 2011; Wright et al. 2007). Physiological stress is extremely difficult to measure in wild animals, but several methods have recently emerged that may allow for reliable measurements in marine mammals. Baleen plates store both adrenal steroids that serve as stress biomarkers (e.g., cortisol) and reproductive hormones and, at least in bowhead whales, can be reliably analyzed to determine the retrospective record of prior reproductive cycles (Hunt et al. 2014). Waxy earplugs from baleen whales can be extracted from museum specimens and assayed for cortisol levels; one study demonstrated a potential link between historical whaling levels and stress (Trumble et al. 2018). These retrospective methods are helpful for answering certain questions, while the collection of fecal samples is a promising method for addressing questions about more recent stressors (Rolland et al. 2005).

The effects of anthropogenic sound on marine life have been studied for more than half a century. In that time, it has become clear that this is a complex subject with many interacting factors and extreme variability in response from one sound source to another and from species to species. But some general trends have emerged from this body of work. First, the louder and more impulsive the received sound (see Section B.5 in Appendix B for a discussion of sound source characteristics), the higher the likelihood that there will be an adverse physiological effect, such as PTS or TTS. These impacts generally occur at relatively close distances to a source, in comparison to behavioral effects, masking, or increases in stress, which can occur wherever the sound can be heard. Secondly, the hearing sensitivity of an animal plays a major role in whether it will be affected by a sound or not, and there is a wide range of hearing sensitivities among marine mammal species. Regulation to protect marine life from anthropogenic sound has formed around these general concepts. Criteria for assessing effects of underwater noise on marine mammals are described below. More information about the regulatory process associated with noise impacts, including the development of these criteria, can be found in Section B.5 of Appendix B.

Auditory Criteria for Injury and Disturbance

Assessment of the potential effects of underwater noise on marine mammals requires acoustic thresholds against which received sound levels can be compared. Acoustic thresholds for underwater noise are expressed using three common metrics: root-mean-square sound pressure level (SPL or L_{rms}), peak sound pressure level (L_{pk}), and sound exposure level (SEL or L_E). Sound pressure level is measured in decibels relative to 1 micropascal (dB re 1 µPa), and sound exposure level is measured in decibels relative to 1 micropascal squared second (dB re 1 $\mu Pa^2 s$). L_{pk} is an instantaneous value, whereas L_E is the total noise energy over a given time period or event. As such, SEL accumulated over 24 hours, (SEL_{24h} or $L_{E,\,24h}$) is appropriate when assessing effects on marine mammals from cumulative exposure to multiple pulses or durations of exposure. L_{rms} is a root-mean-square average over a period of time and is equal to the sound exposure divided (linearly) by the time period of exposure. Therefore, if the time period is 1 second, L_E and L_{rms} have equal values because the sound level is divided by 1 second.

For marine mammals, NMFS has developed *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (NMFS 2018a). The technical guidance established acoustic criteria identifying the potential for onset of PTS and TTS. NMFS developed dual metric thresholds that consider the peak SPL (L_{pk}) and 24-hour cumulative SEL, which utilizes marine mammal auditory weighting functions. The SEL thresholds are differentiated by hearing group (Table 3.5.6-4) to acknowledge that not all marine mammal species have identical hearing or susceptibility to noise-induced hearing loss. NMFS has also established SPL behavioral disturbance thresholds for all marine mammal species, that utilize an L_{rms} of 160 dB re 1 µPa for impulsive sounds and 120 dB re 1 µPa for non-impulsive sounds for all marine mammal species (NOAA 2013). Unlike PTS and TTS thresholds, behavioral disturbance thresholds are not frequency weighted to account for different hearing abilities by the five marine mammal hearing groups.

Table 3.5.6-7 outlines the acoustic thresholds for onset of hearing impairment (i.e., PTS and TTS) for marine mammals for both impulsive and non-impulsive noise sources. For further detail about classification of underwater sounds, please see Section B.5 in Appendix B. Impulsive noise sources considered in this assessment include impact pile driving and some HRG equipment. Non-impulsive noise sources include vibratory pile driving, vessel traffic, some HRG equipment, turbine operations, and dredging.

Table 3.5.6-7. PTS and TTS Thresholds for Marine Mammals

Hearing Group	Effect	Impulsive Source		Non-Impulsive Source
		L_{pk} (dB re 1 µPa)	SEL_{24h}[1] (dB re 1 µPa^{2}s)	SEL_{24h}[1] (dB re 1 µPa^{2}s)
LFC	PTS	219	183	199
	TTS	213	168	179
MFC	PTS	230	185	198
	TTS	224	170	178
HFC	PTS	202	155	173
	TTS	196	140	153
Phocid pinnipeds	PTS	218	185	201
	TTS	212	170	181

Source: NMFS 2018a.
[1]SEL thresholds are frequency-weighted.

Noise Impacts under Alternative A – No Action

Vessel traffic, seismic surveys, and active naval sonars are the main anthropogenic contributors to low- and mid-frequency noises in oceanic waters (NMFS 2018b), with vessel traffic the dominant contributor to ambient sound levels in frequencies below 200 hertz (Hz) (Arveson and Vendittis 2000; Veirs et al. 2016). In the marine mammal geographic analysis area, underwater noise from anthropogenic sources includes offshore marine construction activities (including pile driving), vessel traffic, seismic surveys, and sonar and other military training activities. The long-term effects of multiple anthropogenic underwater noise stressors on marine mammals across their large geographical range are difficult to determine and relatively unknown. The potential for these stressors to have population-level consequences likely varies by species, among individuals, across situational contexts, and by geographic and temporal scales (Southall et al. 2021a).

Noise generated from ongoing non-offshore wind activities includes impulsive sources (e.g., seismic surveys, sonar) and non-impulsive sources (e.g., vessels, aircraft, dredging). Impact pile driving, seismic exploration, and sonar surveys can lead to injury-level effects (i.e., PTS) in marine mammals. In addition, high-intensity sonar activities have been linked to stranding events (Balcolmb and Claridge 2001; Cox et al. 2006; D'Amico et al. 2009; Dolman et al. 2010; Fernandez et al. 2005; Jepson et al. 2003; Parsons et al. 2008; Wang and Yang 2006). All noise sources have the potential to cause behavior-level effects, and some may also cause PTS and TTS in certain species. The frequency and number of noise-generating anthropogenic activities in the marine mammal geographic analysis area are relatively unknown. If marine mammal populations are subjected to multiple anthropogenic noise stressors throughout their lifetimes that disrupt critical life stages (e.g., feeding, breeding, calving) and throughout their ranges, then impacts from noise from ongoing non-offshore wind activities could be major, particularly for listed species such as NARW, and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

BOEM previously determined that noise impacts on marine mammals from pile driving for Vineyard Wind 1 would be negligible for MFC, HFC, and pinnipeds. Minor impacts on NARW were determined due to avoidance of peak seasons of occurrence and the incorporation of extensive mitigation specific to the species. Impacts from pile driving were determined to be moderate for all other LFC. Impacts of vessel noise during construction were determined to be moderate for all mysticetes (i.e., LFC) because the lower frequency of sound emitted from vessels overlaps in the most sensitive hearing range of mysticetes. Potential temporary behavioral impacts on all other marine mammals from vessel traffic and temporary impacts on marine mammals from cable-laying noise were determined to be minor. Operation of WTGs was determined to result in negligible impacts on marine mammals (BOEM 2021a). No mortality or non-auditory injury of any marine mammal would occur.

For South Fork, BOEM's analysis determined construction noise exposures associated with impact pile driving would have moderate effects on fin whales, minke whales, humpback whales, and harbor porpoises; minor effects on NARWs, Atlantic spotted dolphins, Atlantic white-sided dolphins, bottlenose dolphins, and common dolphins; and negligible effects on Risso's dolphin, sei whales, sperm whales, and pilot whales. Construction vessel noise impacts on marine mammals were assessed to be minor. Dredging noise effects on marine mammals from O&M facility construction were expected to be negligible, while vibratory and impact pile-driving noise to install moorage improvements at the O&M facility would likely result in minor effects on seals and porpoises (BOEM 2021b).

BOEM reviewed underwater noise levels produced by the available types of HRG survey equipment as part of a programmatic biological assessment for activities associated with regional offshore wind energy development. NMFS concurred with BOEM's determination that planned HRG survey activities using even the loudest available equipment types would be unlikely to injure or measurably affect the behavior of ESA-listed marine mammals. The rationale supporting this conclusion also applies to non-listed marine mammal species. Specifically, the noise levels produced by HRG survey equipment are relatively low, meaning that an individual marine mammal would have to remain close to the sound source for extended periods of time to experience injury. This type of exposure is unlikely as the sound sources are continuously mobile and directional (i.e., pointed at the bottom) (BOEM 2021a).

Port utilization: Vineyard Wind will use port facilities in Connecticut, Massachusetts, Rhode Island, and Canada during construction and O&M, and BOEM found that no changes to port utilization would occur (BOEM 2021a). South Fork will use existing port facilities in New York, Rhode Island, Massachusetts, Connecticut, New Jersey, Maryland, Virginia, or Nova Scotia for offshore construction, staging, fabrication, crew transfer, and logistics support, and BOEM found that although dredging or in-water work could be required for the Port of Montauk, these actions would occur within heavily modified habitats (BOEM 2021b). Impacts from port utilization from ongoing construction and operation of offshore wind projects have been previously analyzed and would be negligible.

Presence of structures: There are more than 130 artificial reefs in the Mid-Atlantic region, 15 of which are offshore New Jersey. Artificial reefs are made of a variety of materials including cars, trucks, subway cars, bridge rubble, barges, boats, and large cables (MAFMC 2023). Artificial reefs may have higher levels of recreational fishing, which increases the chances of marine mammals encountering lost fishing gear, resulting in possible ingestion, entanglement, injury, or death of individuals, if present where artificial reefs are located. Ongoing offshore wind projects will add a total of 81 WTGs and 2 OSSs to the offshore environment. The addition of hard bottom from scour and cable protection and vertical structures such as WTG foundations in a soft-bottom habitat can create artificial reefs, thus inducing the "reef" effect. The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans, providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft bottoms. Increased prey abundance would be localized at foundation and cable protection locations, and a substantial increase in use of offshore wind project areas by foraging marine mammals is not anticipated (NMFS 2021b). Impacts from presence of structures associated with the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible to minor as a result of the potential for increased interaction with active or ghost fishing gear. Minor beneficial impacts on pinniped and odontocete foraging and sheltering may occur as a result of the monopiles and scour protection creating an artificial reef effect (BOEM 2021a, 2012b; Russell et al. 2016). These beneficial effects have the potential to be offset by risk of entanglement in derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species.

Traffic: Studies indicate that maritime activities can have adverse effects on marine mammals due to vessel strikes (Laist et al. 2001; Moore and Clarke 2002). Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world, including large container ships, ferries, cruise ships, military vessels, recreational vessels, commercial fishing boats, whale-watch vessels, research vessels, and even jet-skis (Dolman et al. 2006). In general, large baleen whales are more susceptible to a vessel strike than smaller cetaceans and pinnipeds. While there are rare reports of toothed whales being struck by ships (Van Waerebeek et al. 2007; Wells and Scott 1997), these animals are at relatively low risk due to their speed and agility (Richardson et al. 1995). Pinnipeds are also fast and maneuverable in the water and have sensitive underwater hearing, potentially enabling them to avoid being struck by approaching vessels (Olson et al. 2021).

Research into vessel strikes and marine mammals has focused largely on baleen whales given their higher susceptibility to a strike because of their larger size, slower maneuverability, larger proportion of time spent at the surface foraging, and inability to actively detect vessels using sound (i.e., echolocation). Focused research on vessel strikes on toothed whales is lacking. Factors that affect the probability of a marine mammal vessel strike and its severity include number, species, age, size, speed, health, and behavior of animal(s) (Martin et al. 2016; Vanderlaan and Taggart 2007); number, speed, and size of vessel(s) (Martin et al. 2016; Vanderlaan and Taggart 2007); habitat type characteristics (Gerstein et al. 2006; Vanderlaan and Taggart 2007); operator's ability to avoid collisions (Martin et al. 2016); vessel path (Martin et al. 2016; Vanderlaan and Taggart 2007); and the ability of a marine mammal to detect and locate the sound of an approaching vessel.

North Atlantic cetaceans and pinnipeds, including, but not limited to, fin whale, humpback whale, NARW, sei whale, minke whale, sperm whale, long-finned pilot whale, Risso's dolphin, Atlantic white-sided dolphin, common bottlenose dolphin, harbor porpoise, harbor seal, and gray seal, are all common or regular visitors within the geographic analysis area and could be susceptible to vessel collisions. Most odontocetes (e.g., harbor porpoise) and pinnipeds (e.g., harbor seals) are considered to be at low risk for vessel strikes due to their swimming speed and agility in the water. Although data are limited, events of vessel collisions were recorded by Hayes et al. 2021 for the following species:

- Since 2017, there have been 16 confirmed vessel strikes on NARWs; 14 of those resulted in mortality or serious injury. From 2016–2020, 29 percent of the observed mortality and serious injury cases were attributed to vessel strike (Hayes et al. 2022). Applying this percentage to the estimated mortality/serious injury cases (n= 156), it is estimated that 46 cases of mortality have occurred within the same time period (Hayes et al. 2022). In 2020, 1.3 collisions occurred with U.S. vessels. Two cases of morbidity (a lesser impact than mortality/serious injury) are documented in the NARW UME. Although vessel strikes with NARW may not seriously injure or kill the animal, sustained injuries can be internal and affect reproductive success (Corkeron et al. 2018; van der Hoop et al. 2012).

- For data collected in 2020, the fin whale had an annual average rate of 0.8 collision per year with U.S. vessels. Between 2014 and 2018, there were confirmed fin whale mortalities linked with vessel collisions: two in 2016 and one each in 2017 and 2018.

- Similar to the fin whale, the annual average rate of vessel collisions was 0.8 per year for the sei whale.

- The minke whale had between one and two confirmed cases of whale mortalities linked with vessel traffic in North Atlantic waters each year between 2014 and 2018, with the exception of the year 2016, which had no confirmed deaths. The average rate of vessel collisions is 1.2 per year in U.S. waters.

- Of the 184 whales involved in the 2016–2023 humpback whale UME, 40 percent showed evidence of human interaction (either entanglement or vessel strike). The exact percentage attributable to vessel strike alone is not available; however, recent strandings in the New York/New Jersey area demonstrate that vessel strikes of humpback whales remain a serious threat.

- From 2014 to 2018, 692 bottlenose dolphins of the Northern Migratory Coastal Stock stranded between North Carolina and New York; 11 percent (n = 80) had evidence of human interaction, and of those 5 percent (n = 4) exhibited evidence of vessel strikes; 19 percent (n = 134) showed no evidence of human interaction. For 69 percent (n = 478) of strandings a cause of death could not be determined.
- Hayes et al. 2021 did not report any harbor porpoise strandings exhibiting evidence of vessel strikes for the Gulf of Maine/Bay of Fundy stock.

Vessel speed and size are particularly important factors for determining the probability and severity of vessel strikes as the size and bulk of large vessels inhibit the ability for crew to detect and react to marine mammals along the vessel's transit route. In 93 percent of marine mammal collisions with large vessels reported in Laist et al. (2001), whales were either not seen beforehand or were seen too late to be avoided. Laist et al. 2001 reported that most lethal or severe injuries are caused by ships 262 feet (80 meters) or longer traveling at speeds greater than 13 knots (24 kilometers per hour). A more recent analysis conducted by Conn and Silber (2013) built upon collision data collected by Vanderlaan and Taggart (2007) and Pace and Silber (2005) and included new observations of serious injury to marine mammals as a result of vessel strikes at lower speeds (e.g., 2 and 5.5 knots [3.7 and 10.2 kilometers per hour]). The relationship between lethality and strike speed was still evident; however, the speeds at which 50 percent probability of lethality occurred was approximately 9 knots (17 kilometers per hour). Vanderlaan and Taggart (2007) reported that the probability of whale mortality increased with vessel speed, with greatest increases occurring between 8.6 and 15 knots (15.9 and 27.8 kilometers per hour), and that the probability of death declined by 50 percent at speeds less than 11.8 knots (21.9 kilometers per hour).

As a result of these findings, NMFS implemented a seasonal, mandatory vessel speed rule in certain areas along the U.S. East Coast in 2008 to reduce the risk of vessel collisions with NARW. These Seasonal Management Areas require operators of vessels 65 feet (19.8 meters) or longer to maintain speeds of 10 knots (18.5 kilometers per hour) or less and to avoid Seasonal Management Areas when possible. Vessel strikes were thought to be a leading cause of an Unusual Mortality Event for NARW that began in 2017 (NMFS 2022b). From 2017 to 2022, a total of 34 individuals died. Pace et al. (2021) estimated that between 1990 and 2017, only 36 percent of right whale deaths were detected, suggesting the actual number of deaths could be much higher. Effectiveness of the Seasonal Management Area program was reviewed by NMFS in 2020. Results indicated that while it was not possible to determine a direct causal link, the mortality and serious injury incidents on a per-capita basis suggest a downward trend in recent years (NMFS 2020a). NARW vessel strike mortalities decreased from 10 prior to the implementation of Seasonal Management Areas to 3 after implementation, while serious injuries (defined as a 50-percent probability of leading to mortality) increased from 2 to 4 and injuries increased from 8 to 14 (potentially due to increased monitoring levels). Laist et al. 2014 assessed the effectiveness of Seasonal Management Areas 5 years after their initiation by comparing the number of NARW and humpback whale carcasses attributed to ship strikes since 1990 to proximity to the Seasonal Management Areas. Prior to implementation of Seasonal Management Areas, they found that 87 percent of NARW and 46 percent of humpback whale ship-strike deaths were found either inside Seasonal Management Areas or within 52 miles (83 kilometers), and that no ship-struck carcasses were found within the same proximity during the first 5 years of Seasonal Management Areas.

NMFS also recognized that NARW foraging aggregations take place outside of established Seasonal Management Areas; therefore, temporal voluntary Dynamic Management Areas are established when a group of three or more NARWs are sighted within close proximity. Mariners are encouraged to avoid the Dynamic Management Area or reduce speed to less than 10 knots (18.5 kilometers per hour) when transiting through the area. NMFS establishes a Dynamic Management Area boundary around the whales for 15 days and alerts mariners through radio and local notices. Adhering to reduced speed limits within Dynamic Management Areas is voluntary; though vessel traffic data indicates that vessels generally reduce their speed during active Dynamic Management Area periods, cooperation with the voluntary 10 knot (18.5 kilometers per hour) speed restriction has been modest and not at the same levels as achieved with Seasonal Management Areas (NMFS 2020a).

Smaller vessels have also been involved in marine mammal collisions. Minke whales, humpback whales, fin whales, and NARWs have been killed or fatally wounded by whale-watching vessels around the world (Jensen et al. 2003; Pfleger et al. 2021). Strikes have occurred when whale-watching boats were actively watching whales as well as when they were transiting through an area (Laist et al. 2001; Jensen et al. 2003). Small vessels, other than whale watching vessels, are also potential sources of large whale vessel strikes; however, many go unreported and are a source of cryptic mortality (Pace et al. 2021).

Vessel strikes have been preliminarily determined as a leading cause of death for humpback whales during the current Unusual Mortality Event (NMFS 2023a). Of vessels that carry AIS transponders, two types are thought to be of the highest threat to humpback whales in the New York Bight apex: tug/tow vessels, due to their ability to traverse shallower waters outside shipping channels where humpbacks are frequently found, and passenger vessels, due to their high rate of speed (Brown et al. 2019).

Vessel traffic in the vicinity of the Offshore Project area from 2017 to 2019 was composed of recreational vessels (34 percent), dry cargo vessels (27 percent), fishing vessels (11 percent), unspecified vessels (9 percent), tankers (6 percent), tug-barge vessels (6 percent), passenger vessels (3 percent), and other vessels (4 percent) (COP Volume II, Appendix II-S; Atlantic Shores 2023a). Vessels more than 262 feet (80 meters) in length are more likely to cause lethal or severe injury to large whales (Laist et al. 2001).

As previously noted, large whales are more susceptible to vessel strikes than other marine mammals due to their large size, slower travel and maneuvering speeds, lower avoidance capability, and increased proportion of time they spend near the surface (Laist et al. 2001; Vanderlaan and Taggart 2007). In the marine mammal geographic analysis area, whales at risk of collision include NARW, humpback whale, blue whale, fin whale, sei whale, sperm whale, and, to a lesser extent, minke whale due to its smaller size (Hayes et al. 2020, 2021). Although the duration of increased vessel traffic for ongoing non-offshore wind activities is long term, the frequency of an individual vessel in any one location throughout the geographic analysis area is short term and localized. Because vessel strikes can result in severe injury to and mortality of individual marine mammals, their intensity can be medium for non-listed species or severe for listed species.

The impacts of traffic (i.e., vessel strikes) on marine mammals, with the exception of NARW, from ongoing activities (i.e., from any vessel) would be moderate because traffic is likely to result in long-term consequences to individuals or populations that are detectable and measurable. Impacts of traffic on individual mysticetes, other than NARW, could have population-level effects, but the population should sufficiently recover. BOEM notes that not all populations (e.g., minke whales, fin whales) are experiencing population-level consequences from vessel strikes; however, vessel strikes are a threat for all whales. The impacts of traffic on NARW from ongoing activities would be major and long term because vessel strikes have had and continue to have population-level effects that compromise the viability of the species. The impacts of traffic on odontocetes and pinnipeds from ongoing activities would be minor to moderate because population-level effects are unlikely although consequences to individuals would be detectable and measurable.

The likelihood of an offshore wind vessel striking a marine mammal is negligible. BOEM concluded that vessel strikes were unlikely to occur from ongoing offshore wind projects because of the relatively low number of vessel trips and monitoring and mitigation activities to avoid vessel strikes (BOEM 2021a, 2021b). Therefore, ongoing offshore wind activities are anticipated to have no effect on marine mammals via the vessel traffic IPF, as vessel strikes from this industry are not likely to occur.

Impacts of Alternative A – No Action on ESA-Listed Marine Mammals

As noted in Section 3.5.6.1, two ESA-listed marine mammal species are expected to occur regularly in the Offshore Project area: fin whale and NARW. Two additional species, sei whale and sperm whale, may experience acoustic impacts associated with the Proposed Action. General impacts of the No Action Alternative on marine mammals were described in the previous subsection. This subsection addresses specific impacts of the No Action Alternative on ESA-listed species for those impacts with species-specific information (i.e., vessel noise, presence of structures, and vessel traffic).

Noise: Noise effects associated with aircraft, G&G surveys, WTGs, pile driving, and cable laying are not expected to differ between ESA-listed marine mammals and other marine mammal species. Impacts associated with vessel noise could be greater for fin whales and NARWs compared to some other marine mammal species.

The low frequencies produced by vessel noise and the relatively large propagation distances and associated sound at these frequencies put LFC, including fin whales and NARWs, at the greatest risk of impacts associated with vessel noise compared to other marine mammal species. Stress responses to vessel noise may be of particular significance to the critically endangered NARW. In this species, vessel noise is known to increase stress hormone levels, which may contribute to suppressed immunity and reduced reproductive rates and fecundity (Hatch et al. 2012; Rolland et al. 2012). Auditory masking may also be a significant issue for this species as modeling results indicate that vessel noise has the potential to substantially reduce communication distances for NARWs (Hatch et al. 2012). Though fin whales would also be vulnerable to masking due to vessel noise, their larger population size reduces the risk of population-level effects of masking.

Presence of structures: Many effects associated with the presence of structures, including hydrodynamic changes, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption are not expected to differ between ESA-listed mammals and other marine mammal species. Impacts associated with increased entanglement risk could be greater for fin whales and NARWs compared to other marine mammal species.

The presence of structures may result in an increase in recreational fishing activity or displacement of commercial fishing activity, which may lead to a shift in gear types. An increase in fishing activity or an overall shift to fixed gear types would increase the risk of marine mammal entanglement. Entanglement is a significant threat for NARW. As noted in Section 3.5.6.1, NARW has been experiencing an unusual mortality event since 2017 attributed to vessel strikes and entanglement in fisheries gear; more than 80 percent of NARWs show evidence of past entanglements, and almost 60 percent show evidence of multiple entanglements (Johnson et al. 2005; Knowlton et al. 2012), and entanglement in fishing gear is a leading cause of death for this species and may be limiting population recovery (Knowlton et al. 2012). Additionally, recent literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace 2021). Therefore, the increased risk of entanglement associated with the presence of structures could have demographic consequences for this species. Fin whales are considered to be at lower risk of entanglement compared to other baleen whales due to their more offshore distribution (i.e., farther from fishing activities that utilize vertical lines) and large size (Ramp et al. 2021 citing NMFS 2010). However, vessel-based and aerial photography indicate that entanglement rates in fin whales may be underestimated based on their surfacing behavior (Ramp et al. 2021).

Traffic: Vessel strikes are a significant concern for mysticetes, including fin whales and NARWs. NARWs are particularly vulnerable to vessel strikes due to their slow swim speeds and the relatively high amount of time they spend at or near the surface, and vessel strikes are a primary cause of death for this species (Kite-Powell et al. 2007). As noted in Section 3.5.6.1, NARW has been experiencing an unusual mortality event since 2017 attributed to vessel strikes and entanglement in fisheries gear (NMFS 2021g). NARWs are at highest risk for vessel strike when vessels travel in excess of 10 knots (18.5 kilometers per hour) (Vanderlaan and Taggart 2007). Average vessel speeds in the geographic analysis area may exceed 10 knots (18.5 kilometers per hour), indicating that vessel traffic associated with the No Action Alternative may pose a collision risk for NARW. Vessel strikes may be particularly significant for this species given their relatively high risk and their low population numbers. Fin whales are likely less vulnerable to vessel strike than NARW given their higher swim speeds

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; and onshore development activities (see Section D.2 in Appendix D for a description of planned activities). BOEM expects planned activities other than offshore wind to affect marine mammals through several primary IPFs, including accidental releases, electric and magnetic fields and cable heat, cable emplacement and maintenance, port utilization, noise, and the presence of structures.

The sections below summarize the potential impacts of other planned offshore wind activities on marine mammals during construction, O&M, and decommissioning of the Projects. Other planned offshore wind activities in the geographic analysis area for marine mammals include the construction, O&M, and decommissioning of 32 planned offshore wind projects, which would result in an additional 2,893 WTGs and 37 OSSs/ESPs in the geographic analysis area.

BOEM expects planned offshore wind activities to affect marine mammals through the following primary IPFs.

Accidental releases: Offshore wind activities may increase accidental releases of fuels, fluids, and hazardous materials and trash and debris due to increased vessel traffic and installation of WTGs and other offshore structures. The risk of accidental releases is expected to be highest during construction, but accidental releases could also occur during operation and decommissioning.

Ongoing and planned offshore wind activities are expected to gradually increase vessel traffic over the next 35 years, increasing the risk of accidental releases of fuels, fluids, and hazardous materials. There would also be a low risk of fuel, fluid, and hazardous materials leaks from any of the 2,974 WTGs (81 for ongoing activities and 2,893 for planned activities) (Appendix D, Table D.A2-1) anticipated in the geographic analysis area. The total volume of WTG fuels, fluids, and hazardous materials in the geographic analysis area is estimated at 22.4 million gallons (84.9 million liters) (Appendix D, Table D.A2-3). OSSs and ESPs are expected to hold an additional 10.5 million gallons (39.6 million liters) of fuels, fluids, and hazardous materials (Appendix D, Table D.A2-3). BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons (484,533 liters) is likely to occur no more frequently than once every 1,000 years and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). Marine mammal exposure to releases through aquatic contact or inhalation of fumes can result in death or sublethal effects, including but not limited to adrenal effects, hematological effects, hepatological effects, poor body condition, and dermal effects (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). In addition to direct effects on marine mammals, accidental releases of fuels, fluids, and hazardous materials can indirectly affect these species through impacts on prey species (see Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*). Given the volumes of fuels, fluids, and hazardous materials potentially involved and the likelihood of release occurrence, the long-term increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

Increased vessel traffic would also increase the risk of accidental releases of trash and debris during construction, operation, and decommissioning of offshore wind facilities. About half of all marine mammal species worldwide have been documented to ingest trash and debris (Werner et al. 2016), which can result in death. Based on stranding data, mortality rates associated with debris ingestion range from 0 to 22 percent. Ingestion may also result in sublethal effects, including digestive track blockage, disease, injury, and malnutrition (Baulch and Perry 2014). Linkages between impacts on individual marine mammals associated with debris ingestion and population-level effects are difficult to establish (Browne et al. 2015). BOEM assumes that all vessels will comply with laws and regulations to minimize trash releases and expects that such releases would be small and infrequent. The amount of trash and debris accidentally released long term during planned offshore wind activities would likely be negligible compared to other ongoing trash releases.

Discharges related to cooling offshore wind conversion stations are possible for other offshore wind projects. Potential effects resulting from discharge use include altered micro-climates of warm water surrounding outfalls and altered hydrodynamics around discharges. The number of OSSs per project is likely small; therefore, these impacts, though long term, would be low in intensity and localized.

Cable emplacement and maintenance: Ongoing and planned offshore wind activities will involve the placement and maintenance of export and interarray cables. Cable emplacement and maintenance activities disturb bottom sediment, resulting in temporary increases in suspended sediment concentrations. Cable emplacement associated with offshore wind activities is expected to disturb more than 108,238 acres (43,802 hectares) of seabed (Appendix D, Table D.A2-2) between 2023 and 2030. This acreage could be reduced if open access offshore transmission systems are built, as have been proposed. However, such projects are not considered reasonably foreseeable at this time.

Effects of cable emplacement and maintenance would be similar in nature to those observed during construction of BIWF (Elliot et al. 2017). While suspended sediment impacts would vary in extent and intensity depending on project- and site-specific conditions, measurable impacts are likely to be on the order of 500 mg/L or lower, short term lasting for minutes to hours, and limited in extent to within a few feet vertically and a few hundred feet horizontally from the point of disturbance. Areas subject to increased suspended sediment from simultaneous activities would be limited.

There are no data on physiological effects of suspended sediment on marine mammals or marine mammal avoidance of sediment plumes. Some marine mammal species live in high-turbidity waters or employ foraging techniques that generate sediment plumes, suggesting that some species may tolerate increased suspended sediment concentrations (Todd et al. 2015). There is also evidence that some pinniped species may not rely exclusively on visual cues to forage (McConnell et al. 1999). Elevated suspended sediment concentrations may cause marine mammals to alter their normal movements and behaviors to avoid the area of elevated suspended sediment. Such alterations are expected to be temporary and would be too small to be meaningfully measured or detected (NMFS 2020b). Suspended sediment is most likely to affect these species if the area of elevated concentrations acts as a barrier to normal behaviors. However, no adverse effects are anticipated due to marine mammals swimming through the area of elevated suspended sediment or avoiding the area (NMFS 2020b).

In addition to direct effects on marine mammal behavior, suspended sediment can indirectly affect these species through short-term impacts on prey species. Elevated suspended sediment concentrations are shown to have adverse effects on benthic communities when they exceed 390 mg/L (NMFS 2020b citing USEPA 1986). See Section 3.5.5 for a discussion of impacts on prey species. No individual fitness or population-level impacts would be expected to occur.

Electric and magnetic fields and cable heat: Ongoing and planned offshore wind activities would install up to 13,064 miles (21,024 kilometers) of export and interarray cables (Appendix D, Table D.A2-1), increasing the production of EMF in the geographic analysis area. Transmission cables using HVAC emit 10 times less magnetic field than HVDC (Taormina et al. 2018); therefore, HVAC cables are likely to have less EMF impacts on marine mammals. This Draft EIS anticipates that the proposed offshore energy projects would use HVAC transmission, but HVDC designs are possible and could occur. EMF effects associated with ongoing and planned offshore wind activities would be reduced by cable burial to an appropriate depth and the use of shielding, if necessary. Cables are also expected to be separated by a minimum distance of 330 feet (100 meters), avoiding additive EMF effects from adjacent cables. Marine mammals are capable of detecting magnetic field gradients of 0.1 percent of the Earth's magnetic field (i.e., approximately 0.05 microtesla [µT]) (Kirschvink 1990). This magnetic sensitivity has been documented in fin whale, humpback whale, sperm whale, bottlenose dolphin, common dolphin, long-finned pilot whale, Atlantic white-sided dolphin, striped dolphin, Atlantic spotted dolphin, Risso's dolphin, and harbor porpoise (Tricas and Gill 2011). However, evidence used to make the determinations was only observed behaviorally or physiologically for bottlenose dolphin; the remaining species were concluded based on theory or anatomical details. Assuming a sensitivity threshold of 50 milligauss (mG) (5 µT), it is theoretically possible that marine mammals could detect EMF from export and interarray cables (NMFS 2021f). However, to be exposed to EMF above this 50 mG detection threshold, an individual would have to be within 3 feet (0.9 meter) of a cable that is lying on the surface of the sediment. Marine mammal species that are more likely to forage near benthic habitats, such as certain delphinids, have more potential to experience EMF above baseline levels (Tricas and Gill 2011). Recent reviews by Bilinski (2021) of the effects of EMF on marine organisms concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects.

Due to the limited distance of EMF effects from the cable, any impacts on marine mammals would likely be insignificant and limited to only minor and short-term deviations from normal activity (NMFS 2021f).

Heat from offshore wind cables would not impact marine mammals. Above-sediment cables are cooled by the water, while the extent of heat from buried cables is limited to sediments (Taormina et al. 2018).

Gear utilization: Ongoing and planned offshore wind activities are likely to include monitoring surveys in the offshore wind lease areas. These could include acoustic, trawl, and trap surveys, as well as other methods of sampling the biota in the area. The presence of monitoring gear could affect marine mammals by entrapment or entanglement; however, it is expected that monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts.

Impacts from gear utilization from other offshore wind activities on mysticetes, odontocetes, and pinnipeds are likely to be negligible and are expected to occur at short-term, regular intervals over the lifetime of the projects and to have no perceptible consequences to individuals or the population. However, the potential extent and number of animals potentially exposed cannot be determined without project-specific information.

Noise: As described in Section 3.5.6.1, cetaceans (i.e., mysticetes and odontocetes) rely heavily on sound for essential biological functions, including communication, mating, foraging, predator avoidance, and navigation (Madsen et al. 2006; Weilgart 2007). Anthropogenic underwater noise would be generated by aircraft, G&G surveys, offshore WTGs, pile driving, cable laying, dredging, and vessels associated with planned offshore wind activities. Physical descriptions of sounds associated with these sources can be found in Section B.5 of Appendix B. Anthropogenic underwater noise may have adverse impacts on marine mammals if the sound frequencies produced by the noise sources overlap with marine mammals' hearing ranges (NSF and USGS 2011). If such overlap occurs, underwater noise can result in behavioral or physiological effects, as described under *Impacts of Alternative A – No Action*, potentially interfering with essential biological functions (Southall et al. 2007). This section focuses on potential impacts on marine mammals associated with planned offshore wind activities, and each noise source is addressed separately.

Noise: Aircraft. Helicopters and fixed wing aircraft may be used to transport crew during construction or operation of offshore wind facilities. Further information about the physical qualities of aircraft noise can be found in Section B.5 of Appendix B. When aircraft travel at relatively low altitude, non-impulsive aircraft noise has the potential to elicit short-term behavioral responses by marine mammals, including altered dive patterns, percussive behaviors (i.e., breaching or tail slapping), and disturbance at haul-out sites (Efroymson et al. 2000; Patenaude et al. 2002; Richter et al. 2006; Smultea et al. 2008). Responses appear to be heavily dependent on the behavioral state of the animal, with the strongest reactions seen in resting individuals (Würsig et al. 1998). In general, marine mammal behavioral responses to aircraft most commonly occur at lateral distances of less than 1,000 feet (305 meters) and altitudes of less than 492 feet (150 meters) (Patenaude et al. 2002). Helicopters transiting to offshore wind facilities are expected to fly at sufficient altitudes to avoid behavioral effects on marine mammals, with the exception of WTG inspections, take-off, and landing. Approach regulations for NARWs (50 CFR 222.32) prohibit approaches within 1,500 feet (457 meters). BOEM would require all aircraft operations for planned offshore wind activities to comply with current approach regulations for any NARW or unidentified large whale. Additionally, based on the physics of sound propagation across different media (e.g., air and water), an animal must be almost directly below an aircraft (within a 13° cone; see Section B.5 in Appendix B for details) to hear the sound from the aircraft. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leaves the area, and are not expected to be biologically significant.

Noise: G&G Surveys. G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities to evaluate the feasibility of turbine installation and to identify potential hazards. Site assessment and characterization activities are expected to occur intermittently over a 2- to 10- year period at locations spread throughout lease areas within the New

York Bight. Although schedules for many planned offshore wind activities are still being developed, it would be possible to avoid overlapping noise impacts on marine mammals by scheduling site assessment and characterization activities to avoid conducting simultaneous G&G surveys in proximity to each other.

Detailed information about the physical qualities of G&G surveys can be found in Section B.5 of Appendix B. Certain active acoustic sources used in these surveys (e.g., boomers, sparkers, and bubble guns) can generate impulsive noise that has the potential to disturb marine mammals if they are in proximity to some G&G survey activities. Recently, BOEM and USGS characterized underwater sounds produced by HRG sources and their potential to affect marine mammals (Ruppel et al. 2022). Although some geophysical sources can be detected by marine mammals, given several key physical characteristics of the sound sources, including source level, frequency range, duty cycle, and beamwidth, most HRG sources, even without mitigation, are unlikely to result in substantial behavioral disturbances of marine mammals (Ruppel et al. 2022). This finding is supported by multiple empirical studies. Kates Varghese et al. (2020) found no change in three of four beaked whale foraging behavior metrics (i.e., number of foraging clicks, foraging event duration, click rate) during two deep-water mapping surveys using a 12 kilohertz (kHz) multibeam echosounder. There was an increase in the number of foraging events during one of the mapping surveys, but this trend continued after the survey ended, suggesting that the change was more likely in response to another factor, such as the prey field of the beaked whales, than to the mapping survey. During both multibeam mapping surveys, foraging continued in the survey area and the animals did not leave the area (Kates Varghese et al. 2020, 2021). Vires (2011) found no change in Blainville's beaked whale click durations before, during, and after a scientific survey with a 38 kHz EK-60 echosounder, though Cholewiak et al. (2017) found a decrease in beaked whale echolocation click detections during use of an EK-60. Quick et al. (2017) found that short-finned pilot whales did not change foraging behavior but did increase their heading variance during use of an EK-60. For some of the higher-amplitude sources such as bubble guns, some boomers, and the highest-power sparkers, behavioral disturbance is possible, but unlikely if mitigation measures such as clearance zones and shutdowns are applied. Geotechnical surveys may introduce low-level, intermittent, broadband noise into the marine environment. These sounds could result in acoustic masking in low or mid-frequency cetaceans but are unlikely to result in behavioral disturbance given their low source levels and intermittent use.

BOEM has developed Project Design Criteria and Best Management Practices for offshore wind data collection activities (e.g., G&G surveys) to minimize impacts on protected species (BOEM 2021d) that lessees will be required to follow. BOEM also requires applicants to develop mitigation plans that include measures to protect marine mammals during HRG surveys, such as those outlined in Appendix G, *Mitigation and Monitoring* (e.g., protected species observers, clearance zones, shutdowns), which would further minimize exposure risk. Additionally, NMFS requires mitigation measures that eliminate the risk of exposure to sound levels above relevant regulatory thresholds for injury, thereby eliminating the risk of PTS and minimizing the risk of TTS and behavioral disturbance. Any resulting impacts on individual marine mammals are not expected to result in stock- or population-level effects.

Noise: Operating WTGs. Sound is generated by operating WTGs due to pressure differentials across the airfoils of moving turbine blades and from mechanical noise of bearings and the generator converting kinetic energy to electricity. Sound generated by the airfoils, like aircraft, is produced in the air and enters the water through the air-water interface. Mechanical noise associated with the operating WTG is transmitted into the water as vibration through the foundation and subsea cable. The sound generated by operating WTGs is non-impulsive noise that is audible to marine mammals. It is important to note that just because a sound is audible, that does not mean that it would be disturbing or be at a sufficient level to mask important acoustic cues. There are many natural sources of underwater sound that vary over space and time and would affect an animal's ability to hear turbine operational noise over ambient conditions. Detailed information about the physical qualities of operational noise can be found in Section B.5 of Appendix B.

Offshore WTGs produce continuous underwater noise during operation, mostly in lower-frequency bands (below 8 kHz). There are several recent studies that present sound properties of similar turbines in environments comparable to that of the Proposed Action. Measured underwater sound levels in the literature are limited to geared smaller wind turbines. Broadband SPLs measured 164 feet (50 meters) from a BIWF turbine were 119 dB re 1 µPa with tonal peaks observed at 30, 60, 70, and 120 Hz (Elliott et al. 2019). The BIWF turbines are 6 MW, direct-drive, four-legged jacket-pile structures. At BIWF in winter, a 71 Hz constant tone was measured 328 feet (100 meters) from a turbine. Overall, results from this study indicate that there is a correlation between underwater sound levels and increasing wind speed, but this is not clearly influenced by turbine machinery; rather it may be the natural effects that wind and sea state have on underwater sound (Elliott et al. 2019; Urick 1983).

A compilation of operational noise from several wind farms with turbines up to 6.15 MW in size showed that operational noise generally attenuates rapidly with distance from the turbines (falling below normal ocean ambient noise within 0.6 mile [1 kilometer] from the source) and that the combined noise levels from multiple turbines is lower or comparable to that generated by a small cargo ship (Tougaard et al. 2020). Larger turbines do produce higher levels of operational noise, and the least squares fit of that dataset would predict that an SPL measured 328 feet (100 meters) from a hypothetical 15 MW turbine in operation in 22 mile per hour (10 meter per second) wind would be 125 dB re 1 µPa. However, all of the turbines in the dataset, apart from those at BIWF, were operated with gear boxes of various designs that did not use newer direct-drive technology that is expected to lower noise levels significantly. Stöber and Thomsen (2021) noted that BIWF was expected to be approximately 10 dB quieter than other equivalent sized jacket-pile turbines because of the use of direct drive instead of a gearbox. Based on the Tougaard et al. 2020 dataset, operational noise from jacket piles could be louder than from monopiles due to there being more surface area for the foundation to interact with the water; however, the paper points out that received level differences among different pile types could be confounded by differences in water depth and turbine size. In any case, additional data are needed to fully understand the effects of size, foundation type, and drive type on the amount of sound produced during turbine operation.

For high ambient noise conditions, the distance at which the turbine can be heard above ambient noise was even less. Kraus et al. (2016) measured ambient noise conditions at three locations adjacent to the proposed South Fork Wind Farm over a 3-year period and identified baseline root mean square levels of 102 to 110 dB re 1 µPa.[4] Jansen and de Jong (2014) and Tougaard et al. (2009b) concluded that marine mammals would be able to detect operational noise within a few thousand feet of 2-MW WTGs, but the effects would have no significant impacts on individual survival, population viability, distribution, or behavior.

Very few empirical studies have looked at the effect of operational wind turbine noise on wild marine mammals. Some have shown an increase in acoustic detections of marine mammals during the operational phase of wind farms (e.g., harbor seals: Russell et al. 2016; harbor porpoise: Scheidat et al. 2011), while another study showed a decrease in the abundance of porpoises 1 year after operation began in comparison with the pre-construction period (Tougaard et al. 2005). However, no change in acoustic behavior was detected in the animals that were present (Tougaard et al. 2005). In these field monitoring studies, it is unclear if the behavioral responses result from operational noise, or merely the presence of turbine structures. Regardless, these findings suggest that turbine operational noise did not have any gross adverse effect on the acoustic behavior of the animals.

Lucke et al. (2008) explored the potential for acoustic masking from operational noise by conducting hearing tests on trained harbor porpoises while they were exposed to simulated noise from operational wind turbines (i.e., < 1 kHz) at high and moderate masking levels (up to 128 dB re 1 µPa and 115 dB re 1 µPa, respectively), which were designed based on noise measurements from operational turbines of sizes less than 5 MW. Of the two masking levels, they saw masking effects at a received level of 128 dB re 1 µPa at frequencies of 0.7, 1, and 2 kHz, but found no masking at received levels of 115 dB re 1 µPa. At this higher broadband received level (128 dB re 1 µPa), the noise at 0.7, 1, and 2 kHz was 6.8, 7.3, and 4.8 dB over unmasked conditions, respectively. Based on these results, Lucke et al. (2008) concluded that masking may occur within approximately 66 feet (20 meters) of an operating turbine. This suggests the potential for a reduction in effective communication space within the wind farm environment for marine mammals that communicate primarily in frequency bands below 2,000 Hz. Any such effects would likely be dependent on hearing sensitivity and the ability to adapt to low-intensity changes in the noise environment.

Available data on large direct-drive turbines are sparse. Direct-drive turbine design eliminates the gears of a conventional wind turbine, which increases the speed at which the generator spins. Direct-drive generators are larger generators that produce the same amount of power at slower rotational speeds. Only one study of direct-drive turbines presented in Elliott et al. (2019) is available in the literature. The study recorded root mean square sound pressure levels of 114 to 121 dB re 1 µPa at 164 feet (50 meters) from a 6-MW direct-drive turbine.

Recent modeling conducted by Stöber and Thomsen (2021) and Tougaard et al. (2020) has suggested that operational noise from larger, current-generation WTGs would generate higher source levels (root mean square sound pressure levels of 170 to 177 dB re 1 µPa for a 10-MW WTG) than the range noted

[4] These are 50th and 90th percentile values for monitoring locations RI-1, RI-2, and RI-3, as reported by Kraus et al. (2016).

above from earlier research. However, the models were based on a small sample size, which adds uncertainty to the modeling results. In addition, modeling results were based on measured sound pressure levels from geared turbines. Even though current turbine engines are larger, WTGs with direct-drive technology could reduce sound pressure levels because they eliminate gears and rotate at a slower speed than the conventional geared generators.

Based on the currently available data for turbines smaller than 6.2 MW (Tougaard et al. 2020) and comparisons to acoustic impact thresholds (NMFS 2018a), underwater noise from turbine operations from offshore wind activities (without the Proposed Action) is unlikely to cause PTS or TTS in marine mammals but could cause behavioral and masking effects. It is expected that these effects would be at relatively short distances from the foundations and would reach ambient underwater noise levels within 164 feet (50 meters) of the foundations (Miller and Potty 2017; Tougaard et al. 2009a). However, more acoustic research is warranted to characterize sound pressure levels originating from large direct-drive turbines, the potential for those turbines to cause TTS effects, and distances at which behavioral and masking effects are likely as a result of their operations.

Noise: Impact and vibratory pile driving. Ongoing and planned offshore wind activities would generate impulsive pile-driving noise during foundation installation. Detailed information about the physical qualities of impact pile-driving noise can be found in Section B.5 of Appendix B. Pile driving is expected to occur for up to 9 hours at a time as 2,974 WTGs and 39 OSSs/ESPs and met towers are constructed between 2023 and 2030 (Appendix D, Tables D-3, D.A2-1 and D.A2-2). Construction is expected to occur intermittently over this 7-year period. A limited amount of concurrent pile driving at adjacent projects is anticipated (see the Vineyard Wind 1 Final EIS [BOEM 2021a] for a description of pile-driving scenarios for planned offshore wind activities). According to estimates provided in BOEM (2021a) and based on a maximum-case scenario of concurrent construction of multiple offshore wind projects, over the 7-year period, 343 or 172 concurrent pile-driving days could occur, depending on whether one or two piles are driven per day. Concurrent pile driving involving two or more piles driven during a 24-hour period has the potential to extend the daily duration of exposure or result in a larger impact area. However, non-concurrent pile driving increases the number of days over which pile driving would occur, potentially increasing the number of exposures an individual may experience. Results from Southall et al. (2021a) showed that concurrent construction of multiple windfarms, if scheduled to avoid critical periods when NARWs are present in higher densities, minimizes the overall risk to the species.

Due to ongoing and planned offshore wind activities, individual animals may be exposed to anywhere from a single pile-driving event (i.e., foundation installation over a 24-hour period) to intermittent events over a period of weeks if an individual travels through the larger geographic area where pile driving may be occurring. Based on the migratory movements and seasonal abundances of marine mammals throughout the offshore wind energy areas, it is likely that some individuals would be exposed to multiple days of construction noise within the same year. Given anticipated construction schedules, BOEM expects that marine mammals could be intermittently exposed to pile-driving noise for up to 7 consecutive years, from one or more projects.

The intense, impulsive noise associated with impact pile driving can cause behavioral and physiological effects. Behavioral effects may occur up to tens of kilometers from the center of pile-driving activity. Toothed whales and baleen whales show varying levels of sensitivity to mid-frequency impulsive noise sources (i.e., active sonar, pile driving), with observed responses ranging from displacement (Maybaum 1993) to avoidance behavior (i.e., animals moving rapidly away from the source) (Hatakeyama et al. 1994; Watkins et al. 1993), decreased vocal activity, and disruption in foraging patterns (Goldbogen et al. 2013). Avoidance and displacement are the most commonly reported behavioral responses to pile driving noise (e.g., Dähne et al. 2013; Lindeboom et al. 2011; Russell et al. 2016; Scheidat et al. 2011). These effects have been well-documented for harbor porpoises, a species of high concern in European waters. Given that odontocetes produce echolocation clicks nearly constantly, strategically placed passive acoustic monitoring instruments allow researchers to derive insights about the animals' presence and behavior around wind farms by listening for their clicks. A 2011 study of harbor porpoise acoustic activity in the North Sea at the Horns Rev II wind farm revealed that porpoise acoustic activity was reduced as far as 11.1 miles (17.8 kilometers) from the construction site during pile driving (Brandt et al. 2011). At the closest measured distance of 1.5 miles (2.5 kilometers), acoustic activity completely ceased at the start of pile driving and did not recommence for up to 1 hour after pile driving ended, and remained below average acoustic activity levels for 24–72 hours. Dahne et al. (2013) visually and acoustically monitored harbor porpoises during construction of the Alpha Ventus wind farm in German waters and found a decline in porpoise detections at distances up to 6.7 miles (10.8 kilometers) from pile driving, while an increase in porpoise detections occurred at points 15.5 and 31.1 miles (25 and 50 kilometers) away, suggesting displacement away from the pile-driving activity. During several construction phases of two Scottish windfarms, an 8 to 17 percent decline in porpoise acoustic presence was seen in the 15.5- by 15.5-mile (25- by 25-kilometer) block containing pile-driving activity in comparison to a control block (Benhemma-Le Gall et al. 2021). Displacement within the pile-driving monitored area was seen up to 7.5 miles (12 kilometers) away.

A more recent analysis in the North Sea looked at harbor porpoise density and acoustic occurrence relative to the timing and location of pile-driving activity, as well as the sound levels generated during the development of eight wind farms (Brandt et al. 2016). Using passive acoustic monitoring data pooled across all projects, changes in porpoise detections across space and time were modeled. Compared to the 25- to 48-hour pre-piling baseline period, porpoise detections during construction declined by about 25 percent at sound exposure levels between 145 and 150 dB re 1 $\mu Pa^2 \cdot s$ and 90 percent at sound exposure levels above 170 dB re 1 $\mu Pa^2 \cdot s$. Across the eight projects, a graded decline in porpoise detections was observed at different distances from pile-driving activities. The results revealed a 68 percent decline in detections within 3.1 miles (5 kilometers) of the noise source during construction, a 33 percent decline 3.1 to 6.2 miles (5 to 10 kilometers) away, a 26 percent decline 6.2 to 9.3 miles (10 to 15 kilometers) away, and a decline of less than 20 percent[5] at greater distances, up to the 37-mile (60-kilometer) range modeled. However, within 20 to 31 hours after pile driving, porpoise detections increased in the 0- to 3.1-mile (0- to 5-kilometer) range, suggesting no long-term displacement of the animals. Little to no habituation was found (i.e., over the course of installation,

[5] Brandt et al. (2016) used a 20 percent decline as the threshold to indicate an adverse effect had occurred.

porpoises stayed away from pile-driving activities) (Brandt et al. 2016). It is worth noting that there was substantial inter-project variability in the reactions of porpoises that were not all explained by differences in noise level. The authors hypothesized that the varying qualities of prey available across the sites may have led to a difference in motivation for the animals to remain in an area. Temporal patterns were observed as well: porpoise abundance was significantly reduced in advance of construction up to 6.2 miles (10 kilometers) around the wind farm area, likely due to the increase in vessel traffic activity. This study showed that although harbor porpoises actively avoid pile-driving activities during the construction phase, these short-term effects did not lead to population-level declines over the 5-year study period (Brandt et al. 2016).

In addition to avoidance behavior, studies have observed other behavioral responses in marine mammals. A playback study on two harbor porpoises revealed that high-amplitude sounds, like pile driving, may adversely affect foraging behavior in this species by decreasing catch success rate (Kastelein et al. 2019).

In addition to harbor porpoise, the effects of impact pile driving have been studied on a limited set of additional species. Würsig et al. (2000) studied the response of Indo-Pacific hump-backed dolphins (*Sousa chinensis*) to impact pile driving in the seabed in water depths of approximately 20 to 26 feet (6 to 8 meters). No overt behavioral changes were observed in response to the pile-driving activities, but the animals' speed of travel increased, and some dolphins remained in the vicinity while others temporarily abandoned the area. Once pile-driving ceased, dolphin abundance and behavioral activities returned to pre-pile-driving levels. A study using historical telemetry data collected before and during the construction and operation of a British wind farm showed that harbor seals may temporarily leave an area affected by pile-driving sound beginning at estimated received peak to peak pressure levels between 166 and 178 dB re 1 μPa (Russell et al. 2016). Seal abundance was reduced by 19 to 83 percent during individual piling events (i.e., the installation of a single pile) within 15.5 miles (25 kilometers) of the center of the pile. Displacement lasted no longer than 2 hours after the cessation of pile-driving activities, and the study found no significant displacement during construction as a whole. Interestingly, the study also showed that seal usage in the wind farm area increased during the operational phase of the wind farm, although this may have been due to another factor, as seal density increased outside the wind farm area as well. Monitoring studies in the Dutch North Sea showed that harbor seals may avoid large areas (24.8 miles [39.9 kilometers]) during pile driving and other construction activities. However, seals returned to the area following construction activities, indicating that avoidance was temporary (Lindeboom et al. 2011).

As there are no studies that have directly examined the behavioral responses of baleen whales to pile-driving, studies using other impulsive sound sources (e.g., seismic airguns) serve as the best available proxies. With seismic airguns, the distance at which responses occur depends on many factors, including the volume (and consequent source level) of the airgun, as well as the hearing sensitivity, behavioral state, and life stage of the animal (Southall et al. 2021b). In a 1986 study, researchers observed the responses of feeding gray whales (*Eschrichtius robustus*) to a 100-cubic inch airgun and found that there was a 50 percent probability that the whales would stop feeding and move away from the area when the received sound pressure levels reached 173 dB re 1 μPa (Malme et al. 1986). Other studies have documented baleen whales initiating avoidance behaviors to full-scale seismic surveys at distances as short as 1.9 miles (3 kilometers) away (Johnson 2002; McCauley et al. 1998; Richardson et al. 1986) and as far away as 12.4 miles (20 kilometers) (Richardson et al. 1999). Bowhead whales (*Balaena mysticetus*) have exhibited other behavioral changes, including reduced surface intervals and dive durations, at received sound pressure levels between 125 and 133 dB re 1 µPa (Malme et al. 1989). A more recent study by Dunlop et al. (2017) compared the migratory behavior of humpback whales exposed to a 3,130-cubic inch airgun array with those that were not. There was no gross change in behavior observed, including respiration rates. However, whales exposed to the seismic survey made a slower progression southward along their migratory route compared to the control group. This was largely seen in female-calf groups, suggesting there may be differences in vulnerability to underwater sound based on life stage (Dunlop et al. 2017). The researchers produced a dose-response model, which suggested behavioral change was most likely to occur within 2.5 miles (4 kilometers) of the ship at sound exposure levels over 135 dB re 1 $\mu Pa^2 \cdot s$ (Dunlop et al. 2017).

Potential physiological effects associated with impact pile driving noise include TTS or PTS. Depending on the hearing sensitivity of the species, exceedance of NMFS PTS and TTS thresholds may occur on the scale of several kilometers. PTS could permanently limit an individual’s ability to locate prey, detect predators, navigate, or find mates and could therefore have long-term effects on individual fitness. However, based on the mobility of most marine mammals and an assumed avoidance behavior to aversive stimuli (Schakner and Blumstein 2013), like pile driving, certain marine mammal species (i.e., MFC, HFC, and pinnipeds) are less likely to be exposed to underwater sound for sufficient duration to cause PTS and TTS. In addition, if mitigation measures are applied (e.g., bubble curtains, exclusion zones) all of these effects and exposure ranges can be reduced.

Acoustic masking can occur if the frequencies of the sound source overlap with the frequencies of sound used by marine species. Given that most of the acoustic energy from pile driving is below 1 kHz, LFC and pinnipeds are more likely to experience acoustic masking from pile-driving than MFC or HFC. In addition, low frequency sound can propagate greater distances than higher frequencies, meaning masking may occur over larger distances than masking related to higher frequency noise. There is evidence that some marine mammals can avoid acoustic masking by changing their vocalization rates (e.g., bowhead whale: Blackwell et al. 2013; blue whale: Di Iorio and Clark 2010; humpback whale: Cerchio et al. 2014), increasing call amplitude (e.g., beluga whale [*Delphinapterus leucas*]: Scheifele et al. 2005; killer whale: Holt et al. 2009]), or shifting dominant frequencies (Lesage et al. 1999; Parks et al. 2007). When masking cannot be avoided, increasing noise could affect the ability to locate and communicate with other individuals. However, given that pile-driving occurs intermittently, with some quiet periods between pile strikes, it is unlikely that complete masking would occur.

BOEM anticipates that pile-driving activities would be conducted in accordance with project-specific Incidental Take Regulations and associated LOAs that would include measures to minimize impacts on marine mammals, reducing the risk of TTS or PTS. Most individual marine mammals would be exposed to noise levels resulting in behavioral effects or TTS. PTS could occur in a relatively small number of marine mammals, but PTS is expected to be mild and limited to low-frequency bands. BOEM expects that marine mammals would be displaced for up to 18 hours per day during foundation installation, depending on the type of turbine foundation. Given that impact pile driving for planned offshore wind activities will occur in the open ocean, BOEM anticipates that marine mammals will be able to escape from disturbing levels of underwater noise. Therefore, any disruptions to foraging or other normal behaviors would be short term, and increased energy expenditures associated with this displacement are expected to be small. It is possible that impact pile driving could displace animals into areas with lower habitat quality or higher risk of vessel collision or fisheries interaction.

Multiple construction activities within the same calendar year could potentially affect migration, foraging, calving, and individual fitness. The magnitude of impacts would depend upon the locations, duration, and timing of concurrent construction. Such impacts could be long term, of severe intensity, and of high exposure level. Generally, the more frequently an individual's normal behaviors are disrupted or the longer the duration of the disruption, the greater the potential for biologically significant consequences to individual fitness. The potential for biologically significant effects is expected to increase with the number of impact pile-driving events to which an individual is exposed.

Planned offshore wind activities may also use vibratory pile driving as an alternative to impact pile driving. Vibratory pile driving is a non-impulsive sound source, but because the hammer is on continuously, underwater sound introduced would be in the water column for a longer period of time than with impact pile driving. Detailed information about the physical qualities of vibratory pile-driving noise can be found in Section B.5 of Appendix B. Similar to other activities that generate continuous noise, vibratory pile driving may elicit behavioral or physiological effects in marine mammals, though risk of physiological effects is expected to be lower for vibratory pile driving than impact pile driving.

A study conducted during wind farm construction in Cromarty Firth, Scotland, compared the effect of impact and vibratory pile driving on the vocal presence of both bottlenose dolphins and harbor porpoises in and outside the Cromarty Firth area (Graham et al. 2017). The researchers found a similar level of response of both species to both impact and vibratory piling, likely due to the higher than expected SPL source level for vibratory pile driving (192 dB re 1 µPa m) compared with the single impact SEL source level for impact pile driving (198 dB re 1 μPa^2 s m). There were no statistically significant responses attributable to either type of pile-driving activity in the three metrics considered: daily presence/absence of a species, number of hours in which a species was detected, or duration of daytime (i.e., between 06:00 and 18:00) encounters of a species. The only exception was seen in bottlenose dolphins on days with impact pile driving. The duration of bottlenose dolphin acoustic encounters decreased by an average of approximately 4 minutes at sites within the Cromarty Firth (closest to pile-driving activity) in comparison to areas outside the Cromarty Firth (Graham et al. 2017). The authors hypothesized that the lack of a strong response was because the received levels were very low in this particularly shallow environment, despite similar size piles and hammer energy to other studies. This study underscores the important influence of environmental conditions on the propagation of sound and its subsequent impacts on marine mammals (Graham et al. 2017).

In a playback study, trained bottlenose dolphins were asked to perform a target detection exercise during increasing levels of vibratory pile driver playback sounds (up to 140 dB re 1 µPa) (Branstetter et al. 2018). Three of the five dolphins exhibited either a decrease in their ability to detect targets in the water, or a near complete cessation of echolocation activity, suggesting the animals became distracted from the task by the vibratory pile-driving sound.

BOEM assumes that project-specific Incidental Take Regulations and associated LOAs would include mitigation measures to reduce impacts of vibratory pile driving on marine mammals. Though individual marine mammals may experience behavioral or physiological effects, no stock- or population-level effects are anticipated.

Noise: Drilling. Drilling, which may occur during geotechnical surveys, foundation installation, and HDD at the export cable landfalls, produces low frequency (20 to 1000 Hz), non-impulsive, continuous noise. Most measurements of offshore drilling noise have been taken during oil exploration and production drilling, which is likely to produce higher sound levels than drilling associated with offshore wind activities. Geotechnical drilling SPL source levels have been measured at up to 145 dB re 1 µPa m (Erbe and McPherson 2017). HDD equipment is generally located on shore, and the sound that propagates into the water is negligible (Willis et al. 2010). Based on the low source levels, drilling is unlikely to result in auditory injury, but individual marine mammals may experience sound levels sufficient to cause behavioral effects.

Noise: Cable laying. Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, vertical injection, controlled-flow excavation, and cable protection installation. Cable installation vessels are likely to use dynamic positioning systems while laying the cables. The sound associated with dynamic positioning generally dominates over other sound sources present especially in the situation of cable laying. A description of the physical qualities of these sound sources can be found in Section B.5 of Appendix B.

Modeling based on noise data collecting during cable-laying operations in Europe estimates that underwater noise levels would exceed 120 dB referenced to 1 micropascal in a 99,000-acre (40,000-hectare) area surrounding the source (Nedwell and Howell 2004; Taormina et al. 2018); the affected area associated with cable-laying activities is expected to be smaller than those modeled for other activities, including pile driving and G&G surveys. A majority of marine mammal species are predicted to exhibit behavioral avoidance responses within 98 to 722 feet (30 to 220 meters) of cable-laying operations and within about 2,100 feet (650 meters) of trenching activities, but may habituate to noise produced during cable laying except when closer (Nedwell et al. 2012).

As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the mobile ensonified area, a given location would not be ensonified for more than a few hours. Foraging cetaceans are not expected to interrupt foraging activity when exposed to cable-laying noise but may forage less efficiently due to increased energy spent on vigilance behaviors (NMFS 2015). Decreased foraging efficiency could have short-term metabolic effects resulting in physiological stress, but these effects would dissipate once the prey distribution no longer overlaps the mobile ensonified area. Given the mobile nature of the ensonified area and associated temporary ensonification of a given habitat area, it is unlikely that cable-laying noise would result in adverse effects on marine mammals.

Noise: Dredging. Offshore wind activities include dredging for seabed preparation prior to foundation and export cable installation. Underwater noise levels generated by dredging depend on the type of equipment used. The two most common types of dredge equipment used for offshore wind projects are mechanical (e.g., clamshell or backhoe) and hydraulic (i.e., cutterhead). Detailed information about the physical qualities of dredging noise can be found in Section B.5 of Appendix B.

Dredging is unlikely to exceed marine mammal PTS thresholds, but if dredging occurs in one area for relatively long periods, TTS and behavioral thresholds could be exceeded and masking of marine mammal communications may occur (NMFS 2018b; Todd et al. 2015). Given the low source levels and transitory nature of these sources, exceedance of PTS and TTS levels are not likely for harbor porpoise and seals,[6] according to measurements of trailing suction hopper dredge noise and subsequent modeling by Heinis et al. (2013). Of the few studies that have examined behavioral responses from dredging noise, most have involved other industrial activities, making it difficult to attribute responses specifically to dredging noise. Some found no observable response (beluga whales: Hoffman 2012), while others showed avoidance behavior (bowhead whales in a playback study of drillship and dredge noise: Richardson et al. 1990; bottlenose dolphins in response to real dredging operations: Pirotta et al. 2013). Behavioral reactions and masking of low-frequency calls in baleen whales and seals are considered more likely to occur from dredging noise from either type of dredging due to the low-frequency spectrum over which the sounds occur.

Noise: Vessels. Vessels generate low-frequency (generally 10 to 500 Hz) (MMS 2007), non-impulsive, continuous noise that could affect marine mammals. Detailed information about the physical qualities of vessel noise can be found in Section B.5 of Appendix B. Vessel noise overlaps with the hearing range of marine mammals and may cause behavioral responses, stress responses, and masking (Erbe et al. 2018, 2019; Nowacek et al. 2007; Southall et al. 2007). Based on the low frequencies produced by vessel noise and the relatively large propagation distances associated with low-frequency sound, LFC are at the greatest risk of impacts associated with vessel noise.

A comprehensive review of the literature (Erbe et al. 2019; Richardson et al. 1995) revealed that most of the reported adverse effects of vessel noise and presence are changes in behavior, though the specific behavioral changes vary widely across and within species, and indicated no direct evidence of hearing impairment, either PTS or TTS, occurring in marine mammals as a consequence of exposure to vessel-generated sound. Physical behavioral responses to vessel noise include changes to dive patterns (e.g., longer dives in beluga whales: Finley et al. 1990), disruption to resting behavior (harbor seals: Mikkelsen et al. 2019), increases in swim velocities (belugas: Finley et al. 1990; humpback whales: Sprogis et al. 2020; narwhals: Williams et al. 2022), and changes in respiration patterns (longer inter-breath intervals in bottlenose dolphins: Nowacek et al. 2001; increased breathing synchrony in bottlenose dolphin pods: Hastie et al. 2003; increased respiration rates in humpback whales Sprogis et al. 2020). A playback study of humpback whale mother-calf pairs exposed to varying levels of vessel noise revealed that the mother's respiration rates doubled, and swim speeds increased by 37 percent in the high noise conditions (i.e., LFC-weighted received SPL at 328 feet [100 meters] was 133 dB re 1 μPa) compared to

[6] Heinis et al. (2013) did not evaluate the potential for impacts on other marine mammal species.

control and low-noise conditions (i.e., 104 dB re 1 µPa and 112 dB re 1 µPa, respectively) (Sprogis et al. 2020). Changes to foraging behavior, which can have a direct effect on an animal's fitness, have been observed in porpoises (Wisniewska et al. 2018) and killer whales (Holt et al. 2021) in response to vessel noise. Thus far, one study has demonstrated a potential correlation between low-frequency anthropogenic noise and physiological stress in baleen whales. Rolland et al. (2012) showed that fecal cortisol levels in NARWs decreased following the 9-11 terrorist attacks, when vessel activity was significantly reduced. Interestingly, NARWs do not seem to avoid vessel noise or vessel presence (Nowacek et al. 2004), yet they may incur physiological effects as demonstrated by Rolland et al. (2012). This lack of observable response, despite a physiological response, makes it challenging to assess the biological consequences of exposure. In addition, there is evidence that individuals of the same species may have differing responses if the animal has been previously exposed to the sound versus if it is completely novel interaction (Finley et al. 1990). Reactions may also be correlated with other contextual features, such as the number of vessels present, their proximity, speed, direction or pattern of transit, or vessel type. For a more detailed and comprehensive review of the effects of vessel noise on specific marine mammal groups see Erbe et al. (2019).

Some marine mammals may change their acoustic behaviors in response to vessel noise, either due to a sense of alarm or in an attempt to avoid masking. For example, fin whales (Castellote et al. 2012) and belugas (Lesage et al. 1999) have altered frequency characteristics of their calls in the presence of vessel noise. When vessels are present, bottlenose dolphins have increased the number of whistles (Buckstaff 2004; Guerra et al. 2014), while sperm whales decrease the number of clicks (Azzara et al. 2013), and humpbacks and belugas have been seen to completely stop acoustic activity (Finley et al. 1990; Tsujii et al. 2018,). Some species may change the duration of vocalizations (fin whales shortened their calls: Castellote et al. 2012) or increase call amplitude (killer whales: Holt et al. 2009) to avoid acoustic masking from vessel noise, which may interfere with detection of prey and predators and reduce communication distances. Understanding the scope of acoustic masking is difficult to observe directly, but several studies have modeled the potential decrease in "communication space" when vessels are present (Clark et al. 2009; Erbe et al. 2016; Putland et al. 2017). Modeling results indicate that vessel noise has the potential to substantially reduce communication distances for both odontocetes and mysticetes (Hatch et al. 2012; Jensen et al. 2009), including NARW (see *Impacts of Alternative A – No Action on ESA-Listed Marine Mammals* in this section).

It is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for marine mammals at any given time between 2023 and 2030. This increase in vessel activity could cause repeated, intermittent impacts on marine mammals resulting from short-term, localized behavioral responses, which would dissipate once the vessel or individual leaves the area. The required vessel slow-downs to reduce strike risk are expected to reduce the amount of noise that is emitted into the environment (Joy et al. 2019). In addition, helicopters may be used to transport crew from land to the construction site, which would further reduce noise transmitted into the water. BOEM expects behavioral responses to vessel noise to be infrequent given the patchy distribution of marine mammals in the geographic analysis area, and effects of such responses are not expected to be biologically significant (Navy 2018). Therefore, no stock- or population-level effects would be expected.

Port utilization: Port expansion is likely to accommodate the increased size of vessels and increased volume of vessel traffic associated with planned offshore wind activities. At least two proposed offshore wind projects are considering port expansion, and other ports along the East Coast may be upgraded (see Appendix D, Section D.2.6 for further details on port improvement and expansion projects). However, port expansion associated with planned offshore wind activities is expected to be only a minor component of port expansion activities associated with all planned activities.

Increased port utilization and expansion would result in increased vessel noise, increased risk of vessel interactions, increased suspended sediment concentrations, and benthic disturbance during port expansion activities. Effects of vessel noise on marine mammals associated with port utilization are expected to be limited to short-term responses. See the *Noise* IPF discussion for potential marine mammal responses to vessel noise. The increased risk of vessel interactions is evaluated in the *Traffic* IPF discussion. Impacts on water quality associated with increased suspended sediment would be short term and localized, as previously described for the *Cable emplacement and maintenance* IPF in this section. Impacts on marine mammal prey species due to benthic disturbance would be short term and localized. Additionally, the area affected by benthic disturbance would be small compared to available foraging habitat.

Presence of structures: An estimated 2,974 WTGs and 39 OSSs/ESPs and met towers could be built in the geographic analysis area for ongoing and planned offshore wind activities. Approximately 4,858 acres (1,966 hectares) of hard scour protection would be installed around the WTG foundations, and an additional 2,576 acres (1,042 hectares) of hard protection would be installed on the seafloor to protect export and interarray cables that cannot be buried to the specified depth (Appendix D, Table D.A2-2). Installation of WTGs and OSSs/ESPs and hard protection could result in hydrodynamic changes, entanglement in or ingestion of lost fishing gear that becomes tangled on structures, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption.

The presence of WTGs and OSSs/ESPs could alter local hydrodynamic patterns at a fine scale. Water flows are reduced immediately downstream of foundations but return to ambient levels within a relatively short distance (Miles et al. 2017). The downstream area affected by reduced flows is dependent on pile diameter. For monopiles (i.e., the structures with the largest diameter), effects are expected to dissipate within 300 to 400 feet (90 to 120 meters). Individual foundations may increase vertical mixing and deepen the thermocline, potentially increasing pelagic productivity locally (English et al. 2017; Kellison and Sedberry 1998). A recent modeling study found that offshore wind structures could deepen the thermocline in the WTA by 3.3 to 6.6 feet (1 to 2 meters) and also lead to a greater retention of cooler water in the WTA during the summer (Johnson et al. 2021). Although effects from individual structures are highly localized, the presence of an estimated 2,831 WTG structures could result in regional impacts. Modeling in the North Sea demonstrated that offshore wind farms have the potential to reduce wind speed at the water surface and in turn influence temperature and salinity distribution in the wind farm area (Christiansen et al. 2022). In comparison to long-term variation in temperature and salinity, wind farm effects were relatively small. However, impacts on stratification strength at a large scale and atypical mesoscale variations in current may occur (Christiansen et al. 2022). Golbazi et al. (2022) modeled the effects of 10 MW turbines in WEAs off the eastern coast of the United States and found that wind speed, among other meteorological metrics, would be reduced at the surface. However, these reductions would be negligible (Golbazi et al. 2022). Conversely, infrastructure associated with offshore wind farms may increase mixing, particularly in stratified shelf seas (Carpenter et al. 2016; Dorrell et al. 2022; Schultze et al. 2020). Stratification may influence the mixed layer depth, which in turn affects primary productivity. Increased mixing during summer, when the water column is typically stratified, could increase primary productivity around offshore wind facilities (English et al. 2017; Kellison and Sedberry 1998). Alterations in primary productivity may alter typical distributions of fish and invertebrates on the OCS, which are normally driven by primary productivity associated with cold pool upwelling (Chen et al. 2018; Lentz 2017; Matte and Waldhauer 1984). Alterations to primary productivity could have impacts on prey species for marine mammals. However, increased primary productivity may not lead to increases in prey species, as the increased productivity may be consumed by filter feeders colonizing the structures (Slavik et al. 2019). Project-specific effects would vary between offshore wind projects, recognizing that larger and contiguous projects could have more significant hydrodynamic effects and broader scales. This could in turn lead to more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information.

In-water structures associated with offshore wind activities may serve as artificial reefs, resulting in increased recreational fishing activity in the vicinity of the structures. An increase in recreational fishing activity increases the risk of marine mammals becoming entangled in lost fishing gear, which could result in injury or mortality due to infection, starvation, or drowning (Moore and van der Hoop 2012). Although recreational anglers would be expected to disperse effort across many WTG foundations to avoid overcrowding, risk of entanglement could increase, as anglers and marine mammals may be attracted to the same areas. However, abandoned or lost fishing gear may become tangled with foundations, reducing the chance that abandoned gear would cause additional harm to marine mammals and other wildlife, although debris tangled with WTG foundations may still pose a hazard to marine mammals. These potential long-term, intermittent impacts would be low in intensity and persist until decommissioning is complete and structures are removed.

In-water structures result in the conversion of open-water and soft-bottom habitat to hard-bottom habitat. This habitat conversion attracts and aggregates prey species (i.e., fish and decapod crustaceans) (Causon and Gill 2018; Taormina et al. 2018). The aggregation of prey at artificial reefs could result in increased foraging opportunities for some marine mammal species. Studies of artificial reefs have demonstrated potential increased biomass of larger predator species, including pelagic fish, birds, and marine mammals (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), and attraction of predatory species, including sea birds, sea turtles, and marine mammals, to offshore wind structures (Degraer et al. 2020). Available data indicate that seals and harbor porpoises may be attracted to the structure provided by offshore wind facilities (Russell et al. 2014; Scheidat et al. 2011), indicating that pinnipeds and odontocetes are likely to use habitat created by offshore wind facility structures to forage.

The presence of structures associated with offshore wind facilities could result in avoidance and displacement of marine mammals, which could potentially move them from preferred habitats into areas with lower habitat value or with higher risk of vessel collision or fisheries interactions. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. In contrast, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 years) displacement of harbor porpoise from commercial wind farm areas in Denmark. Displacement effects remain a focus of ongoing study (Kraus et al. 2019).

The presence of structures could also displace commercial or recreational fishing vessels to areas outside of wind energy facilities or potentially lead to a shift in gear types due to displacement. If displacement leads to an overall shift from mobile to fixed gear types, there could be an increased number of vertical lines in the water, increasing the risk of interactions with fishing gear. Fisheries interactions are likely to have demographic effects on some marine mammal species. Entanglement may also be a significant cause of death for several mysticete species (Read et al. 2006), including NARW (see *Impacts of Alternative A – No Action on ESA-Listed Marine Mammals*).

Disruption of normal behaviors could occur due to the presence of offshore structures. Although spacing between the 3,013 WTG and OSS/ESP structures would be sufficient to allow marine mammals to utilize habitat between and around structures, information about large whale responses to offshore wind structures is lacking. Given the uncertainty regarding marine mammal responses to the presence of offshore wind structures, BOEM cannot discount the possibility that the presence of structures could have long-term, intermittent impacts on foraging, migration, and other normal behaviors.

The widespread development of offshore renewable energy facilities may facilitate climate change adaptation for certain marine mammal prey and forage species. Hayes et al. (2021) note that marine mammals are following shifts in the spatial distribution and abundance of their primary prey resources driven by increased water temperatures and other climate-related impacts. These range shifts are primarily oriented northward and toward deeper waters. The artificial reef effect created by offshore wind structures forms biological hotspots that could support species range shifts and expansions and changes in biological community structure resulting from a changing climate (Degraer et al. 2020; Methratta and Dardick 2019; Raoux et al. 2017). There is no example of a large-scale offshore renewable energy project within the geographic analysis area for marine mammals. However, in a smaller-scale project, it is not expected that any reef effect would result in an increase in species preyed on by NARWs, fin whales, or sei whales, and sperm whales are not expected to forage in the shallow waters of the offshore wind lease areas (NMFS 2021b). Although reef effects may aggregate fish species and potentially attract increased predators, they are not anticipated to have any measurable effect on marine mammals. Furthermore, it is not expected that any effects on the distribution, abundance, or use of the offshore wind lease areas by ESA-listed whales would be attributable to the physical presence of the foundations (NMFS 2021). In contrast, broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020). This possible effect is primarily relevant to NARWs, as their planktonic prey (calanoid copepods) are the only listed species' prey in the region whose aggregations are primarily driven by hydrodynamic processes. As aggregations of plankton, which provide a dense food source for NARWs to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities. Potential effects of hydrodynamic changes in prey aggregations are specific to listed species that feed on plankton, whose movement is largely controlled by water flow, as opposed to other listed species that eat fish, cephalopods, crustaceans, and marine vegetation, which are either more stationary on the seafloor or are more able to move independent of typical ocean currents (NMFS 2021). There is considerable uncertainty as to how these broader ecological changes will affect marine mammals in the future, and how those changes will interact with other human-caused impacts. The effect of the increased presence of structures on marine mammals and their habitats is likely to be negative, varying by species, and their significance is unknown.

Traffic: Ongoing and planned offshore wind activities would result in increased vessel traffic due to vessels transiting to and from individual lease areas during construction, operation, and decommissioning. Vessel strikes are a significant concern for marine mammals, particularly mysticetes, which are relatively slow swimmers, and calves, which spend considerably more time at or near the surface compared to older life stages. Vessel strikes are relatively common for cetaceans (Kraus et al. 2005) and are a known or suspected cause of two active unusual mortality events in the geographic analysis area for cetaceans (humpback whale and NARW) (NMFS 2021g). Marine mammals are expected to be most vulnerable to vessel strikes when within the vessel's draft and when not detectable by visual observers (e.g., animal below the surface or poor visibility conditions such as bad weather or low light), and probability of vessel strike increases with increasing vessel speed (Pace and Silber 2005; Vanderlaan and Taggart 2007). Serious injury to cetaceans due to vessel collision rarely occurs when vessels travel below 10 knots (18.5 kilometers per hour) (Laist et al. 2001). Average vessel speeds in the geographic analysis area may exceed 10 knots (18.5 kilometers per hour), indicating that vessel traffic associated with ongoing and planned offshore wind activities may pose a collision risk for marine mammals.

It is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for marine mammals at any given time between 2023 and 2030. Once projects are operational, they would be serviced by crew transfer vessels making routine trips between the wind farms and port-based O&M facilities several times per week. Unplanned maintenance activities would require the periodic use of larger vessels of the same class used for project construction. Unplanned maintenance would occur infrequently, dictated by equipment failures, accidents, or other events. The number and size of crew transfer vessels and number of trips per week required for unplanned maintenance would vary by project based on the number of WTGs. Vessel requirements for unplanned maintenance would also likely vary based on overall project size. Additionally, vessels required to complete monitoring programs at various stages of project development will add to the number of vessel trips undertaken by other projects.

Vessel activity associated with planned offshore wind activities is expected to peak in 2024 when up to 379 vessels could be involved in construction of offshore wind facilities. Vessel collision risk is expected to be highest during construction, when traffic volumes would be greatest; risk of collisions is expected to be highest when vessels are transiting to and from offshore wind lease areas. Within offshore wind lease areas, vessels are expected to be largely stationary and to travel at slow speeds when transiting between locations within the offshore wind lease area. The increase in traffic associated with planned offshore wind activities would only be a small, incremental increase in overall traffic in the geographic analysis area. Therefore, no measurable impacts on marine mammals would be expected. Additionally, BOEM expects minimization measures for vessel impacts would be required for planned offshore wind activities, further reducing the risk of injury or mortality for marine mammals.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, marine mammals would continue to be affected by existing environmental trends and ongoing activities. The No Action Alternative, including ongoing non-offshore wind and offshore wind activities, would result in **negligible** to **major** adverse impacts on marine mammals. Adverse impacts would result mainly from gear utilization, noise, and vessel traffic. Overall, BOEM anticipates that adverse impacts associated with ongoing activities would be **moderate** for pinnipeds, odontocetes, and mysticetes other than NARW, and **major** for NARW (e.g., if vessel strikes were to occur).

Cumulative Impacts of Alternative A – No Action. For the No Action Alternative, BOEM anticipates that ongoing and planned activities would result in continuing short-term to permanent impacts on marine mammals. Considering all IPFs together, ongoing activities, planned activities other than offshore wind, and planned offshore wind activities, would result in **negligible** to **major** adverse impacts on marine mammals and could include **minor beneficial** impacts. Adverse impacts would result mainly from gear utilization, pile-driving noise, vessel noise, presence of structures, and vessel traffic. Beneficial impacts could result from the presence of structures. Habitat conversion and prey aggregation associated with the presence of structures could result in minor beneficial impacts for odontocetes and pinnipeds due to increased foraging opportunities for these marine mammal groups. However, these effects may be offset by increased interactions with fishing gear associated with the presence of structures.

BOEM anticipates that the overall impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would be **moderate** on odontocetes, pinnipeds, and mysticetes other than NARW. **Moderate** to **major** impacts on NARW would be largely due to gear utilization, pile-driving noise, and the presence of structures, and **major** impacts would be from vessel strikes if they were to occur.

3.5.6.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on marine mammals:

- Foundation types used for WTGs and OSSs;

- Hammer energy;
- The number of foundations installed;
- The number of days of pile driving;
- The size of foundations installed;
- Vessels and ports; and
- Mitigation and monitoring measures.

Variability of the proposed Project design exists as outlined in Appendix C. Below is a summary of potential variances in impacts:

- WTG and OSS foundation types: the type(s) of foundation installed affect(s) the impacts associated with installation.
- WTG and OSS foundation number: the number of foundations installed affects the duration of potential pile driving. The more WTG foundations, the greater the number of pile-driving days.
- WTG foundation size: the size of the pile (if a piled foundation is selected) affects the amount of noise produced during pile driving and thus the size of the ensonified area. Generally, a larger pile would result in a larger ensonified area.
- Hammer energy: the hammer energy affects the amount of noise produced during pile driving and thus the size of the ensonified area. The hammer energy also affects the duration of a single pile-driving event. Generally, a larger hammer would result in a larger ensonified area but a shorter event duration.
- Indicative duration of foundation installation: the duration of pile installation affects the number of pile-driving days. The longer the duration, the greater the number of pile-driving days.

Although variation is expected in the design parameters, the impact assessments in Sections 3.5.6.5 through 3.5.6.8 evaluate impacts associated with the maximum-case scenario for marine mammals identified in Appendix C.

3.5.6.5 Impacts of Alternative B – Proposed Action on Marine Mammals

As described in Section 2.1.2, *Alternative B – Proposed Action,* the Proposed Action includes the construction of up to 200 WTGs, 10 OSSs, and 1 permanent met tower and the installation of up to 547 miles (880 kilometers) of interarray cables, 37 miles (60 kilometers) of interlink cables, and 441 miles (710 kilometers) of export cables between 2025 and 2027. The Proposed Action also includes 30 years of O&M over its commercial lifespan and decommissioning activities at the end of commercial life.

Onshore Activities and Facilities

Onshore construction and installation, O&M, and decommissioning activities for the Proposed Action are not expected to contribute to IPFs for marine mammals.

Offshore Activities and Facilities

Accidental releases: The Proposed Action may increase accidental releases of fuels, fluids, and hazardous materials and trash and debris during construction and installation, O&M, and decommissioning activities. However, accidental releases are considered unlikely. All Project vessels would comply with USCG regulations for the prevention and control of oil spills (33 CFR Part 155) (WAT-05; Appendix G, Table G-1), further reducing the likelihood of an accidental release. Atlantic Shores has also developed an OSRP with measures to prevent accidental releases and a protocol to respond to such a release (WAT-03; Appendix G, Table G-1). However, the incremental impacts of the Proposed Action would not increase the risk of accidental releases beyond that described under the No Action Alternative. Potential impacts on marine mammals from exposure to accidental releases are expected to be sublethal due to quick dispersion, evaporation, and emulsification, which would limit the amount and duration of exposure.

Cable emplacement and maintenance: The Proposed Action would involve the placement of 1,025 miles (1,650 kilometers) of export, interlink, and interarray cables. The incremental contribution of the construction and installation of the Proposed Action is an approximate 4.1-square-mile (10.6-square-kilometer) area of seabed disturbance for the emplacement of export cables (including anchoring disturbance) and an approximate 3.4-square-mile (8.7-square-kilometer) area of seabed disturbance for the emplacement of interarray cables (Appendix D, Table D.A2-2). As described in Section 3.5.6.3, *Impacts of Alternative A – No Action on Marine Mammals,* cable emplacement and maintenance activities disturb bottom sediment, temporarily increasing suspended sediment concentrations, which could result in behavioral effects on marine mammals or effects on marine mammal prey species. Cable emplacement is expected to affect only a small percentage of available benthic habitat, and any effects on marine mammals or their prey species would be localized and short term. Recolonization and recovery of benthic species is expected to occur within 2 to 4 years of emplacement (Van Dalfsen and Essink 2001) but could occur in as little as 100 days (Dernie et al. 2003). Given the short-term and localized nature of impacts and the available benthic habitat in the geographic analysis area, impacts of cable emplacement and maintenance on marine mammals are expected to be too small to be measured.

Gear utilization: Monitoring surveys for the Proposed Action include otter trawl surveys, trap surveys, hydraulic clam dredge surveys, grab sampling, and underwater imagery. As described in Section 3.5.6.3, survey gear could affect marine mammals through entanglement or entrapment.

Trawl nets pose a discountable threat to mysticetes (NMFS 2016a), and the slow speed of mobile gear and the short tow times (less than 30 minutes) further reduce the potential for entanglements or other interactions. Fish traps and the anchoring lines and buoys used to secure them may pose an entanglement risk to marine mammals, although these risks would be mitigated because trap surveys would utilize groundlines, ropeless gear, and biodegradable components. Therefore, impacts on marine mammals from traps are expected to be discountable based upon the limited number of associated buoy lines, the short duration of sampling events, and the fact that entanglement in gear would be extremely unlikely to occur. Given the short-term, low-intensity, and localized nature of the impacts of gear utilization for the Proposed Action, as well as the proposed mitigation and minimization measures, it Is likely that effects on marine mammals would be negligible.

Electric and magnetic fields and cable heat: During operation, the Proposed Action would result in the production of EMF, which may be detectable by marine mammals (NMFS 2021f), as described in Section 3.5.6.3. However, to be exposed to EMF above the 50 mG detection threshold for marine mammals, an individual would have to be within 3 feet of a cable that is lying on the surface of the seafloor. Atlantic Shores would bury cables to a minimum depth of 5 to 6.6 feet (1.5 to 2 meters) wherever possible (GEO-07; Appendix G, Table G-1). In areas where sufficient cable burial is not feasible, surface cable protection would be utilized. Cable burial and surface protection, where necessary, would minimize EMF exposure. Currently, no scientific evidence of marine mammal responses to EMF associated with underwater cables exists; however, due to the limited distance of EMF effects from the cable, any impacts on marine mammals would likely be insignificant and limited to only minor and short-term deviations from normal activity (NMFS 2021f).

Heat from Project cables would not impact marine mammals. Above-sediment cables would be cooled by the water, while heat from buried cables would be restricted to sediments (Taormina et al. 2018).

Noise: Underwater anthropogenic noise sources associated with construction and installation, O&M, and decommissioning of the Proposed Action would include G&G surveys, pile driving, cable laying, vessels, noise from operational WTGs, and potentially aircraft and drilling. A detailed description of the noise produced during these activities can be found in Section B.5 of Appendix B. As described in Section 3.5.6.3, these noise sources have the potential to affect marine mammals through behavioral or physiological effects. Underwater sound propagation modeling for impact pile driving was conducted in support of the COP (Volume II, Appendix II-L; Atlantic Shores 2023a). Potential impacts associated with each Project-related noise source are discussed separately in the following paragraphs.

Noise: Aircraft. Aircraft may be used to support construction and installation of the Proposed Action. Helicopters may be used for crew transfer operations or visual inspection of equipment during installation. Atlantic Shores may utilize fixed-wing aircraft to support environmental monitoring and mitigation during construction and installation activities. As described in Section 3.5.6.3, aircraft traveling at relatively low altitude have the potential to elicit short-term behavioral responses in marine mammals. BOEM assumes aircraft transiting to and from the Offshore Project area would fly at sufficient altitudes to avoid behavioral effects on marine mammals, with the exception of WTG inspections, take-off, and landing. Additionally, Project aircraft would comply with current approach regulations for NARWs. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area, and are not expected to be biologically significant.

Noise: Drilling. Though not anticipated, drilling could occur if pile driving encounters refusal. The probability of such an action is considered low. MAI (2011) measured sounds from a jack-up rig in Cook Inlet, Alaska. They found that sounds were generated by the diesel engines, mud pumps, ventilation fans, and generators. Most of the energy for these sources was below 1 kHz. The highest sound pressure levels were estimated to be 137 dB re 1 µPa-1 meter for the 141 to 178 Hz frequency band.

Noise: G&G surveys. HRG surveys may be conducted during construction and installation to support site characterization activities, siting, and engineering design of the WTGs, OSSs, and export cables. As described in Section 3.5.6.3, G&G survey noise could affect marine mammals through auditory injuries, stress, disturbance, and behavioral responses. However, HRG survey equipment produces less-intense noise and operates in smaller areas than other G&G survey equipment (e.g., seismic air guns) and is unlikely to result in injury given that sound levels diminish rapidly with distance from the survey equipment (BOEM 2018). To evaluate noise impacts of HRG surveys, Atlantic Shores assumes HRG survey activities would commence during 2025, and estimates that a maximum of 60 survey days would occur per year over the subsequent 4 years (i.e., from 2025 through 2028). Results of the noise evaluation for HRG survey activity indicate that marine mammals exposed to sound levels exceeding the behavioral threshold over 5 years of surveys range from up to 5 Atlantic spotted dolphins, humpback whales, NARWs, Risso's dolphins, sei whales, and sperm whales to as many as 1,125 bottlenose dolphins from the offshore stock (Table 3.5.6-8).

Table 3.5.6-8. Estimated number of marine mammals exposed to HRG survey noise exceeding the behavioral threshold

Species	Maximum Annual Exposures	Maximum Total Exposures[1]
LFC		
Fin whale	2	10
Humpback whale	1	5
Minke whale	4	20
North Atlantic right whale	1	5
Sei whale	1	5
MFC		
Atlantic spotted dolphin	1	5
Atlantic white-sided dolphin	3	15
Bottlenose dolphin, coastal	113	565
Bottlenose dolphin, offshore	225	1,125
Common dolphin	14	70
Pilot whales	2	10
Risso's dolphin	1	5
Sperm whale	1	5
HFC		
Harbor porpoise	24	120
Pinnipeds		
Gray seal	41	205
Harbor seal	91	455

Source: Table 33; Atlantic Shores 2023b.
[1]Total exposures are summed over 5 years of HRG survey activities.

Atlantic Shores has proposed measures to avoid or minimize impacts of HRG survey noise on marine mammals, including utilization of protected species observers, who would be equipped with night vision devices, to monitor and enforce appropriate monitoring and exclusion zones (MAR-07, MAR-08; Appendix G, Table G-1), and ramp-up and ramp-down procedures (MAR-12; Appendix G, Table G-1). Additionally, any G&G surveys conducted for the Proposed Action would comply with Project-specific Incidental Take Regulations, which would include measures to minimize impacts. Any impacts on individual marine mammals associated with G&G surveys for the Proposed Action would be short term and are not expected to result in stock- or population-level effects.

Noise: Impact and vibratory pile driving. The loudest source of underwater noise associated with the Proposed Action would be impact pile driving during construction and installation. Vibratory pile driving would be conducted in nearshore Project areas for the installation and removal of temporary cofferdams. Pressure amplitudes from vibratory pile driving are lower compared to those of impact pile driving (Tsouvalas and Metrikine 2014). As described in Section 3.5.6.3, pile driving can result in physiological and behavioral effects on marine mammals. As noted above, underwater sound propagation modeling for impact pile driving was conducted in support of the COP (Volume II, Appendix II-L; Atlantic Shores 2023a).

Generally, in order to predict the number of individuals of a given species that may be exposed to harmful levels of sound from a specific activity, a series of modeling exercises are conducted. First, the sound field of a sound-generating activity is modeled based on characteristics of the source and the physical environment. From the sound field, the range to the U.S. regulatory acoustic threshold isopleths, described in Section 3.5.6.3 and in greater detail in Section B.5 of Appendix B, can be predicted. This approach is referred to as acoustic modeling. By overlaying the marine mammal density information for a certain species or population in the geographical area of the activity, the number of animals exposed within the acoustic threshold isopleths is then predicted. This is called exposure modeling. Some models further incorporate animal movement to make more realistic predictions of exposure numbers. Animal movement models may incorporate behavioral parameters including swim speeds, dive depths, course changes, or reactions to certain sound types, among other factors. Exposure modeling may be conducted for a range of scenarios including different seasons, hammer energy, mitigation strategies (e.g., 6 dB versus 10 dB of attenuation), and levels of effort (e.g., number of piles per day).

Modeling for the Project included two different pile-driving scenarios for monopiles: one monopile per day or two monopiles per day. Modeling also included two different types of jacket foundation installation: pre-piled and post-piled.

MMPA regulations define two levels of marine mammal harassment that fall under the term “take” as prohibited by the MMPA:

- Level A: any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild, and

- Level B: any act of pursuit, torment or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (16 U.S.C. 1362).

To estimate radial distances to PTS thresholds (i.e., Level A harassment) for impact pile driving, NMFS (2018) hearing-group-specific, dual-metric thresholds for impulsive noise were used (Table 3.5.6-7). See Section B.5 of Appendix B for a discussion of acoustic thresholds for marine mammals. When expected marine mammal movements in the Offshore Project area are modeled, exposure ranges ($ER_{95\%}$) can be estimated. These ranges represent the radial distance from a pile-driving noise source that encompassed the closest point of approach for 95 percent of simulated animals (animats) exposed above relevant cumulate SEL injury thresholds. For further explanation of $ER_{95\%}$, see COP Volume II, Appendix II-L, Section 2.7 (Atlantic Shores 20232a). Maximum exposure range estimates (i.e., the greatest of the two monopile scenarios or two foundation installations for jacket piles) to PTS thresholds for 49-foot (15-meter) monopiles (i.e., the maximum foundation pile diameter modeled) and 16-foot (5-meter) pin piles (i.e., the maximum strike number modeled), with and without noise mitigation, are presented in Tables 3.5.6-9 and 3.5.6-10.

To estimate radial distances to behavioral thresholds, NMFS' impulsive noise threshold for Level B harassment under the MMPA was used (L_{rms} of 160 dB re 1 µPa). See Section B.5 of Appendix B for a discussion of acoustic thresholds for marine mammals. Monopile exposure ranges to behavioral thresholds are expected to range from up to approximately 3.91 miles (6.29 kilometers) for MFC to up to 4.13 miles (6.65 kilometers) for phocid pinnipeds without mitigation (Table 3.5.6-9). Assuming 10 dB of noise attenuation, exposure ranges to behavioral thresholds are expected to range from up to approximately 2.32 miles (3.74 kilometers) for HFC to up to 2.42 miles (3.90 kilometers) for MFC. Pin pile exposure ranges to behavioral thresholds are expected to range from up to approximately 3.67 miles (5.90 kilometers) for MFC to up to 3.85 miles (6.20 kilometers) for LFC without mitigation (Table 3.5.6-10). Assuming 10 dB of noise attenuation, exposure ranges to behavioral thresholds are expected to range from up to approximately 1.94 miles (3.13 kilometers) for HFC to up to 2.00 miles (3.23 kilometers) for phocid pinnipeds.

Table 3.5.6-9. Marine mammal hearing group maximum[1] $ER_{95\%}$ exposure ranges (kilometers) to injury (Level A) and behavioral (Level B) thresholds for monopiles with and without noise mitigation

Functional Hearing Group	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	Lpk	SEL	Lrms	Lpk	SEL	Lrms
LFC	0.05	3.59	6.41	0.01	1.83	3.77
MFC	0.01	0.02	6.29	0.01	0.00	3.90
HFC	0.63	1.42	6.36	0.20	0.28	3.74
Phocid pinnipeds	0.05	0.84	6.65	0.00	0.02	3.79

Source: Section 6.2.4. Tables 20-21; Atlantic Shores 2022.
[1] The greatest of the exposure range estimates between the 1 pile per day and 2 pile per day scenarios.

Table 3.5.6-10. Marine mammal hearing group maximum[1] $ER_{95\%}$ exposure ranges (kilometers) to injury (Level A) and behavioral (Level B) thresholds for pin piles with and without noise mitigation

Functional Hearing Group	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	Lpk	SEL	Lrms	Lpk	SEL	Lrms
LFC	0.06	4.34	6.20	0.00	1.90	3.18
MFC	0.01	0.21	5.90	0.00	0.01	3.14
HFC	0.43	3.86	5.92	0.13	1.48	3.13
Phocid pinnipeds	0.04	2.09	6.06	0.00	0.32	3.23

Source: Section 6.2.4, Tables 22-23; Atlantic Shores 2022.
[1]The greatest of the exposure range estimates between the pre- and post-piled jacket foundations.

Marine mammal noise exposure was modeled for three construction schedules. Schedule 2, a 2-year construction schedule with monopiles used for the 111 WTG foundations and 1 met tower foundation in Project 1, with one monopile installed per day, and four-legged jacket foundations used for the 89 WTG foundations in Project 2, with four pin piles installed per day, resulted in the highest number of marine mammal exposures. Without mitigation, exposure estimates for numbers of marine mammals exposed to sound levels exceeding injury thresholds range from up to 1 individual of multiple species, including NARW, to as many as 183 minke whales (Table 3.5.6-11). Assuming mitigation resulting in a 10 dB noise attenuation, estimates for numbers of exposed marine mammals range from up to 1 individual of multiple species, including NARW, to approximately 27 minke whales; for the offshore stock of bottlenose dolphin, risk of exposure to sound levels exceeding injury thresholds is eliminated if this level of attenuation is achieved. Estimates for marine mammals exposed to sound levels exceeding behavioral thresholds range from up to 4 sei whales to approximately 11,914 bottlenose dolphins from the offshore stock without mitigation and from up to 3 NARWs and sei whales to as many as 6,518 bottlenose dolphins from the offshore stock assuming 10 dB of attenuation from mitigation measures (Table 3.5.6-11).

Table 3.5.6-11. Estimated number of marine mammals exposed to impact pile-driving noise with and without noise mitigation[1]

Species	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	L_{pk}	SEL	Lrms[2]	L_{pk}	SEL	Lrms[2]
LFC						
Fin whale	1	18	30	0	7	18
Humpback whale	1	20	35	0	6	19
Minke whale	1	183	461	0	27	278
North Atlantic right whale	1	2	5	1	1	3
Sei whale	1	3	4	0	1	3
MFC						
Atlantic spotted dolphin	0	0	0	0	0	0
Atlantic white-sided dolphin	0	1	573	0	1	332
Bottlenose dolphin, coastal	0	0	1,826	0	0	51
Bottlenose dolphin, offshore	3	9	11,914	0	0	6,518
Common dolphin	0	0	0	0	0	0
Pilot whales	0	0	0	0	0	0

Species	0 dB Attenuation			10 dB Attenuation		
	Level A		Level B	Level A		Level B
	L_{pk}	SEL	Lrms[2]	L_{pk}	SEL	Lrms[2]
Risso's dolphin	1	1	20	0	1	12
Sperm whale	0	0	0	0	0	0
HFC						
Harbor porpoise	13	57	154	3	14	90
Pinnipeds						
Gray seal	1	47	393	0	3	193
Harbor seal	4	120	916	0	9	449

Source: Table 26; Atlantic Shores 2023b.

[1] Schedule 2: one 49-foot-diameter (15-meter-diameter) WTG or met tower monopile and four 16-foot-diameter (5-meter-diameter) OSS jacket piles per day in Year 1 and four 16-foot-diameter (5-meter-diameter) WTG jacket piles and four 16-foot-diameter (5-meter-diameter) OSS jacket piles per day in Year 2.

[2] GARFO (2020) threshold.

Given the large radial distances to PTS and behavioral thresholds, noise impacts associated with pile driving for the Proposed Action could occur. Atlantic Shores has proposed measures to avoid or minimize impacts of pile-driving noise on marine mammals, including utilization of protected species observers to monitor and enforce appropriate monitoring and exclusion zones (MAR-07, MAR-08; Appendix G, Table G-1), passive acoustic monitoring and night vision devices (e.g., night vision binoculars, infrared cameras) to detect marine mammals during low-visibility conditions (i.e., nighttime hours or inclement weather) (MAR-08, MAR-09; Appendix G, Table G-1), noise attenuation systems and potential use of soft starts (MAR-12; Appendix G, Table G-1), scheduling pile driving to avoid completion after dark (MAR-11; Appendix G, Table G-1), and seasonal pile-driving restrictions with no pile driving occurring between January and April to minimize risks to NARW (MAR-10; Appendix G, Table G-1). Additionally, Atlantic Shores has committed to investigate the application of acoustic technologies, autonomous underwater vehicles, and unmanned aerial systems to monitor for protected species (MAR-13, MAR-14, and MAR-15; Appendix G, Table G-1).

Vibratory pile driving would be used for installation of temporary offshore cofferdams at the exit point of HDD for each of the export cable landfalls. Non-impulsive noise associated with vibratory pile driving has the potential to result in physiological or behavioral effects in marine mammals. Sound measurements by Illingworth and Rodkin (2017) were used to conduct underwater sound propagation modeling for vibratory pile driving of the temporary cofferdams to support Atlantic Shores' LOA application. To estimate radial distances to PTS and behavioral thresholds for vibratory pile driving of cofferdams, NMFS (2018) hearing-group specific injury thresholds for non-impulsive noise and NMFS non-impulsive, continuous noise threshold for Level B harassment under the MMPA were used (Table 3.5.6-12). Maximum vibratory pile driving ranges (i.e., the greatest of the two landfall sites) to injury thresholds are expected to range from up to approximately 0 feet (0 meters) for MFC to up to 1,919 feet (585 meters) for HFC (Table 3.5.6-13). Marine mammals belonging to any hearing group that approach within up to 8.05 miles (12.96 kilometers) of vibratory pile driving may experience sound levels exceeding the behavioral threshold (Table 3.5.6-13).

Table 3.5.6-12 Marine mammal acoustic thresholds (dB) for continuous noise sources

Hearing Group	PTS Onset SEL (dB re 1 µPa²s)	Behavior Lrms (dB re 1 µPa)
LFC	199	120
MFC	198	120
HFC	173	120
Phocid pinnipeds	201	120

Source: NMFS 2018a.

Table 3.5.6-13 Marine mammal hearing group maximum[1] winter acoustic ranges to injury (PTS onset) and behavioral thresholds for vibratory pile driving of cofferdams

Hearing Group	PTS Onset (m)	Behavior (km)
	SEL	Lrms
LFC	70	12.96
MFC	0	12.96
HFC	585	12.96
Phocid pinnipeds	30	12.96

Source: *Atlantic Shores Offshore Wind Application for Marine Mammal Protection Act (MMPA) Rulemaking and Letter of Authorization*, Appendix D, Table 5; Atlantic Shores 2022.
[1]The greatest of the acoustic range estimates between the two landfall sites

Given the small radial distances to injury thresholds and relatively shallow waters in which vibratory pile driving for cofferdam installation would occur, marine mammals are unlikely to be exposed to noise levels exceeding injury criteria (all exposures estimates were less than 0.01, aside from an estimate of 0.37 for harbor porpoise, which were rounded up to whole animals) (Table 3.5.6-14).

Based on the large radial distances to the behavioral threshold, behavioral effects associated with vibratory pile driving could occur. Animal movement modeling results estimated that marine mammals exposed to sound levels exceeding the behavioral threshold range from up to 1 pilot whale, Risso's dolphin, and sperm whale to as many as 2,443 bottlenose dolphins from the coastal stock (Table 3.5.6-14).

Table 3.5.6-14. Estimated number of marine mammals exposed to vibratory pile driving noise during cofferdam installation

Species	Injury	Behavior
	SEL	Lrms
LFC		
Fin whale	1	5
Humpback whale	1	7
Minke whale	1	21
North Atlantic right whale	1	3
Sei whale	1	2
MFC		
Atlantic spotted dolphin	0	2
Atlantic white-sided dolphin	0	8
Bottlenose dolphin, coastal	0	2,443

Species	Injury	Behavior
	SEL	Lrms
Bottlenose dolphin, offshore	0	308
Common dolphin	0	80
Pilot whales	0	1
Risso's dolphin	0	1
Sperm whale	0	1
HFC		
Harbor porpoise	1	109
Pinnipeds		
Gray seal	1	272
Harbor seal	1	611

Source: Tables 31 and 32; Atlantic Shores 2023b.

Noise: Operational WTGs. As discussed in Section 3.5.6.3, operating WTGs generate non-impulsive, continuous underwater noise that is audible to marine mammals. Detailed information about the physical qualities of operational noise can be found in Section B.5 of Appendix B. Based on the currently available data for turbines smaller than 6.2 MW (Tougaard et al. 2020) and comparisons to acoustic impact thresholds (NMFS 2018a), underwater noise from turbine operations associated with the Proposed Action is unlikely to cause PTS or TTS in marine mammals but could cause behavioral and masking effects. It is expected that these effects would be at relatively short distances from the foundations and would reach ambient underwater noise levels within 164 feet (50 meters) of the foundations (Miller and Potty 2017; Tougaard et al. 2009a).

Noise: Dredging. Dredge equipment used for the Proposed Action may include mechanical dredging (i.e., backhoe) or hydraulic dredging (i.e., trailing suction hopper or cutterhead). Detailed information about the physical qualities of dredging noise can be found in Section B.5 of Appendix B. As described in Section 3.5.6.3, dredging is unlikely to exceed marine mammal PTS thresholds, but if dredging occurs in one area for relatively long periods, TTS and behavioral thresholds could be exceeded and masking of marine mammal communications may occur (NMFS 2018b; Todd et al. 2015). Reported sound levels associated with mechanical dredging include 176 dB re 1 µPa L_{RMS} at 1 meter (BC MoTI 2016) and 107 to 124 dB re 1 µPa at 154 meters from the source with peak frequencies of 162.8 Hz (Dickerson et al. 2001; McQueen et al. 2019). Noise produced by hydraulic cutterhead dredging ranges in frequency from approximately 1 to 2 kilohertz, with reported Lrms source levels of 172 to 190 dB re 1 µPa-m (McQueen et al. 2019; Robinson et al. 2011; Todd et al. 2015). Based on the available source level information, dredging by mechanical or hydraulic dredges is unlikely to exceed marine mammal PTS thresholds. However, if dredging occurs in one area for relatively long periods, exposure to sound levels above the TTS and behavioral thresholds and masking could occur (NMFS 2018b; Todd et al. 2015). As noted in Section 3.5.6.3, behavioral reactions and masking are more likely to occur in mysticetes and pinnipeds due to the low frequency of dredging noise and the low frequencies utilized by these species. Given that dredging sound levels do not exceed the PTS threshold and that dredging for the Proposed Action is not expected to occur for long periods, adverse impacts from dredging noise associated with the Proposed Action on marine mammals are unlikely to occur.

Noise: **Cable laying.** As described in Section 3.5.6.3, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and cable protection installation. The incremental contribution of the Proposed Action to similar activities performed as a result of the construction of other offshore wind projects would include noise-producing activities associated with construction of an additional 1,025 miles (1,650 kilometers) of export, interlink, and interarray cables. The incremental impacts of the Proposed Action are not expected to exceed the noise impacts of cable-laying activities under the No Action Alternative, which are not expected to result in adverse effects on marine mammals associated with cable-laying noise.

Noise: Vessels. As described in Section 3.5.6.3, vessels associated with the Proposed Action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in marine mammals. It is estimated that up to 51 vessels could be utilized during construction and installation of the Proposed Action, though a maximum of 16 vessels are expected to operate at one time for a given construction activity (COP Volume I, Section 4.10.1; Atlantic Shores 20232a). Effects of vessel noise on individual marine mammals are expected to be short term and localized. Effects are expected to be greatest for LFC due to low frequency of vessel noise and the relatively large propagation distances of low-frequency sounds. No stock- or population-level impacts are expected for any marine mammal species.

Presence of structures. The Proposed Action would include construction of up to 200 WTGs, 10 OSSs, 1 permanent met tower, and installation of up to 268 acres (108 hectares) of hard scour protection around the WTG foundations, up to 26 acres (10.5 hectares) of hard scour protection around the OSS foundations, and up to 595 acres (241 hectares) of hard cable protection (294 and 301 acres [119 and 122 hectares] around the export and interarray cables, respectively) (Appendix D, Table D.A2-2; COP Volume I, Table 4.4-2; Atlantic Shores 2023a). As described in Section 3.5.6.3, the installation of WTGs and OSSs and hard protection could result in hydrodynamic changes, entanglement or ingestion of lost fishing gear, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption. The presence of WTGs, OSSs, and the met tower could alter local hydrodynamic patterns at a fine scale, which could have localized impacts on prey distribution and abundance, as described in Section 3.5.6.3. However, these localized impacts may not translate to impacts on prey species for marine mammals.

The presence of structures may have an artificial reef effect, resulting in increased recreational fishing activity in the vicinity of the WTGs, OSSs, and the met tower. An increase in fishing activity would increase risk of entanglement for marine mammals, which could result in injury or death. Atlantic Shores has proposed to remove marine debris caught on Offshore Project structures to reduce the risk of marine mammal entanglement in lost fishing gear (MAR-06; Appendix G, Table G-1). The artificial reef effect could also result in beneficial impacts on odontocetes or pinnipeds due to prey aggregation. The aggregation of prey species would increase foraging opportunities for marine mammals and could lead to measurable, long-term benefits. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species.

The presence of offshore wind facility structures could result in avoidance and displacement of marine mammals, which could potentially move marine mammals into areas with lower habitat value or with higher risk of vessel collision or fisheries interactions. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of wind energy facilities or result in gear shifts. Gear shifts that result in an increased number of vertical lines in the water would increase the risk of marine mammal interactions with fishing gear, which is a significant threat to some mysticete species (see *Impacts of Alternative B – Proposed Action on ESA-Listed Marine Mammals*). Disruption of normal behaviors could occur due to the presence of offshore structures. The presence of structures could have long-term, intermittent impacts on foraging, migration, and other normal behaviors.

Traffic: The Proposed Action would result in increased vessel traffic due to vessels transiting to and from the Project area during construction and installation, O&M, and decommissioning. As described in Section 3.5.6.3, vessel strikes are a significant concern for marine mammals and could result in injury or death. Atlantic Shores expects up to 51 vessels to be used during construction and installation of the Project, though a maximum of 16 vessels are expected to operate at one time for a given construction activity. During O&M, Atlantic Shores generally expects 5 to 11 vessels to operate at a given time, though up to 22 vessels may be required in some repair scenarios. The increase in traffic associated with the Proposed Action would only be a small incremental increase in overall traffic in the geographic analysis area. Atlantic Shores has proposed vessel strike avoidance measures to avoid or minimize impacts associated with vessel traffic (MAR-01; Appendix G, Table G-1), including adherence to NMFS' (2021e) marine wildlife viewing and safe boating guidelines (MAR-02; Appendix G, Table G-1); crew training in marine mammal spotting, identification, reporting protocols, and strike avoidance procedures (MAR-03; Appendix G, Table G-1); vessel speed restriction in NARW Seasonal Management Areas and Dynamic Management Areas (MAR-04; Appendix G, Table G-1); and monitoring marine mammal activity in the Offshore Project area through NOAA Right Whale Slow Zones Program and the NOAA Right Whale Sighting Advisory System (MAR-05; Appendix G, Table G-1). Given the small incremental increase in vessel traffic compared to existing traffic and the measures that would be taken to avoid, minimize, and mitigate vessel traffic impacts, the increased collision risk associated with the incremental increase in vessel traffic due to Project vessels would not be expected to have measurable impacts on marine mammal species.

Impacts of Alternative B – Proposed Action on ESA-Listed Marine Mammals

General impacts of the Proposed Action on marine mammals were described in the previous subsection. This subsection addresses specific impacts of the Proposed Action on ESA-listed species (i.e., fin whale, NARW, sei whale, and sperm whale) for those impacts with species-specific information.

Noise: As noted for the No Action Alternative, noise effects associated with aircraft, G&G surveys, WTGs, and cable laying for the Proposed Action are not expected to differ between ESA-listed marine mammals and other marine mammal species. Impacts associated with pile-driving noise may be reduced compared to other species, and impacts associated with vessel noise could be greater for fin whales, NARWs, and sei whales, all LFCs, compared to some other marine mammal species.

As described for offshore activities and facilities in the construction and installation phase of the Proposed Action, pile driving can result in physiological and behavioral effects on marine mammals, and LFC are expected to have the largest exposure ranges for injury. However, as previously noted, Atlantic Shores has proposed seasonal pile-driving restrictions with no pile driving occurring between January and April to minimize risks to NARW. Given this measure, pile-driving noise impacts on NARW are expected to be minor for NARW compared to moderate impacts for other species.

As described in Section 3.5.6.3, the low frequencies produced by vessel noise and the relatively large propagation distances associated with sound at these frequencies put LFC at the greatest risk of impacts associated with vessel noise. Vessel noise is considered a serious concern for NARW (Moore et al. 2021). Vessel noise is known to increase stress hormone levels in this species, which may contribute to suppressed immunity and reduced reproductive rates and fecundity (Hatch et al. 2012; Rolland et al. 2012). Masking may also be a significant issue for this species as modeling results indicate that vessel noise has the potential to substantially reduce communication distances for NARWs (Hatch et al. 2012).

Presence of structures: As noted for the No Action Alternative, many effects associated with the presence of structures, including hydrodynamic changes, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption are not expected to differ between ESA-listed mammals and other marine mammal species. Impacts associated with increased entanglement risk could be greater for NARWs compared to other marine mammal species.

As described in Section 3.5.6.3, the presence of structures may result in an increase in the risk of marine mammal entanglement due to increased fishing activity or a shift to fixed gear types. Entanglement is a significant threat for NARW (Moore et al. 2021), which has been experiencing an unusual mortality event since 2017 attributed to vessel strikes and entanglement in fisheries gear. A majority of NARWs show evidence of past entanglements (Johnson et al. 2005), and entanglement in fishing gear is a leading cause of death for this species (Knowlton et al. 2012; Moore et al. 2021). Individual NARWs that survive entanglement may suffer energetic costs. A study of isotope and hormone levels in the baleen of a chronically entangled NARW indicated that entanglement leads to increased energy expenditure, presumably from drag, decreased ability to feed, and increased thermal stress, likely related to a decrease in blubber thickness (Lysiak et al. 2018). Such energetic costs may result in decreased body condition, which may have negative effects on reproduction and calf growth rates (Christiansen et al. 2020). In juveniles, entanglement in fishing gear, when not lethal, results in decreased post-entanglement survival (Robbins et al. 2015). Entanglement, both lethal and non-lethal, may be limiting population recovery for NARW (Knowlton et al. 2012; Moore et al. 2021). Therefore, the increased risk of entanglement is more significant for this species. However, the incremental contributions of the Proposed Action to the combined impacts due to the presence of structures associated with ongoing and planned activities would be negligible, and the Proposed Action is not expected to result in stock- or population-level effects for this species.

Traffic: As described in Section 3.5.6.3, vessel strikes are a significant concern for mysticetes, including fin whales, NARWs, and sei whales. NARWs are particularly vulnerable to vessel strikes, and vessel strikes are a primary cause of death for this species (Kite-Powell et al. 2007; Moore et al. 2021). As noted for the presence of structures IPF, NARW has been experiencing an unusual mortality event since 2017 attributed to vessel strikes and entanglement in fisheries gear. Vessel strikes may be particularly significant for this species given their relatively high risk and their low population numbers. However, the incremental contributions of the Proposed Action to the combined impacts due to vessel traffic associated with ongoing and planned activities would be negligible. Given its negligible incremental contribution and Atlantic Shores' proposed vessel strike avoidance measures, the Proposed Action is not expected to result in stock- or population-level effects for this species.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). Installation of a new bulkhead and maintenance dredging, conducted in coordination with Atlantic City's dredging of the adjacent berths, have been proposed in Atlantic City's Inlet Marina, where the Atlantic City O&M facility would be located. Bulkhead installation and dredging may affect marine mammals. These activities in Atlantic City's Inlet Marina would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead and dredging activities are considered to be a connected action under NEPA. Although the connected action has the potential to affect aquatic species, marine mammals are not expected to occur in the area affected by the connected action. Therefore, the connected action would have no impacts on these species.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; and onshore development activities. The connected action would involve installation of a new bulkhead and maintenance dredging at Atlantic City Inlet Marina. Ongoing and planned offshore wind activities in the geographic analysis area for marine mammals include the construction, O&M, and decommissioning of 33 planned offshore wind projects.

Accidental releases: The contribution of the Proposed Action to the cumulative impacts on marine mammals related to exposure to accidental releases from ongoing and planned activities would likely be negligible.

Cable emplacement and maintenance: The incremental impact of the Proposed Action combined with planned offshore wind activities would disturb an estimated 16,659 acres (6,742 hectares) of seafloor from the offshore export cable and 16,906 acres (6,842 hectares) from interarray cable installation activities (Appendix D, Table D.A2-2). The contribution of the Proposed Action to the cumulative cable emplacement impacts from ongoing and planned activities could occur if impacts are in close temporal and spatial proximity. However, these impacts from cable emplacement would be short term and expected to be negligible and not biologically significant.

Electric and magnetic fields and cable heat: The 1,025 miles (1,650 kilometers) of submarine cables associated with the Proposed Action represent 9 percent of the 11,146 miles (17,938 kilometers) of subsea cables anticipated for existing and planned offshore wind farms, including the Proposed Action. The contribution of the Proposed Action to the cumulative EMF and cable heat generated by ongoing and planned activities would be minor given the small area that would be affected by the Project.

Gear utilization: The incremental contributions of the Proposed Action to gear utilization on the OCS associated with ongoing and planned activities would be noticeable.

Noise: The loudest sources of noise associated with the Proposed Action are expected to be pile driving, followed by vessels. The up-to-211 structures for the Proposed Action represent less than 7 percent of the 3,226 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms, including the Proposed Action, although some foundations for the Project and at other planned wind farms may be installed without impact pile driving (Appendix D, Table D.A2-2). Project vessels would only represent a small fraction of the large volume of existing traffic in the geographic analysis area. The contribution of the Proposed Action to the cumulative noise impacts associated with ongoing and planned activities would be negligible given the magnitude of ongoing and planned activities.

Port utilization: As port expansion is not proposed for the Project, the Proposed Action would not contribute to the cumulative impacts of port utilization associated with ongoing and planned activities in the geographic analysis area.

Presence of structures: The up-to-211 structures for the Proposed Action represent less than 7 percent of the 3,226 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D.A2-2). The contribution of the Proposed Action to the cumulative impacts due to the presence of structures associated with ongoing and planned activities would be negligible.

Traffic: The contribution of the Proposed Action to the cumulative impacts of vessel traffic associated with ongoing and planned activities would be negligible given the large volume of existing vessel traffic in the geographic analysis area.

Conclusions

Impacts of Alternative B – Proposed Action. Construction and installation, O&M, and decommissioning of the Proposed Action would result in **negligible** to **moderate** adverse impacts on marine mammals and could include **minor beneficial** impacts for odontocetes and pinnipeds. Adverse impacts would result mainly from pile-driving noise, vessel noise, and presence of structures. Beneficial impacts could result from the presence of structures. Impact determinations for each IPF are provided in the following paragraphs. Overall, the Proposed Action is expected to have **minor** adverse impacts on odontocetes and pinnipeds, which may experience effects at an individual level, but no stock- or population-level impacts are anticipated. The Proposed Action is expected to have **moderate** adverse impacts on mysticetes, as the presence of structures and associated potential for gear entanglement could have population-level consequences for some species. Impact determinations for each IPF are provided in the following paragraphs.

Adverse impacts associated with accidental releases, electric and magnetic fields and cable heat, cable emplacement and maintenance, aircraft noise and G&G survey noise, behavioral disruptions associated with the presence of structures, and potentially WTG noise and behavioral disruptions associated with the presence of structures would be **negligible** for mysticetes, odontocetes, and pinnipeds due to being unlikely to occur and localized, short term, or too small to be measured.

Adverse impacts associated with cable-laying noise, entanglement in or ingestion of fishing gear associated with the presence of structures, avoidance or displacement associated with the presence of structures, vessel traffic, and potentially WTG noise would be **minor** for mysticetes, odontocetes, and pinnipeds due to their localized nature. Adverse impacts associated with vessel noise would be **minor** for odontocetes and pinnipeds. All these impacts are generally expected to be short term, although some may be long term. Adverse effects on individual marine mammals may occur due to these impacts, but no stock- or population-level effects are anticipated.

Adverse impacts associated with pile-driving noise and displacement of marine mammals into higher-risk areas associated with the presence of structures would be **moderate** for mysticetes, odontocetes, and pinnipeds due to their extended duration and large area of effects. Despite potential moderate impacts on individual marine mammals, the number of affected individuals is expected to be small, and no stock- or population-level effects are anticipated. Adverse impacts associated with vessel noise would be **moderate** for mysticetes (i.e., LFC), as the potential for masking in some species could have stock- or population-level effects.

Habitat conversion and prey aggregation associated with the presence of structures could result in **minor beneficial** impacts for odontocetes and pinnipeds due to increased foraging opportunities. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. Finally, these effects would be localized and are not expected to affect individual fitness.

BOEM expects that the connected action alone would have no impacts on marine mammals.

Cumulative Impacts of Alternative B – Proposed Action. The cumulative impacts on marine mammals from ongoing and planned activities, including the Proposed Action and the connected action, would range from **negligible** to **major** adverse and could include **minor beneficial** impacts for small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. Considering all IPFs together, BOEM anticipates that the cumulative impacts would result in **minor** impacts on odontocetes and pinnipeds, **moderate** impacts on mysticetes other than NARW, and **moderate** to **major** impacts on NARW. BOEM made this determination because the anticipated impact would be notable and measurable, but most marine mammals are expected to recover completely when IPF stressors are removed and remedial or mitigating actions are taken. However, impacts on individual NARWs could have severe population-level effects (e.g., vessel strikes if they were to occur). The main drivers for these impact ratings are gear utilization, impact pile-driving noise, vessel noise, the presence of structures, and vessel traffic (i.e., vessel strike). The Proposed Action would contribute to the cumulative impact rating primarily through impact pile-driving noise, vessel noise, and the presence of structures.

3.5.6.6 Impacts of Alternative C on Marine Mammals

Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) would avoid or minimize impacts on two AOCs identified by NMFS within the Lease Area that have pronounced bottom features (e.g., ridges, swales) and produce valuable habitats.

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternative C would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.6.5).

Offshore Activities and Facilities

Offshore activities would not differ between the Proposed Action and Alternative C. However, the location of interarray and export cable routes may differ somewhat. Differences in location would be minor but would avoid one or, in the case of Alternative C4 or the combination of Alternatives C1 and C2, both AOCs. The avoidance or minimization of impacts on these valuable habitat areas would potentially benefit some marine mammal species. Though avoidance or minimization of impacts on these valuable habitats may benefit some marine mammal species, this benefit would not measurably reduce construction and installation impacts on marine mammals.

The number of WTG and OSS facilities may also differ under Alternative C; up to 29 WTGs and 1 OSS may be removed, which may also reduce the length of the interarray cable. A reduction in the number of WTGs and OSSs, and a reduction in the length of interarray cable, would reduce impacts due to cable emplacement and maintenance, EMF, noise, and the presence of structures. However, this reduction would not substantially reduce risk of exposure to these IPFs for marine mammals.

Impacts of Alternative C on ESA-Listed Marine Mammals

Impacts of Alternative C on ESA-listed species of marine mammals (i.e., fin whale, NARW, sei whale, and sperm whale) would generally be similar to those described for construction and installation, O&M, and decommissioning activities associated with the Proposed Action. As none of these species utilize benthic habitats, avoidance of these habitats under Alternative C would not benefit these species. The effect of reducing the number of WTG and OSS structures and length of interarray cable would not differ between ESA-listed marine mammal species and other marine mammal species.

Cumulative Impacts of Alternative C

The contribution of Alternative C to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on marine mammals of ongoing and planned activities in combination with Alternative C would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternative C. Impacts of Alternative C would not be sufficiently reduced from the impacts of the Proposed Action to warrant a lower impact determination. Therefore, construction and installation, O&M, and decommissioning of Alternative C would result in **negligible** to **minor** adverse impacts on odontocetes and pinnipeds and **negligible** to **moderate** adverse impacts on mysticetes due primarily to pile-driving noise, vessel noise (for LFC), and displacement of marine mammals into higher-risk areas associated with the presence of structures and could include **minor beneficial** impacts on odontocetes and pinnipeds due to the presence of structures.

Cumulative Impacts of Alternative C. Cumulative impacts on marine mammals from ongoing and planned activities, including Alternative C, would range from **negligible** to **major** adverse and would also include **minor beneficial** impacts for small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative C, would result in **minor** impacts on odontocetes and pinnipeds, **moderate** impacts on mysticetes other than NARW, and **moderate** to **major** impacts on NARW. BOEM made this determination because the anticipated impact would be detectable and measurable but would not compromise viability of most marine mammal species at a local or range-wide scale. Effects on individual NARWs may have severe population-level effects (e.g., vessel strikes).

3.5.6.7 Impacts of Alternatives D and E on Marine Mammals

Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) would include an alteration in WTG layout and number to minimize visual impacts. Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would include modifications to the WTG layout to minimize impacts on existing ocean uses by creating a 0.81-nautical mile (1,500-meter) to 1.08-nautical mile (2,000-meter) setback between Atlantic Shores South and Ocean Wind 1 (OCS-A 0498).

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternatives D and E would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.6.5).

Offshore Activities and Facilities

Offshore activities would not differ between the Proposed Action and Alternatives D and E. However, the location or number of WTGs would differ under Alternatives D and E. Under Alternative D, up to 31 WTGs may be removed. Under Alternative E, up to 5 WTGs may be removed or microsited. A reduction in the number of WTGs, if they are located at the ends of WTG array columns or rows, may also reduce the length of the interarray cable. A reduction in the number of WTGs, and a potential reduction in the length of interarray cable, would reduce impacts due to cable emplacement and maintenance, EMF, noise, and the presence of structures. However, this reduction would not substantially reduce risk of exposure to these IPFs for marine mammals.

Impacts of Alternatives D and E on ESA-Listed Marine Mammals

Impacts of Alternatives D and E on ESA-listed fin whales, NARWs, sei whales, and sperm whales would not differ from the impacts on other marine mammal species.

Cumulative Impacts of Alternatives D and E

The contribution of Alternatives D and E to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on marine mammals of ongoing and planned activities in combination with Alternatives D and E would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternatives D and E. Impacts of Alternatives D and E would not be sufficiently reduced from the impacts of the Proposed Action to warrant a lower impact determination. Therefore, construction and installation, O&M, and decommissioning of Alternatives D and E would result in **negligible** to **minor** adverse impacts on odontocetes and pinnipeds and **negligible** to **moderate** adverse impacts on mysticetes due primarily to pile-driving noise, vessel noise (for LFC), and displacement of marine mammals into higher-risk areas associated with the presence of structures and could include **minor beneficial** impacts on odontocetes and pinnipeds due to the presence of structures. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species.

Cumulative Impacts of Alternatives D and E. Cumulative impacts on marine mammals from ongoing and planned activities, including Alternative D or E, would range from **negligible** to **major** adverse and would also include **minor beneficial** impacts for small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative D or E, would result in **minor** impacts on odontocetes and pinnipeds, **moderate** impacts on mysticetes other than NARW, and **moderate** to **major** impacts on NARW. BOEM made this determination because the anticipated impact would be notable and measurable but would not compromise viability of most marine mammal species at a local or range-wide scale. Effects on individual NARWs may have severe population-level effects (e.g., vessel strikes).

3.5.6.8 Impacts of Alternative F on Marine Mammals

Under the Proposed Action, a variety of foundation types may be used for the Project. Alternative F (Foundation Structures) allows for an evaluation of impacts associated with specific foundation types. Under Alternative F1, monopiles and piled jacked foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (monopile or piled jacket), up to 5 medium OSSs (piled jacket), or up to 4 large OSSs (piled jacket) for Project 1 and Project 2. Under Alternative F2, mono-bucket, suction bucket jacket, and suction bucket tetrahedron base foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (mono-bucket or suction bucket jacket), up to 5 medium OSSs (suction bucket jacket), or up to 4 large OSSs (suction bucket jacket), for Project 1 and Project 2. Under Alternative F3, gravity-pad tetrahedron and GBS foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs, up to 5 medium OSSs, or up to 4 large OSSs, with GBS for Project 1 and Project 2.

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternative F would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.6.5).

Offshore Activities and Facilities

Though all potential offshore activities under Alternative F were evaluated under the Proposed Action, sub-alternatives of Alternative F may exclude some activities evaluated under the Proposed Action. Activities would not differ between the Proposed Action and Alternative F1. Under Alternatives F2 and F3, no impact pile driving would be conducted. Therefore, there would be no underwater noise impacts on marine mammals due to impact pile driving. The avoidance of impact pile-driving noise impacts would reduce overall impacts on marine mammals under Alternatives F2 and F3 compared to the Proposed Action. Offshore impacts under some sub-alternatives may be reduced due to reductions in habitat conversion associated with some foundation types. Suction bucket foundations, under Alternative F2, would result in the greatest area of habitat conversion due to scour protection, and these impacts were evaluated under the Proposed Action. Alternatives F1 and F3 would result in a reduction in scour protection compared to the Proposed Action and Alternative F2. Such reductions would reduce impacts due to the presence of structures. Less scour protection would result in loss of less soft-bottom habitat. It would also result in a lower artificial reef effect, which may reduce foraging opportunities for some marine mammal species compared to the Proposed Action and Alternative F2 but may also reduce risk of entanglement in lost recreational fishing gear. Given that Alternatives F1 and F3 would result in reductions in both adverse and beneficial impacts, impacts on marine mammals under these alternatives are not expected to be substantially reduced from those anticipated under the Proposed Action.

Impacts of Alternative F on ESA-Listed Marine Mammals

Impacts of Alternative F on fin whales, NARWs, sei whales, and sperm whales would generally be similar to those described for construction and installation, O&M, and decommissioning activities associated with Alternative F. However, impacts on ESA-listed marine mammals associated with reductions in scour protection may differ from some other marine mammal species. Scour protection is not expected to differ from the Proposed Action under Alternative F2 but would be reduced under Alternatives F1 and F3. As these species do not utilize soft-bottom habitats, do not have increased foraging opportunities due to the artificial reef effect, and are at low risk of entanglement in recreational fishing gear, reductions in habitat conversion associated with scour protection under Alternatives F1 and F3 would not affect these species

Cumulative Impacts of Alternative F

The contribution of Alternative F to the cumulative impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on marine mammals of ongoing and planned activities in combination with Alternative F would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternative F. Impacts of Alternative F1 would not be measurably different than the impacts of the Proposed Action. Therefore, construction and installation, operation, and decommissioning of Alternative F1 would result in **negligible** to **minor** adverse impacts on odontocetes and pinnipeds and **negligible** to **moderate** adverse impacts on marine mammals due primarily to pile-driving noise, vessel noise (for LFC), and displacement of marine mammals into higher-risk areas associated with the presence of structures and could include **minor beneficial** impacts to small odontocetes and pinnipeds, due to the presence of structures. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species.

Impacts of Alternatives F2 and F3 would be measurably different from the impacts of the Proposed Action due to the avoidance of impact pile-driving noise impacts, one of the greatest impacts on marine mammals. However, given that **moderate** impacts are still expected due to vessel noise (for LFC) and displacement of marine mammals into higher-risk areas (i.e., areas with greater risk of vessel strike or fisheries interaction) associated with the presence of structures, construction and installation, operation, and decommissioning of Alternatives F2 and F3 would still result in **negligible** to **minor** impacts on odontocetes and pinnipeds and **negligible** to **moderate** adverse impacts on marine mammals primarily due to vessel noise (for LFC) and displacement of marine mammals into higher-risk areas associated with the presence of structures and could include **minor beneficial** impacts on odontocetes and pinnipeds due to the presence of structures. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species.

Cumulative Impacts of Alternative F. Cumulative impacts on marine mammals from ongoing and planned activities, including Alternative F1, F2, or F3, would range from **negligible** to **major** adverse and would also include **minor beneficial** impacts on small odontocetes and pinnipeds. These beneficial effects have the potential to be offset by risk of entanglement from derelict fishing gear and/or reduced feeding potential (prey concentrations) for some marine mammal species. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative F, would result in **minor** impacts on odontocetes and pinnipeds, **moderate** impacts on mysticetes other than NARW, and **moderate** to **major** impacts on NARW. BOEM made this determination because the anticipated impacts would be notable and measurable, but most marine mammals are expected to recover completely when IPF stressors are removed and remedial or mitigating actions are taken. Effects on individual NARWs may have severe population-level effects (e.g., vessel strikes).

3.5.6.9 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and assessed in Table 3.5.6-15 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.5.6-15. Proposed mitigation measures – marine mammals

Measure	Description	Effect
Marine debris awareness training	Vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP must complete marine trash and debris awareness training annually. Atlantic Shores must submit an annual report describing its marine trash and debris awareness training process and certify that the training process was followed for the previous calendar year.	Marine debris and trash awareness training would minimize the risk of marine mammal ingestion of or entanglement in marine debris. While adoption of this measure would decrease risk to marine mammals under the Proposed Action, it would not alter the impact determination of negligible for accidental spills and releases.
Passive Acoustic Monitoring Plan	Atlantic Shores must prepare a Passive Acoustic Monitoring Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of passive acoustic monitoring for mitigation and long-term monitoring.	The development and implementation of a Passive Acoustic Monitoring Plan would minimize the potential for Level A or Level B exposures during impact pile driving. While adoption of this measure would decrease risk to marine mammals during impact pile driving under the Proposed Action, it would not alter the impact determination of minor for impact pile-driving noise.
Pile Driving Monitoring Plan	Atlantic Shores must prepare and submit a Pile Driving Monitoring Plan detailing all plans and procedures for sound attenuation as well as for monitoring ESA-	The development and implementation of a Pile Driving Monitoring Plan would increase the accountability of underwater noise mitigation during pile driving. While adoption of this measure would increase

Measure	Description	Effect
	listed whales during all impact and vibratory pile driving.	accountability during this construction activity under the Proposed Action, it would not alter the impact determination of minor for impact pile-driving noise.
PSO coverage	PSO coverage must be sufficient to reliably detect ESA-listed whales at the surface in clearance and shutdown zones to execute any pile-driving delays or shutdown requirements.	PSO coverage would minimize the potential for Level A or Level B exposures during impact pile driving. While adoption of this measure would decrease risk to marine mammals during impact pile driving under the Proposed Action, it would not alter the impact determination of minor for impact pile-driving noise.
Sound field verification	If the clearance and/or shutdown zones are expanded due to the verification of sound fields from Project activities, PSO coverage must be sufficient to reliably monitor the expanded clearance and/or shutdown zones.	Sound field verification would increase the accountability of underwater noise mitigation during pile driving. While adoption of this measure would increase accountability during this construction activity under the Proposed Action, it would not alter the impact determination of minor for impact pile-driving noise.
Shutdown zones	BOEM and USACE may consider reductions in the shutdown zones based upon sound field verification of a minimum of three piles. However, BOEM/USACE would ensure that the shutdown zone is not reduced to less than 0.6 mile (1,000 meters) for sei, fin, or sperm whales. No reductions in the clearance or shutdown zones for NARWs would be considered regardless of the results of sound field verification.	Shutdown zones would minimize the potential for Level A or Level B exposures during impact pile driving. While adoption of this measure would decrease risk to marine mammals during impact pile driving under the Proposed Action, it would not alter the impact determination of minor for impact pile-driving noise.
Alternative Monitoring Plan for pile driving	Atlantic Shores must develop an Alternative Monitoring Plan for pile driving operations during low-visibility conditions (e.g., darkness, inclement weather) that prevent visual monitoring of the full extent of the clearance and shutdown zones. This plan must include identification of any night vision devices proposed for detection of protected species during low visibility conditions; a demonstration of the capability of the proposed monitoring methodology to detect protected species within the full extent of the clearance and shutdown zones with the same effectiveness as daytime visual monitoring; a discussion of the efficacy of each device proposed for low visibility monitoring; and reporting procedures, contacts, and timeframes.	The development and implementation of an Alternative Monitoring Plan would minimize the potential for Level A or Level B exposures during impact pile driving. While adoption of this measure would decrease risk to marine mammals during impact pile driving under the Proposed Action, it would not alter the impact determination of minor for impact pile-driving noise.

Measure	Description	Effect
Sampling gear	All sampling gear must be hauled at least once every 30 days, and all gear must be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	The regular hauling of sampling gear would reduce risk of entanglement in fisheries survey gear. While adoption of this measure would reduce risk under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in Project surveys must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long (0.9-meter-long) strip of black and white duct tape within 2 fathoms of a buoy attachment. In addition, three additional marks must be placed on the top, middle and bottom of the line using black and white paint or duct tape.	Gear identification would improve accountability in the case of gear loss. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Lost survey gear	All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost survey gear must be reported to NMFS and BSEE.	Lost survey gear would improve accountability in the case of gear loss. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Survey training	For any vessel trips where gear is set or hauled for trawl or ventless trap surveys, at least one of the survey staff onboard must have completed Northeast Fisheries Observer Program observer training within the last 5 years or completed other equivalent training in protected species identification and safe handling. Appropriate reference materials must be on board each survey vessel. Atlantic Shores must prepare a training plan that addresses how these survey requirements will be met.	Survey staff training would reduce risk of entanglement in fisheries survey gear. While adoption of this measure would reduce risk under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Monthly/annual reporting requirements	To document the amount or extent of take that occurs during all phases of the Proposed Action, Atlantic Shores must submit monthly reports during the construction phase and during the first year of operation and must submit annual reports beginning in year 2 of operation.	Reporting requirements to document take would improve accountability for documenting marine mammal take associated with the Proposed Action. While adoption of these measures would improve accountability, it would not alter the overall impact determination of moderate for the Proposed Action.
Passive acoustic monitoring	Atlantic Shores must deploy three moored or autonomous passive acoustic monitoring devices to continuously record ambient noise and marine mammals in	The use of passive acoustic monitoring to record ambient noise and document presence of marine mammals before, during, and after construction would

Measure	Description	Effect
	each of the Project 1 and Project 2 areas before construction, during all construction activities, the remaining calendar year following construction, and for at least 3 calendar years of operation following construction.	improve accountability of the impact evaluations. While adoption of this measure would improve accountability, it would not alter impact determinations associated with construction activities for the Proposed Action.
Data collection BA BMPs	All Project Design Criteria and Best Management Practices incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance and operations of the Atlantic Shores Wind project as applicable.	Compliance with Project Design Criteria and Best Management Practices for Protected Species would minimize risk to marine mammals during HRG surveys. While adoption of this measure would decrease risk to marine mammals under the Proposed Action, it would not alter the impact determination of minor for HRG activities.
Periodic underwater surveys, reporting of monofilament and other fishing gear around WTG foundations	Atlantic Shores must monitor potential loss of fishing gear in the vicinity of WTG foundations by surveying at least ten different WTGs in each Project 1 and Project 2 area annually. Survey design and effort may be modified based upon previous survey results after review and concurrence by BOEM. Atlantic Shores must conduct surveys by remotely operated vehicles, divers, or other means to determine the locations and amounts of marine debris.	Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. While adoption of this measure would reduce risk to marine mammals under the Proposed Action, it would not alter the impact determination of minor for odontocetes and pinnipeds and moderate for mysticetes associated with the presence of structures.
PDC minimize vessel interactions with listed species	All vessels associated with survey activities must comply with the following vessel strike avoidance measures: if any ESA-listed marine mammal is sighted within 500 meters of the forward path of a vessel, the vessel operator must steer a course away from the whale at less than 10 knots until the minimum separation distance has been established; and if any ESA-listed marine mammal is sighted within 200 meters of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 meters. If stationary, the vessel must not engage engines until the large whale has moved beyond 500 meters. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements.	Compliance with Project Design Criteria to minimize vessel interactions would reduce risk of vessel strike. While adoption of this measure would reduce risk to marine mammals under the Proposed Action, it would not alter the impact determination of minor for vessel traffic.
Operational Sound Field Verification Plan	Atlantic Shores must develop an operational sound field verification plan to	The development of an Operational Sound Field Verification Plan would allow BOEM to confirm that impacts of operating WTG

Measure	Description	Effect
	determine the operational noises emitted from the offshore wind area	noise does not exceed predicted impacts based on existing monitoring data and modeling efforts. While adoption of this measure would improve accountability of WTG operational noise under the Proposed Action, it would not alter the impact determination of negligible for WTG noise.
LOA requirements	Atlantic Shores must comply with all requirements specified in the Project's LOA.	Compliance with LOA requirements would reduce risks for marine mammals under the Proposed Action. However, this measure would not alter impact determinations for marine mammals.

3.5.6.10 Comparison of Alternatives

Construction, operation, and decommissioning of Alternatives C, D, E, and F1 would have the same **negligible** to **moderate** adverse impacts and **minor beneficial** impacts on marine mammals as described under the Proposed Action. Alternative C would result in slightly less effects on some marine mammals due to the avoidance and minimization of impacts on valuable habitats and the potential removal or micrositing of up to 29 WTGs, 1 OSS, and associated interarray cables. The combination of Alternatives C1 and C2 would further reduce effects on some marine mammals by avoiding impacts on both valuable habitat areas in the Lease Area. Alternatives D and E would result in slightly less effects on marine mammals due to the potential removal of up to 31 and up to 5 WTGs and associated interarray cables, respectively. Alternatives F2 and F3 would result in measurably less effects on marine mammals due to avoidance of impact pile-driving noise effects. However, **moderate** impacts would still be expected due to vessel noise (for LFC) and displacement of marine mammals associated with the presence of structures.

This page was intentionally left blank.

3.5.7 Sea Turtles

This section discusses potential impacts on sea turtles from the proposed Project, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area. The geographic analysis area, as shown on Figure 3.5.7-1, includes the Northeast Shelf, Southeast Shelf, and Gulf of Mexico LMEs. These LMEs capture most of the movement range of sea turtles within the U.S. Atlantic Ocean and Gulf of Mexico waters. Due to the size of the geographic analysis area, for analysis purposes in this EIS, the focus is on sea turtles that would likely occur in the proposed Project area and be affected by Project activities. The geographic analysis area does not include all areas that could be transited by Project vessels (e.g., it does not consider vessel transits from Europe).

3.5.7.1 Description of the Affected Environment and Future Baseline Conditions

Five species of sea turtles have been documented in U.S. waters of the northwest Atlantic Ocean, where the Offshore Project area occurs: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and loggerhead (*Caretta caretta*). All five species are listed under the ESA; hawksbill, Kemp's ridley, and leatherback sea turtles are listed as endangered, and green and loggerhead sea turtles are listed as threatened. Critical habitat has been designated for green, hawksbill, leatherback, and loggerhead sea turtles; however, critical habitat for these species is not within or in the vicinity of the Offshore Project area. Although hawksbill sea turtles have been documented in OCS waters of the northwest Atlantic Ocean, they are rare in this region and have not been documented within New Jersey waters (Conserve Wildlife Foundation of New Jersey 2022). Therefore, this species is considered unlikely to occur. Hawksbill sea turtles occur regularly in the Gulf of Mexico; however, vessel traffic is the only Project activity that could affect sea turtles in this region, and only 20 vessel round trips to the Gulf of Mexico are expected for the Project. Given the low number of vessel trips and the vessel strike avoidance measures that would be in place (Section 3.5.7.5, *Impacts of Alternative B*), impacts in the Gulf of Mexico are considered unlikely. Therefore, hawksbill sea turtle will not be evaluated further in this EIS.

Source: BOEM 2023.

N
0 100 200
Miles
1:20,000,000

Figure 3.5.7-1. Sea turtles geographic analysis area

Sea turtles generally migrate into or through the Offshore Project area as they travel between their northern-latitude feeding grounds and their nesting grounds in the southern U.S., the Gulf of Mexico, and the Caribbean. As ocean waters warm in the spring, sea turtles migrate northward to their feeding grounds in the mid-Atlantic, typically arriving in the spring or summer and remaining through the fall. As water temperatures cool, most sea turtles begin their return migration to the south. Historically, this southward migration begins in October, and most turtles have left by the first week in November. Based on this seasonal migration pattern, sea turtles are generally expected to occur in the Offshore Project area between May and November (NMFS 2021e). Some individuals may remain in the mid-Atlantic into the winter when they could experience cold stunning as temperatures drop below 50°F (10°C) (NMFS 2021a), but occurrence is less likely when water temperatures are low (i.e., winter and spring) (BOEM 2012; Greene et al. 2010).

The best available information on the occurrence and distribution of sea turtles in the Project area is provided by a combination of sighting data, technical reports, and academic publications, including:

- Aerial and shipboard survey data collected by the Northwest Atlantic Marine Ecoregional Assessment (Greene et al. 2010), the Northeast Fisheries Science Center, and the New York State Energy Research and Development Authority (NYSERDA) (Normandeau Associates Inc. and APEM Inc. 2018, 2019a, 2019b, 2019c, 2020); and
- Data retrieved from the North Atlantic Right Whale Consortium database (NARWC 2021).

Species occurrence is summarized in Table 3.5.7-1 and described in the following paragraphs. Seasonal density estimates derived from NYSERDA annual reports are provided in Table 3.5.7-2.

Table 3.5.7-1. Sea turtles likely to occur in the Project area

Common Name	Scientific Name	Distinct Population Segment (DPS)/ Population	ESA Status	Relative Occurrence in the Project Area[1]
Green sea turtle	*Chelonia mydas*	North Atlantic DPS	Threatened	Uncommon
Kemp's ridley sea turtle	*Lepidochelys kempii*	--	Endangered	Uncommon
Leatherback sea turtle	*Dermochelys coriacea*	Northwest Atlantic	Endangered	Common
Loggerhead sea turtle	*Caretta caretta*	Northwest Atlantic DPS	Threatened	Common

Source: COP Volume II, Section 4.8, Table 4.8-1; Atlantic Shores 2023.

[1] Uncommon = occurring in low numbers or on an irregular basis; Common = occurring consistently in moderate to large numbers.

Table 3.5.7-2. Seasonal sea turtle density estimates derived from NYSERDA annual reports

Species	Density (animals/100 square kilometers)[1]			
	Spring	**Summer**	**Fall**	**Winter**
Green sea turtle	0.000	0.038	0.000	0.000
Kemp's ridley sea turtle	0.050	0.991	0.190	0.000
Leatherback sea turtle	0.000	0.331	0.789	0.000
Loggerhead sea turtle	0.254	26.799	0.190	0.025

Source: COP Volume II, Section 4.8, Table 4.8-2; Atlantic Shores 2023.
[1] Density estimates are derived from seasonal abundance surveys conducted offshore New York (Normandeau Associates Inc., and APEM Inc. 2018, 2019a, 2019b, 2019c, 2020).

Green sea turtle: Green sea turtles found in the Project area belong to the North Atlantic DPS. This species inhabits tropical and subtropical waters around the globe. In the U.S., green sea turtles occur from Texas to Maine, as well as the Caribbean. Late juveniles and adults are typically found in nearshore waters of shallow coastal habitats (NMFS 2021b). In the pelagic environment, green sea turtles are often found in convergence zones (NMFS and USFWS 1991).

No green sea turtle nesting has been documented on the New Jersey coast. Their diet is largely herbivorous, composed primarily of algae and seagrasses with occasional sponges and invertebrates (NMFS 2021b). Although they have the potential to occur year-round, green sea turtles generally occur seasonally offshore of New Jersey in summer and fall. Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 3.5.7-2. Green sea turtles have a seasonal density of 0.038 animals per 39 square miles (100 square kilometers) during the summer and seasonal densities of 0.000 animals per 39 square miles (100 square kilometers) in the other three seasons. There is no population estimate for the North Atlantic DPS of green sea turtles. However, nester abundance for this DPS is estimated at 167,424 (Seminoff et al. 2015). All major nesting populations in this DPS have shown long-term increases in abundance (Seminoff et al. 2015).

Kemp's ridley sea turtle: All Kemp's ridley sea turtles, including those found in the Project area, belong to a single population. This species primarily inhabits the Gulf of Mexico, although large juveniles and adults travel along the U.S. Atlantic coast. At these life stages, Kemp's ridley sea turtles occupy nearshore habitats in subtropical to warm temperate waters, including sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters.

A single Kemp's ridley nest was documented on Queens County's West Beach, New York, in 2018. However, this nest was outside the known nesting range for the species, which is essentially limited to the beaches of the western Gulf of Mexico (NMFS and USFWS 2015). The diet of Kemp's ridley sea turtles is composed primarily of crabs (NMFS 2022). Kemp's ridley sea turtles could occur in the Project area year-round, but they are mainly in the region during the summer and fall. Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 3.5.7-2. Kemp's ridley sea turtles have seasonal densities of 0.050 animals per 39 square miles (100 square kilometers) for spring, 0.991 animals per 39 square miles (100 square kilometers) for summer, 0.190 animals per 39 square miles (100 square kilometers) for fall, and 0.000 animals per 39 square miles (100 square kilometers) for winter. In 2012, the population of individuals aged 2 and up was estimated at 248,307 turtles (NMFS and

USFWS 2015 citing Gallaway et al. 2013). Since 2009, there has been a decline in nest abundance for this population (NMFS and USFWS 2015).

Leatherback sea turtle: Leatherback sea turtles that occur in the Project area belong to the Northwest Atlantic population identified in the 2020 status review for the species (NMFS and USFWS 2020). However, this population has not been identified as a DPS or listed separately under the ESA at this time. This species is found in the Atlantic, Pacific, and Indian Oceans (NMFS 2021c). Leatherback sea turtles can be found throughout the western North Atlantic Ocean as far north as Nova Scotia, Newfoundland, and Labrador. While early life stages prefer oceanic waters, adult leatherback sea turtles are generally found in mid-ocean, continental shelf, and nearshore waters (NMFS and USFWS 1992).

This species does not nest along the New Jersey coast. Leatherback sea turtle diets are composed primarily of jellyfish and other gelatinous prey, but they may also incidentally consume sea urchins, squid, crustaceans, fish, and vegetation (Eckert et al. 2012). Leatherback sea turtles could occur in the Project area throughout the year but are more common in the summer and fall (BOEM 2012; Geo-Marine 2010). During aerial and shipboard surveys for marine mammals and sea turtles off the coast of New Jersey in 2008 and 2009 (Geo-Marine 2010), 12 leatherback sea turtles were sighted. All sightings occurred in the summer. This species was observed in waters ranging from 59 to 98 feet (18 to 30 meters) deep, located 6.2 to 22.3 miles (10 to 36 kilometers) from shore. The mean sea surface temperature associated with leatherback sea turtle sightings was 66.2°F (19°C). Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 3.5.7-2. Leatherback sea turtles have a seasonal density of 0.000 animals per 39 square miles (100 square kilometers) for spring, 0.331 animals per 39 square miles (100 square kilometers) for summer, 0.789 animals per 39 square miles (100 square kilometers) for fall, and 0.000 animals per 39 square miles (100 square kilometers) for winter. The best available estimate of nesting female abundance for the Northwest Atlantic population is 20,659 females. This population is currently exhibiting an overall decreasing trend in annual nesting activity (NMFS and USFWS 2020).

Loggerhead sea turtle: Loggerhead sea turtles found in the Project area belong to the Northwest Atlantic DPS. This species inhabits nearshore and offshore habitats throughout the globe. Loggerhead sea turtles occur throughout the northwest Atlantic as far north as Newfoundland (NMFS 2021d). Coastal waters of the western Atlantic have been identified as foraging habitat for juveniles (USFWS 2020).

A single loggerhead nest was documented at Island Beach State Park, New Jersey, in 1979 (Brandner 1983). However, this nest was outside the known nesting range for the species, which stretches from Texas to Virginia (NMFS and USFWS 2008). Juvenile loggerhead sea turtles have omnivorous diets, consuming crabs, mollusks, jellyfish, and vegetation. Adults are carnivores, consuming primarily benthic invertebrates (NMFS 2021d). Leatherback sea turtles could occur in the Project area throughout the year but are more common in the summer and fall (BOEM 2012; Geo-Marine 2010). During aerial and shipboard surveys for marine mammals and sea turtles off the coast of New Jersey in 2008 and 2009 (Geo-Marine 2010), 69 loggerhead sea turtles were sighted. Sightings occurred between June and October. This species was observed in waters ranging from 30 to 112 feet (9 to 34 meters) deep, located

0.9 to 23.6 miles (1.5 to 38 kilometers) from shore. The mean sea surface temperature associated with loggerhead sea turtle sightings was 65.3°F (18.5°C). Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 3.5.7-2. Loggerhead sea turtles have a seasonal density of 0.254 animals per 39 square miles (100 square kilometers) for spring, 26.779 animals per 39 square miles (100 square kilometers) for summer, 0.190 animals per 39 square miles (100 square kilometers) for fall, and 0.025 animals per 39 square miles (100 square kilometers) for winter. The most recent population estimate for the northwest Atlantic continental shelf, calculated in 2010, is 588,000 juvenile and adult loggerhead sea turtles (NEFSC and SEFSC 2011). The recovery units for the Northwest Atlantic DPS have shown no trend or an increasing trend in nest abundance; however, these recovery units have not met their recovery criteria for annual increases in nest abundance (Bolten et al. 2019).

All four sea turtle species likely to occur in the geographic analysis area are subject to regional, pre-existing threats. These threats include fisheries bycatch, loss or degradation of nesting and foraging habitat, entanglement in fishing gear, vessel strikes, predation and harvest, disease, and climate change. Green, Kemp's ridley, and loggerhead sea turtles are also susceptible to cold stunning.

The hearing range of sea turtles is limited to low frequencies, typically below 1,600 Hz. The documented hearing range for each of the four sea turtle species is provided in Table 3.5.7-3.

Table 3.5.7-3. Sea turtle hearing ranges

Species	Hearing Range (Hz)		Source
	Minimum	Maximum	
Green	50	1,600	Dow Piniak et al. 2012a
Kemp's ridley	100	500	Bartol and Ketten 2006
Leatherback	50	1,200	Dow Piniak et al. 2012b
Loggerhead	50–100	800–1,130	Martin et al. 2012

3.5.7.2 Impact Level Definitions for Sea Turtles

This Draft EIS uses a four-level classification scheme to characterize potential impacts of the alternatives, including the Proposed Action, as shown in Table 3.5.7-4. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

Table 3.5.7-4. Definitions of potential adverse and beneficial impact levels for sea turtles

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
	Beneficial	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
Minor	Adverse	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.
	Beneficial	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts

Impact Level	Impact Type	Definition
		could increase survival and fitness, but would not result in population-level effects.
Moderate	Adverse	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Adverse effects would likely be recoverable and would not affect population or DPS viability.
	Beneficial	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Impacts would be measurable at the population level.
Major	Adverse	Impacts on sea turtles would be significant and extensive and long term in duration, and could have population-level effects that are not recoverable, even with mitigation.
	Beneficial	Impacts would be significant and extensive and contribute to population or DPS recovery.

3.5.7.3 Impacts of Alternative A – No Action on Sea Turtles

When analyzing the impacts of the No Action Alternative on sea turtles, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for sea turtles. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for sea turtles, described in Section 3.5.7.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind and offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles are generally associated with coastal and offshore development, marine transport, fisheries use, and climate change. Coastal and offshore development, marine transport, and fisheries use and associated impacts are expected to continue at current trends and have the potential to affect sea turtles through accidental releases, which can have physiological effects on sea turtles; electric and magnetic fields and cable heat and lighting, which can result in behavioral changes in sea turtles (e.g., Luschi et al. 2007; Wang et al. 2019); cable emplacement and maintenance and port utilization, which can disturb benthic habitats and affect water quality; noise, which can have physiological and behavioral effects on sea turtles; the presence of structures, which can result in behavioral changes in sea turtles, effects on prey species, and increased risk of interactions with fishing gear; and vessel traffic, which increases risk of vessel collision. Global climate change is an ongoing risk for sea turtle species in the geographic analysis area. Warming and sea level rise could affect sea turtles through increased storm frequency and severity, altered habitat/ecology, altered migration patterns, increased disease incidence, increased erosion and sediment deposition, and development of protective measures (e.g., seawalls and barriers). Ocean acidification may also affect sea turtles (Hawkes et al. 2009). Warming and sea level rise, with their associated consequences, and ocean acidification could lead to long-term, high-consequence impacts on sea turtles, including changes to sea turtle distribution, habitat use, migratory patterns, nesting periods, nestling sex ratios, nesting habitat quality or availability, prey distribution or abundance, and foraging habitat availability (Fuentes and Abbs 2010; Janzen 1994; Newson et al. 2009; Witt et al. 2010). See Appendix D, Table D.A1-21 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for sea turtles.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include:

- Continued O&M of the BIWF (five WTGs) installed in state waters;
- Continued O&M of the CVOW pilot project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the BIWF and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect sea turtles through the primary IPFs of noise, presence of structures, and vessel traffic. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and vessel traffic that are described in detail below, under *Cumulative Impacts of Alternative A – No Action*, for planned offshore wind activities, but the impacts would be of lower intensity.

See Table D.A1-22 in Appendix D for a summary of potential impacts associated with ongoing activities by IPF for sea turtles.

Impacts of Alternative A – No Action on ESA-Listed Sea Turtles

All sea turtle species that are likely to occur in the Offshore Project area are listed under the ESA. Therefore, the impacts of the No Action Alternative on ESA-listed sea turtle species are identical to the impacts previously described for ongoing activities under the No Action Alternative.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles, in the absence of the Proposed Action, include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; and onshore development activities (see Section D.2 in Appendix D for a description of planned activities). BOEM expects planned activities other than offshore wind to affect sea turtles through several primary

IPFs, including accidental releases, electric and magnetic fields and cable heat, lighting, cable emplacement and maintenance, port utilization, noise, and the presence of structures.

The sections below summarize the potential impacts of ongoing and planned offshore wind activities, excluding the Proposed Action, on sea turtles during construction, O&M, and decommissioning of the projects. Other planned offshore wind activities in the geographic analysis area for sea turtles include the construction and installation, O&M, and decommissioning of 31offshore wind projects, which would result in an additional 2,893 WTGs and 37 OSSs and met towers in the geographic analysis area (Appendix D, Tables D-3 and D.A2-1).

BOEM expects planned offshore wind development activities to affect sea turtles through the following primary IPFs.

Accidental releases: Offshore wind activities may increase accidental releases of fuels, fluids, hazardous materials, including petroleum products, and trash and debris due to increased vessel traffic and installation of WTGs and other offshore structures. The risk of accidental releases is expected to be highest during construction, but accidental releases could also occur during operation and decommissioning.

Ongoing and planned offshore wind activities are expected to gradually increase vessel traffic over the next 35 years, increasing the risk of accidental releases of fuels, fluids, and hazardous materials. There would be a low risk of fuel, fluid, and hazardous materials leaks from any of the 2,974 WTGs (81 for ongoing activities and 2,893 for planned activities) (Appendix D, Table D.A2-1) anticipated in the geographic analysis area. The total volume of WTG fuels, fluids, and hazardous materials in the geographic analysis area is estimated at 22.4 million gallons (84.9 million liters) (Appendix D, Table D.A2-3). OSSs and ESPs are expected to hold an additional 10.5 million gallons (39.6 million liters) of fuels, fluids, and hazardous materials (Appendix D, Table D.A2-3).

BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons (484,533 liters) is likely to occur no more frequently than once every 1,000 years, and a release of 2,000 gallons (7,570 liters) or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). Sea turtle exposure to oil spills through aquatic contact or inhalation of fumes can result in death (Shigenaka et al. 2010) or sublethal effects, including but not limited to adrenal effects, dehydration, hematological effects, increased disease incidence, hepatological effects, poor body condition, dermal effects, and skeletomuscular effects (Bembenek-Bailey et al. 2019; Camacho et al. 2013; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Such sublethal effects would affect individual fitness but are not expected to affect sea turtle populations. In addition to direct effects on sea turtles, accidental releases can indirectly affect sea turtles through impacts on prey species (see Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*). Given the volumes of fuels, fluids, and hazardous materials potentially involved and the likelihood of release occurrence, the long-term increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

Increased vessel traffic would also increase the risk of accidental releases of trash and debris during construction, operation, and decommissioning of offshore wind facilities. All sea turtle species are known to ingest trash and debris, including plastic fragments, tar, paper, polystyrene foam, hooks, lines, and net fragments (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014; Thomás et al. 2002). Such ingestion can occur accidentally or intentionally when individuals mistake the debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Ingestion of trash and debris can result in death or sublethal effects, including but not limited to dietary dilution, chemical contamination, depressed immune system, poor body condition, reduced growth rates, reduced fecundity, and reduced reproductive success (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). These sublethal effects would affect individual fitness, but mortality and sublethal effects associated with ingestion of trash and debris are not expected to have population-level effects. BOEM assumes that all vessels will comply with laws and regulations to minimize trash releases and expects that such releases would be small and infrequent. The amount of trash and debris accidentally released during planned offshore wind activities would likely be minimal compared to trash releases associated with ongoing activities, including land-based activities and commercial and recreational fishing.

Cable emplacement and maintenance: Ongoing and planned offshore wind activities will involve the placement and maintenance of export and interarray cables. Cable emplacement and maintenance activities disturb bottom sediment, resulting in temporary increases in suspended sediment concentrations. Cable emplacement associated with ongoing and planned offshore wind activities, including export cable emplacement, interarray cable emplacement, and anchoring, is expected to disturb more than 108,238 acres (43,802 hectares) of seabed between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2). This acreage could be reduced if open-access offshore transmission systems are built, as have been proposed. However, such projects are not considered reasonably foreseeable at this time. During cable installation, sediment plumes would be present for up to 6 hours at a time until the activity is completed, and suspended sediment settles back to the seabed. Areas subject to cumulative increases in suspended sediment from simultaneous activities would be limited because the occurrence of concurrent cable installation operations is expected to be limited. The increases in suspended sediment associated with cable emplacement and maintenance would be short term and localized to the cable corridor.

Elevated levels of suspended sediment may cause small changes in sea turtle movement and behavior (NMFS 2020a). Such changes are expected to be too small to be reasonably measured as sea turtles are capable of swimming through turbidity plumes (NMFS 2020a). Elevated suspended sediment may affect sea turtles indirectly if prey species, including benthic mollusks, crustaceans, sponges, and sea pens are affected by redeposition of sediment. Elevated suspended sediment concentrations have adverse effects on benthic communities when they exceed 390 milligrams per liter (NMFS 2020d citing EPA 1986). See Section 3.5.5 for a discussion of impacts on prey species. There are no data to suggest that suspended sediment has physiological effects on sea turtles.

Any dredging required prior to cable emplacement could have additional impacts on sea turtles due to impingement, entrainment, or capture in certain types of dredges. Mechanical dredging is not expected to capture, injure, or kill sea turtles (USACE 2020). Hopper dredges may strike, impinge, or entrain sea turtles, which may result in injury or mortality (Ramirez et al. 2017b, 2017c, citing Dickerson et al. 1990, 1991; Ramirez et al. 2017d citing Reine et al. 1998; Ramirez et al. 2017e citing Richardson 1990). The sea turtle species most often affected by dredge interactions is loggerhead sea turtles, followed by green sea turtles, then Kemp's ridley sea turtles (Ramirez et al. 2017a). However, the risk of interactions between hopper dredges and sea turtles is expected to be lower in the offshore environment where dredging for offshore wind cables would most likely occur (Michel et al. 2013; USACE 2020). The risk of injury or mortality of individual sea turtles due to dredging associated with ongoing and planned offshore wind activities is considered low, and population-level effects are unlikely to occur.

Electric and magnetic fields and cable heat: Offshore wind activities would install up to 13,064 miles (21,024 kilometers) of export and interarray cables (Appendix D, Table D.A2-1), increasing the production of EMF and heat in the geographic analysis area. EMF and heat effects would be reduced by cable burial to an appropriate depth and shielding, if necessary. Cables are also expected to be separated by a minimum distance of 330 feet (100 meters), avoiding additive effects from adjacent cables.

Sea turtles are capable of detecting magnetic fields (e.g., Lohmann and Lohmann 1996; Normandeau et al. 2011; Putman et al. 2015), and behavioral responses to such fields have been documented (e.g., Luschi et al. 2007). The threshold for behavioral responses varies somewhat among species. Loggerhead sea turtles have exhibited responses to field intensities ranging from 0.0047 to 4,000 microteslas, and green sea turtles have responded to field intensities ranging from 29.3 to 200 microteslas (Normandeau et al. 2011); other species are expected to have similar thresholds due to similar anatomical features, behaviors, and life history characteristics. Juvenile and adult sea turtles may detect EMFs associated with ongoing and planned activities when foraging on benthic prey or resting on the bottom in relatively close proximity to cables. There are no data on EMF impacts on sea turtles associated with underwater cables. Migratory disruptions have been documented in sea turtles with magnets attached to their heads (Luschi et al. 2007), but evidence that EMF associated with planned offshore wind activities would likely result in some deviations from direct migration routes is lacking (Snoek et al. 2016). Any deviations are expected to be minor (Normandeau et al. 2011), and any increased energy expenditure due to these deviations would not be biologically significant.

Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters (Taormina et al. 2018). There are no data on cable heat effects on sea turtles (Taormina et al. 2018). However, increased heat in the sediment could affect benthic organisms that serve as prey for sea turtles that forage in the benthos. Based on the narrowness of cable corridors and expected weakness of thermal radiation, impacts on benthic organisms are not expected to be significant (Taormina et al. 2018) and would be limited to a small area around the cable. Given the expected cable burial depths, thermal effects would not occur at the surface of the seabed where sea turtles would forage. Therefore, any effects on sea turtle prey availability would be negligible.

Gear utilization: Ongoing and planned offshore wind activities are expected to include monitoring surveys in the project areas. Sea turtles could be affected by these surveys through survey vessel traffic and interactions with survey gear. Survey vessels would produce underwater noise and increase the risk of vessel strikes. The effects of vessel noise and increased strike risk would be similar to those discussed under the *Noise* and *Traffic* IPFs.

Additional impacts on sea turtles could result from interactions with mobile (e.g., trawl, dredge) or fixed (e.g., trap, hydrophone) survey gear. Offshore wind projects are expected to use trawl surveys, among other methods, for project monitoring. The capture and mortality of sea turtles in fisheries utilizing bottom-trawls are well documented (Henwood and Stuntz 1987; NMFS and USFWS 1991, 1992; NRC 1990). Though sea turtles are capable of extended dive durations, entanglement and forcible submersion in fishing gear leads to rapid oxygen consumption (Lutcavage and Lutz 1997). Based on available research, restricting tow times to 30 minutes or less is expected to prevent sea turtle morality in trawl nets (Epperly et al. 2002; Sasso and Epperly 2006). BOEM anticipates trawl surveys for offshore wind project monitoring would be limited to tow times of 20 minutes, indicating that this activity poses a negligible risk of mortality. Additional mitigation measures would be expected to eliminate the risk of serious injury and mortality from forced submergence for sea turtles caught in bottom-trawl survey gear. Tows for clam dredge surveys would have a very short duration of 120 seconds, and the survey vessels would be subject to mitigation measures similar to those for the trawl survey. Therefore, effects of dredge surveys on sea turtles would be negligible.

The vertical buoy and anchor lines associated with monitoring surveys using fixed gear, such as fish traps or baited remote underwater video, could pose a risk of entanglement for sea turtles. While there is a theoretical risk of sea turtle entanglement in trap and pot gear, particularly for leatherback sea turtles (NMFS 2016), the likelihood of entanglement would be negligible given the patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the relatively limited duration of each sampling event. BOEM also anticipates mitigation measures would be in place to reduce sea turtle interactions during fisheries surveys. Sea turtle prey species (e.g., crabs, whelks, and fish) may be collected as bycatch in trap gear. However, all bycatch is expected to be returned to the water and would still be available as prey for sea turtles regardless of their condition, particularly for loggerhead sea turtles, which are known to forage for live prey and scavenge dead organisms. Given the non-extractive nature of fixed gear surveys, any effects on sea turtles from the collection of potential sea turtle prey would be so small that they cannot be meaningfully measured, detected, or evaluated. Therefore, indirect effects on sea turtles due to collection of potential prey items would be negligible. Hydrophone mooring lines for passive acoustic monitoring studies pose a theoretical entanglement risk to sea turtles, similar to trap and pot surveys. However, BOEM anticipates that monitoring studies utilizing moored systems would be required to use the best available technology to reduce any potential risks of entanglement. Therefore, passive acoustic studies are expected to pose a negligible risk of entanglement to sea turtles.

Monitoring surveys are expected to occur at short-term, regular intervals over the lifetime of a project. Though the potential extent and number of animals potentially exposed cannot be determined without project-specific information, impacts of gear utilization on sea turtles are expected to be negligible given the negligible risk of mortality, the negligible risk of entanglement, and the negligible effect on sea turtle prey availability.

Lighting: Vessels and offshore structures associated with ongoing and planned offshore wind activities will produce light at night. Lighting on vessels and offshore structures could elicit attraction, avoidance, or other behavioral responses in sea turtles. In laboratory experiments, juvenile loggerhead sea turtles consistently oriented toward light sticks of various colors and types used by pelagic longline fisheries (Wang et al. 2019), indicating that hard-shelled sea turtle species expected to occur in the vicinity of the Project (i.e., green, Kemp's ridley, and loggerhead) could be attracted to offshore light sources. In contrast, juvenile leatherback sea turtles failed to orient toward or oriented away from lights in laboratory experiments (Gless et al. 2008), indicating that this species may not be attracted to offshore lighting. Any behavioral responses to offshore lighting are expected to be localized and temporary.

In ongoing and planned offshore wind activities described in Appendix D, 2,974 WTGs and 39 OSSs/ESPs and met towers would be constructed between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2). These offshore structures would have yellow flashing navigational lighting and red flashing FAA hazard lights, in accordance with BOEM's (2021a) lighting and marking guidelines. Following these guidelines, direct lighting would be avoided, and indirect lighting of the water surface would be minimized to the greatest extent practicable. As described in the previous paragraph, offshore lighting may attract juvenile green, Kemp's ridley, and loggerhead sea turtles, based on laboratory experiments. The flashing lights on offshore structures associated with ongoing and planned offshore wind activities are unlikely to disorient juvenile or adult sea turtles, as they do not present a continuous light source (Orr et al. 2013). There is no evidence that lighting on oil and gas platforms in the Gulf of Mexico, which may have considerably more lighting than offshore WTGs, has had any effect on sea turtles over decades of operation (BOEM 2019). Given that lighting of the water surface would be minimized and any behavioral responses in sea turtles would be localized and short term, lighting on offshore structures associated with ongoing and planned offshore wind activities would have minor effects on sea turtles.

Noise: Ongoing and planned offshore wind activities would generate anthropogenic noise from aircraft, G&G surveys, offshore wind turbines, pile driving, cable laying, and vessels. See Section B.5 of Appendix B for information on the physical qualities of these noise sources. These noise sources have the potential to affect sea turtles through behavioral or physiological effects. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

Noise: Aircraft. Helicopters may be used to transport crew during construction or operation of offshore wind facilities. When aircraft travel at relatively low altitude, non-impulsive aircraft noise has the potential to elicit stress or behavioral responses (e.g., diving or swimming away or altered dive patterns) (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). Helicopters transiting to offshore wind facilities are expected to fly at sufficient altitudes to avoid behavioral effects on sea turtles, with the exception of WTG inspections, take-off, and landing. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area; these responses are not expected to be biologically significant.

Noise: G&G surveys. G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities. Site assessment and characterization activities are expected to occur intermittently over a 2- to 10-year period at locations spread throughout much of the geographic analysis area. Although schedules for many planned offshore wind activities are still being developed, it would be possible to avoid overlapping noise impacts on sea turtles by scheduling site assessment and characterization activities to avoid conducting simultaneous G&G surveys in proximity to each other. Such surveys can generate high-intensity, impulsive noise that has the potential to affect sea turtles through auditory injuries, stress, disturbance, and behavioral responses. TTS or PTS could occur if sea turtles are close to survey activities. However, TTS and PTS are considered unlikely, as sea turtles are expected to avoid survey activities, and survey vessels would travel quickly (NSF and USGS 2011). BOEM has concluded that underwater noise associated with G&G surveys for offshore wind activities would likely result in temporary displacement and behavioral effects or biologically insignificant physiological effects (BOEM 2019) and has developed Project Design Criteria and Best Management Practices for offshore wind data collection activities (e.g., G&G surveys) to minimize impacts on protected species (BOEM 2021b) that lessees will be required to follow. Any resulting impacts on individual sea turtles are not expected to result in stock- or population-level effects.

Noise: Impact and vibratory pile driving. Ongoing and planned construction of offshore wind farms will generate impulsive and vibratory pile-driving noise during foundation installation. Pile driving is expected to occur for up to 7 to 9 hours at a time for monopiles, and 3 to 4 hours at a time for pin piles as 2,974 WTGs and 39 OSSs/ESPs and met towers are constructed between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2). The intense, impulsive noise associated with impact pile driving can cause behavioral or physiological effects. Potential behavioral effects of pile-driving noise include altered dive patterns, short-term disturbance, startle responses, and short-term displacement (NSF and USGS 2011; Samuel et al. 2005). Potential physiological effects include temporary stress response and, close to the pile-driving activity, TTS or PTS. Behavioral effects and most physiological effects are expected to be of short duration and localized to the ensonified area. PTS could permanently limit an individual's ability to locate prey, detect predators, or find mates and could therefore have long-term effects on individual fitness. BOEM expects that sea turtles would be displaced for up to 18 hours per day during foundation installation, depending on the type of WTG, OSS, ESP or met tower foundation. Therefore, any disruptions to foraging or other normal behaviors would be temporary, and increased energy expenditures associated with this displacement are expected to be small. It is possible that pile driving could displace animals into areas with lower habitat quality or higher risk (e.g., vessel collision or fisheries interaction).

Multiple construction activities within the same calendar year could potentially affect migration, foraging, breeding, and individual fitness. The magnitude of impacts would depend upon the locations, duration, and timing of concurrent construction; such impacts could be long term and of high intensity and high exposure level. For example, individuals repeatedly exposed to pile driving over a significant period of time (e.g., a season, a year, or a life stage) may incur energetic costs associated with avoidance movements that would be sufficient to cause long-term effects on individual fitness (Navy 2018). However, habituation may occur in sea turtles (Hazel et al. 2007), potentially reducing avoidance and reducing the impacts of repeated exposures.

Noise: Operating WTGs. Operating WTGs generate non-impulsive underwater noise that is audible to sea turtles. Available measurements of operational noise from WTGs of sizes ranging from 0.2 to

6.15 MW were evaluated in a study by Tougaard et al. (2020). Normalizing these various measurements to 328 feet (100 meters) from WTGs and to a wind speed of 33 feet (10 meters) per second, and calculating a best-fit regression led to predictions of root-mean-square sound pressure levels associated with operating WTGs ranging from approximately 105 to 120 dB re 1 µPa for 500 kW to 6 MW WTGs (Tougaard et al. 2020). WTGs selected or under consideration for ongoing and planned offshore wind activities (12 MW or greater) are considerably larger than those currently in operation. Operational sound levels produced by larger WTGs are expected to be greater than those discussed in Tougaard et al. (2020), but in all cases would decrease to ambient levels within a relatively short distance from the turbine foundations (Kraus et al. 2016; Thomsen et al. 2015). At Block Island Wind Farm, turbine noise reaches ambient noise levels (i.e., 110 dB re 1 µPa) within 164 feet (50 meters) of the turbine foundations (Miller and Potty 2017). Maximum noise levels anticipated from operating WTGs are below recommended thresholds for sea turtle injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. Additionally, studies suggest that sea turtles acclimate to repetitive underwater noise in the absence of an accompanying threat (Bartol and Bartol 2011; Hazel et al. 2007; Navy 2018). As the best available data indicates that sound levels produced by operating WTGs would be below sea turtle behavior and injury thresholds, noise impacts on sea turtles from operating WTGs are expected to be negligible. If larger WTGs installed for planned offshore wind activities produce sound levels that exceed recommended thresholds, WTG noise may result in minor impacts on sea turtles.

Noise: Cable laying. Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. Modeling based on noise data collected during cable-laying operations in Europe estimates that underwater root-mean-square sound pressure levels would exceed 120 dB re 1 µPa in a 99,000-acre (40,000-hectare) area surrounding the source (Nedwell and Howell 2004; Taormina et al. 2018). As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the dynamic nature of the ensonified area, a given location would not be ensonified for more than a few hours. Therefore, it is unlikely that cable-laying noise would result in adverse effects on sea turtles.

Noise: Vessels. Vessels generate low-frequency (mostly 10 to 500 Hz) (MMS 2007), non-impulsive noise that could affect sea turtles. Vessel noise overlaps with the hearing range of sea turtles and may elicit behavioral responses, including startle responses and changes in diving patterns, or a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). It is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for marine mammals at any given time from 2023 to 2030. This increase in vessel activity could cause repeated, intermittent impacts on sea turtles due to short-term, localized behavioral responses, which would dissipate once the vessel leaves the area. Behavioral effects on individual sea turtles may occur; however, minimal stock- or population-level effects are expected given the localized and short-term nature of anticipated effects.

Port utilization: The increased size of vessels and increased volume of vessel traffic associated with planned offshore wind activities will likely result in port expansion within the geographic analysis area. At least two proposed offshore wind projects are considering port expansion, and other ports along the

East Coast may be upgraded to accommodate the development of offshore wind projects. Increased port utilization and expansion results in increased noise associated with vessels or pile driving for port expansion and increased suspended sediment concentrations during port expansion activities, including dredging and pile driving. The impacts of vessel noise on sea turtles are expected to be short term and localized, as previously described for the *noise* IPF in this section. Impacts on water quality associated with increased suspended sediment would also be short term and localized, as previously described for the *cable emplacement and maintenance* IPF in this section. Additionally, the area affected by benthic disturbance would be small compared to available foraging habitat.

Increased port utilization may require dredging at ports or within navigation channels to accommodate the large ships required to carry WTG components. In addition to benthic disturbance and increased suspended sediment concentrations, dredging can affect sea turtles through impingement, entrainment, or capture in the dredges, as described for the *cable emplacement and maintenance* IPF in this section. These impacts would be localized to nearshore habitats, and typical mitigation measures (e.g., timing restrictions) are expected to minimize risk to sea turtles. Therefore, risks of injury or mortality are considered low and population-level effects are unlikely to occur.

Presence of structures: An estimated 2,974 WTGs and 39 OSSs/ESPs and met towers could be built in the geographic analysis area due to ongoing and planned offshore wind activities. These structures would occupy open-water, pelagic habitat and would provide presently unavailable hard structure within the water column. Approximately 5,405 acres (2,187 hectares) of hard scour protection would be installed around the foundations, and an additional 2,576 acres (1,042 hectares) of hard protection would be installed around the export and interarray cables (Appendix D, Table D.A2-2). The rock and concrete material used for scour protection and cable protection represents presently unavailable benthic hard structure on the seabed. The installation of WTGs and OSSs/ESPs and hard protection could result in hydrodynamic changes; obstructions that cause loss of fish gear resulting in entanglement or ingestion by sea turtles; habitat conversion from open-water pelagic and benthic soft substrates to structurally complex, mid-water and benthic hard bottom; new areas of prey aggregation; avoidance or displacement; and behavioral disruption.

The presence of foundations for WTGs, OSSs/ESPs, and met towers could alter local hydrodynamic patterns at a fine scale. Water flows are reduced immediately downstream of foundations but return to ambient levels within a relatively short distance (Miles et al. 2017). The downstream area affected by reduced flows is dependent on pile diameter. For monopiles (i.e., the structures with the largest diameter), effects are expected to dissipate within 300 to 400 feet (91 to 122 meters). Although effects from individual structures are highly localized, the presence of an estimated 2,959 offshore wind foundation structures could result in regional impacts on wind wave energy, mixing regimes, and upwelling (van Berkel et al. 2020). These localized and regional alterations to hydrodynamics could have impacts on sea turtle prey species. Fine-scale effects on water flow could have localized impacts on prey distribution and abundance. Regional hydrodynamic effects could affect prey species at a broader scale. Effects on surface currents could influence patterns of larval distribution (Johnson et al. 2021) and seasonal mixing regimes could influence primary productivity, both of which could in turn affect the distribution of fish and invertebrates on the OCS (Chen et al. 2018; Lentz 2017; Matte and Waldhauer

1984). Hydrodynamic alterations due to the presence of offshore wind foundation structures could increase primary productivity in the vicinity of the structures (Carpenter et al. 2016; Schultze et al. 2020). However, such an increase would be highly localized, and the increased productivity may be consumed by filter feeders colonizing the structures (Slavik et al. 2019) rather than leading to increased prey abundance for sea turtles.

In-water structures associated with ongoing activities may serve as artificial reefs, resulting in increased recreational fishing activity in the vicinity of the structures. An increase in recreational fishing activity increases the risk of sea turtles becoming entangled in or ingesting lost fishing gear, which could injure or kill sea turtles. Specifically, entanglement and hooking can cause abrasions, loss of limbs, or increased drag resulting in reduced swimming efficiency and decreased ability to forage or avoid predators (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Between 2016 and 2018, 186 sea turtles were observed to have been hooked or entangled by recreational fishing gear. Although recreational fishermen would be expected to disperse effort across many WTG foundations to avoid overcrowding, risk of entanglement and ingestion of fishing gear could increase as fishermen and sea turtles are attracted to the structures.

Although the artificial reef effect could increase risk of interactions with recreational fishing gear, this effect could also benefit sea turtles due to prey aggregation. In-water structures result in the conversion of open-water and soft-bottom habitat to hard-bottom habitat. This habitat conversion attracts and aggregates prey species (Causon and Gill 2018; Taormina et al. 2018), essentially creating artificial reefs. The aggregation of prey at artificial reefs can result in increased foraging opportunities for sea turtles. In the Gulf of Mexico, green, Kemp's ridley, leatherback, and loggerhead sea turtles have been documented in the presence of offshore oil and gas platforms (Gitschlag and Herczeg 1994; Gitschlag and Renauld 1989; Hastings et al. 1976; Rosman et al. 1987), indicating that sea turtles are likely to use habitat created by in-water structures in the geographic analysis area. However, increased foraging opportunities are not expected to be biologically significant given the broad geographic range used by sea turtles on their annual foraging migrations compared to the localized scale of artificial reef effects.

Though sea turtle prey may be aggregated through the reef effect, it may also aggregate sea turtle predators. In field surveys of artificial and natural reefs off of North Carolina conducted by Paxton et al. (2020), higher densities of large, reef-associated predators, specifically transient predators, were observed on artificial reefs than natural reefs. The aggregation of transient predators (e.g., sharks, barracuda, jacks, and mackerel) at artificial reefs was associated with greater vertical relief (Paxton et al. 2020), indicating that the vertical structure provided WTG foundations may attract relatively high densities of sharks. The attraction of both sea turtles and their predators to offshore wind structures may increase predation risk for sea turtles. Though the potential for increased predation risk associated with the presence of structures may affect individual sea turtles, it is not expected to result in population-level effects given the localized scale of artificial reef effects compared to the geographic range of sea turtles.

The presence of offshore wind facility structures could result in sea turtle avoidance and displacement, which could potentially move sea turtles into areas with lower habitat value or with a higher risk of vessel collision or fisheries interactions. Any avoidance or displacement is expected to be short term. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of offshore wind farms. Assuming fishing vessels are displaced to adjacent areas, risk of interaction with fishing vessels would not be greater than current risk given the patchy distribution of sea turtles. Presence of structures could potentially lead to a shift in gear types due to displacement. If displacement leads to an overall shift from mobile to fixed gear types, there could be an increased number of vertical lines in the water, increasing the risk of sea turtle interactions with fishing gear.

Disruption of normal behaviors, such as foraging and migration, could occur due to the presence of offshore structures. Although 3,013 WTG and OSS/ESP structures are anticipated, spacing would be sufficient to allow sea turtles to utilize habitat between and around structures for foraging, resting, and migrating. Although individual migrations could be temporarily interrupted as sea turtles stop to forage or rest around structures, the presence of structures is not expected to result in measurable changes in general sea turtle migratory patterns.

Traffic: Offshore wind activities would result in increased vessel traffic due to vessels transiting to and from individual lease areas during construction, operation, and decommissioning.

Vessel strikes are an increasing concern for sea turtles. The percentage of stranded loggerhead sea turtles with injuries that were apparently caused by vessel strikes increased from approximately 10 percent in the 1980s to over 20 percent in 2004, although some stranded turtles may have been struck post-mortem (NMFS and USFWS 2007). Sea turtles are expected to be most vulnerable to vessel strikes in coastal foraging areas and may not be able to avoid collisions when vessel speeds exceed 2 knots (4 kilometers per hour) (Hazel et al. 2007). Average vessel speeds in the geographic analysis area may exceed 10 knots (19 kilometers per hour). Therefore, increased vessel traffic may result in sea turtle injury or mortality. It is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for marine mammals at any given time from 2023 to 2030. This increase in traffic would only be a small, incremental increase in overall traffic in the geographic analysis area (see Section 3.6.6, *Navigation and Vessel Traffic*).

The risk of vessel strike from offshore wind vessels would be dependent on the density of sea turtles in each project area, as well as the stage of the project, the time of year, the number of vessels utilized for each project, and the speed of each vessel. Collision risk is expected to be greatest when offshore wind vessels transit between the lease areas and ports utilized by each project as vessel speeds would be highest and turtles are expected to be most susceptible to strike in coastal foraging areas. The increased collision risk associated with this incremental increase in vessel traffic may result in injury or mortality of individual sea turtles. The risk would be greatest for species with the highest densities in a given project area. The increased risk of vessel strike would not be expected to have stock- or population-level impacts on sea turtles given their low densities in the geographic analysis area and patchy distribution. Additionally, minimization measures for vessel impacts would be required for planned offshore wind activities, further reducing the risk of injury or mortality for sea turtles.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, sea turtles would continue to be affected by existing environmental trends and ongoing activities.

The No Action Alternative, including ongoing non-offshore wind and offshore wind activities, would result in **negligible** to **minor** adverse impacts on sea turtles. Adverse impacts would result mainly from vessel traffic. BOEM anticipates that adverse impacts associated with ongoing activities, especially those associated with the traffic and noise IPFs, would be minor. Other adverse impacts associated with ongoing activities would be negligible, particularly those impacts associated with the electric and magnetic fields and cable heat, accidental releases, and lighting IPFs. Overall, BOEM anticipates that adverse impacts associated with ongoing activities would be **minor**.

Cumulative Impacts of Alternative A – No Action. For the No Action Alternative, BOEM expects that ongoing and planned activities would result in continuing temporary to permanent impacts on sea turtles. Considering all IPFs together, ongoing activities, planned activities other than offshore wind, and planned offshore wind activities would result in **negligible** to **minor** adverse impacts on sea turtles and could include **minor beneficial** impacts. Adverse impacts would result mainly from pile-driving noise, presence of structures, and vessel traffic. Beneficial impacts could result from the presence of structures and increased feeding opportunities. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

BOEM anticipates that adverse impacts associated with planned activities other than offshore wind would be minor due to cable emplacement and maintenance and vessel traffic. BOEM anticipates that adverse impacts associated with planned offshore wind activities would be minor due to pile-driving noise and the presence of structures.

Habitat conversion and prey aggregation associated with the presence of structures could result in minor beneficial impacts due to increased foraging opportunities for sea turtles. These effects would be localized and are not expected to affect individual fitness. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in **minor** impacts, largely due to pile-driving noise and the presence of structures.

3.5.7.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on sea turtles:

- Foundation types used for WTGs, OSSs, and the met tower;

- The number of WTG, OSS, and met tower foundations installed; and
- The size of foundations installed.

Variability of the Project design exists as described in Appendix C. Below is a summary of potential variances in impacts:

- WTG, OSS, and met tower foundation types: the type(s) of foundation installed affects the impacts associated with installation.
- WTG, OSS, and met tower foundation number: the number of foundations installed affects the duration of potential pile driving. The more foundations, the longer the duration of pile driving would be.
- WTG, OSS, and met tower foundation size: the size of the pile affects the amount of noise produced during potential pile driving and thus the size of the ensonified area. Generally, a larger pile would result in a larger ensonified area.

Although variation is expected in the design parameters, the impact assessments in Sections 3.5.7.5 through 3.5.7.7 evaluate impacts associated with the maximum-case scenario for sea turtles identified in Appendix C.

3.5.7.5 Impacts of Alternative B – Proposed Action on Sea Turtles

As described in Section 2.1.2, the Proposed Action includes the construction of up to 200 WTGs, up to 10 OSSs, and up to 1 met tower, and the installation of up to 547 miles (880 kilometers) of interarray cables, 37 miles (60 kilometers) of interlink cables, and 441 miles (710 kilometers) of export cables between 2025 and 2027. The Proposed Action also includes 30 years of O&M over a 30-year commercial lifespan and decommissioning activities at the end of commercial life.

Onshore Activities and Facilities

Onshore construction and installation, O&M, and decommissioning activities for the Proposed Action are not expected to contribute to IPFs for sea turtles.

Offshore Activities and Facilities

Accidental releases: The Proposed Action may increase accidental releases of fuels, fluids, hazardous materials, and trash and debris during the construction and installation, O&M, and decommissioning phases of the Project. However, accidental releases are considered unlikely. All Project vessels would comply with USCG regulations for the prevention and control of oil spills (33 CFR Part 155) (WAT-05; Appendix G, Table G-1), further reducing the likelihood of an accidental release. Atlantic Shores has also developed an OSRP (COP Volume I, Appendix I-D; Atlantic Shores 2023) with measures to prevent accidental releases and a protocol to respond to such a release (WAT-03; Appendix G, Table G-1).

Cable emplacement and maintenance: The Proposed Action would involve the placement of 1,025 miles (1,650 kilometers) of export, interlink, and interarray cables. The incremental contribution of the construction and installation of the Proposed Action is a 4.1-square-mile (10.6-square-kilometer) area of seabed disturbance for the emplacement of export cables (including anchoring disturbance), a 0.3-square-mile (0.7-square-kilometer) area of seabed disturbance for the emplacement of interlink cables, and a 3.4-square-mile (8.7-square-kilometer) area of seabed disturbance for the emplacement of interarray cables. The presence of algae or plant-like animals was visually documented at a small number of benthic sampling stations (4 out of 121) (COP Volume II, Appendix II-G2; Atlantic Shores 2023). The algae was characterized as seaweed and was observed at depths in excess of 66 feet (20 meters). As described in Section 3.5.7.3, *Impacts of Alternative A – No Action on Sea Turtles,* cable emplacement and maintenance activities disturb bottom sediment, temporarily increasing suspended sediment concentrations, which could result in behavioral effects on sea turtles or effects on sea turtle prey species. Cable emplacement is expected to affect only a small percentage of foraging habitat available to sea turtles, and any effects on sea turtles or their prey species would be localized and short term. Recolonization and recovery of prey species is expected to occur within 2 to 4 years (Van Dalfsen and Essink 2001) but could occur in as little time as 100 days (Dernie et al. 2003). Given the short-term and localized nature of impacts and the available sea turtle habitat in the geographic analysis area, impacts of new cable emplacement on sea turtles are expected to be minimal.

Cable emplacement and maintenance for the Proposed Action may require sand bedform removal. Potential methods for removal include trailing suction hopper dredge, as well as cutterhead or backhoe dredging in limited areas. Dredging would result in increased suspended sediment concentrations and may result in physical interactions with the dredge (i.e., entrainment, impingement, or capture). As described in Section 3.5.7.3, increased suspended sediment concentrations could result in behavioral effects on sea turtles or effects on sea turtle prey species. Increased suspended sediment concentrations associated with hopper dredges may reach 475.0 mg/L (NMFS 2020b citing Anchor Environmental 2003) and could occur within a radius of up to 3,937 feet (1,200 meters) (NMFS 2020k citing Wilber and Clarke 2001). Increased suspended sediment concentrations associated with cutterhead dredging could reach 550.0 mg/L (NMFS 2020g citing Nightengale and Simenstad 2001) and would occur within a radius of up to 1,640 feet (500 meters) (NMFS 2020e citing Hayes et al. 2000; NMFS 2020f citing LaSalle 1990; NMFS 2020h citing USACE 1983). Elevated suspended sediment concentrations associated with mechanical dredging (e.g., backhoe dredging) could reach 445.0 mg/L (NMFS 2020i citing USACE 2001) and would occur within a radius of up to 2,400 feet (732 meters) (NMFS 2020c citing Burton 1993; NMFS 2020j citing USACE 2015). Elevated suspended sediment concentrations have adverse effects on benthic communities when they exceed 390 milligrams per liter (NMFS 2020d citing USEPA 1986). See Section 3.5.5 for a discussion of impacts on prey species. There are no data to suggest that suspended sediment has physiological effects on sea turtles.

Dredging associated with cable emplacement may also result in physical interactions with the dredge (i.e., entrainment, impingement, or capture). As described in Section 3.5.7.3, hopper dredges may result in injury or mortality of sea turtles (Ramirez et al. 2017b, 2017c, citing Dickerson et al. 1990, 1991; Ramirez et al. 2017d citing Reine et al. 1998; Ramirez et al. 2017e citing Richardson 1990), but mechanical dredging is not expected to capture, injure, or kill sea turtles (USACE 2020). Sea turtles are generally not known to be vulnerable to entrainment in cutterhead dredges. Based on the small size of their intake and relatively low intake velocity, cutterhead dredges are not expected to entrain sea turtles (NMFS 2018). Though hopper dredging would be the primary dredging method for sand bedform removal, the risk of injury or mortality of individual sea turtles due to dredging associated with offshore wind activities, which generally occurs in offshore waters, is considered low.

Electric and magnetic fields and cable heat: During operation, the Proposed Action would result in the production of EMFs and heat. Though there are no data on EMF impacts on sea turtles associated with underwater cables, magnets can cause migratory disruptions (Luschi et al. 2007), indicating that EMFs could cause migratory deviations. Results of Atlantic Shores' EMF study (COP Volume II, Appendix II-I; Atlantic Shores 2023) indicate that EMFs from the Project would pose minimal risk to sea turtles. Given these results and the minor deviations, if any, that would be expected from EMFs associated with offshore wind activities, any increased energy expenditure due to migratory deviations would not be biologically significant for sea turtles. Heat has the potential to impact benthic species, which serve as prey for some sea turtle species, as described in Section 3.5.7.3. Atlantic Shores would bury cables to a target depth of 5 to 6.6 feet (1.5 to 2 meters) wherever possible (GEO-07; Appendix G, Table G-1). In areas where sufficient cable burial is not feasible, surface cable protection would be utilized. Cable burial and surface protection, where necessary, would minimize EMF and heat exposure. Any potential impacts on sea turtles from EMFs and heat associated with the Proposed Action are expected to be too small to be measured.

Gear utilization: Monitoring surveys for the Proposed Action include otter trawl surveys, trap surveys, hydraulic clam dredge surveys, grab sampling, and underwater imagery. As described in Section 3.5.7.3, mobile gear surveys (e.g., trawl and dredge surveys) have the potential to capture sea turtles, and fixed gear surveys with vertical lines (e.g., trap surveys) have the potential to entangle sea turtles. Trawl surveys for the Proposed Action would be limited to 20 minutes and would not be expected to result in mortality of sea turtles if incidentally captured (Epperly et al. 2002; Sasso and Epperly 2006). BOEM anticipates capture probability in otter trawls to be low and expects incidentally caught turtles to resume normal behavior upon release. Therefore, the risk to sea turtles from otter trawl surveys would be negligible. The short tow times of clam dredge surveys are expected to minimize risk of sea turtle interaction. Therefore, effects of clam dredge surveys are expected to be negligible. The likelihood of entanglement in trap surveys for the Proposed Action would be negligible given the patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the relatively limited duration of each sampling event. Additionally, ventless trap surveys for the Proposed Action would utilize groundlines, ropeless gear, and biodegradable components to further reduce entanglement risk.

Sea turtles could also be affected by these surveys through survey vessel traffic. Survey vessels would produce underwater noise and increase the risk of vessel strikes. The effects of vessel noise and increased strike risk would be similar to those discussed under the *Noise* and *Traffic* IPFs in this section.

In addition to direct effects on sea turtles, monitoring surveys may indirectly affect these species through capture of prey items. However, biological monitoring proposed for the Project is expected to be non-extractive, returning captured organisms at the end of each sampling event. Therefore, indirect effects on sea turtles due to collection of potential prey items would be negligible, as described in Section 3.5.7.3.

Monitoring survey sampling events are expected to be short term, occurring at fixed intervals over the lifetime of the Proposed Action. Impacts of gear utilization for the Proposed Action on sea turtles are expected to be negligible given the negligible risk of mortality, the negligible risk of entanglement, and the negligible effect on sea turtle prey availability.

Lighting: The construction and installation, O&M, and decommissioning of the Project would produce artificial light on the OCS. Vessels and lighting of heavy equipment in work areas would produce short-term, continuous light. Offshore structures would be sources of long-term, intermittent light.

Project vessels would have deck and safety lighting. Vessel operation would be greatest during the construction and installation phase of the Project. The incremental contribution associated with construction and installation of the Proposed Action would be lighting of up to 51 vessels,[1] though a maximum of 16 vessels are expected to operate at one time for a given construction activity. These vessel numbers represent a small fraction of the light sources anticipated under Alternative A. Lighting of heavy equipment in work areas during the construction and installation and decommissioning phases of the Project would also introduce continuous artificial light to the OCS. Such lighting would be short term and would represent a small fraction of light sources anticipated under the No Action Alternative.

Under the Proposed Action, up to 200 WTGs, 1 met tower, 4 metocean buoys, and 10 OSSs would be lit with USCG navigational and FAA hazard lighting. In accordance with BOEM lighting guidelines (BOEM 2021a), all WTGs in excess of 699 feet (213 meters) above ground level would be lit with two synchronized red flashing obstruction lights (with medium-intensity FAA model L-864 and light-emitting diode color between 800 and 900 nanometers) placed on the back of the nacelle on opposite sides, and up to three FAA model L-810 red flashing lights at mid-mast level, adding up to 1,000 new red flashing lights to the offshore environment where none currently exist. Additionally, marine navigation lighting would consist of multiple types of flashing yellow lights on the corners of each OSS, corner-located WTGs, and significant peripheral structures such as a met tower, outer boundary WTGs, and interior WTGs. Atlantic Shores is considering use of an FAA-approved ADLS (COP Volume II, Section 4.3.2.2; Atlantic Shores 2023) (VIS-05; Appendix G, Table G-1), subject to FAA and BOEM approval, which is a lighting system that would only activate WTG and met tower lighting when aircraft enter a predefined airspace. For the Proposed Action, based on historical air traffic data, obstruction light activation under ADLS was estimated to occur less than 9 hours over the course of 1 year for flights passing through the Project light activation volume, which equals less than 1 percent of the time that full-time obstruction lights would be active (COP Volume II, Appendix II-M4; Atlantic Shores 2023).

As discussed in Section 3.5.7.3, light may elicit short-term, localized behavioral impacts in sea turtles, including attraction or avoidance. Light may also affect prey for some sea turtle species (Section 3.5.5).

[1] This is the maximum number of vessels that could be present at a given time in the unlikely event that all construction activities for the Project were to occur simultaneously.

Vessel mast lighting and FAA lighting are expected to be too high to penetrate the water surface. However, deck lighting, equipment lighting, and navigation lighting on structures at the perimeters of the wind farm would be close to sea level and could penetrate the water surface. Artificial Project lighting that would penetrate the surface is expected to be localized and minimal. Additionally, there is no evidence that lighting on oil and gas platforms in the Gulf of Mexico has had any effect on sea turtles over decades of operation (BOEM 2019). Therefore, light associated with the Proposed Action is expected to have a minor effect on sea turtles.

Noise: Underwater anthropogenic noise sources associated with construction and installation and O&M of the Proposed Action would include G&G surveys, pile driving, cable laying, WTGs, vessels, and potentially aircraft and drilling. As described in Section 3.5.7.3, these noise sources have the potential to affect sea turtles through behavioral or physiological effects. Underwater sound propagation modeling for impact pile driving was conducted in support of the COP (see COP Volume II, Appendix II-L1; Atlantic Shores 2023). The potential impacts associated with each noise source are discussed separately in the following paragraphs.

Noise: Aircraft. Aircraft may be used to support construction and installation of the Proposed Action. Helicopters may be used for crew transfer operations or visual inspection of equipment during installation. Atlantic Shores may utilize fixed-wing aircraft to support environmental monitoring and mitigation during construction and installation activities. As described in Section 3.5.7.3, aircraft traveling at relatively low altitude have the potential to elicit stress or behavioral responses in sea turtles (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). BOEM assumes aircraft transiting to and from the Project area would fly at sufficient altitudes to avoid behavioral effects on sea turtles, with the exception of inspections, take-off, and landing. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area, and are not expected to be biologically significant.

Noise: Drilling. Though not anticipated, drilling could occur if pile driving encounters refusal. The probability of such an action is considered low.

Noise: G&G surveys. HRG surveys may be conducted during construction and installation to support site clearance activities. As described in Section 3.5.7.3, G&G survey noise could affect sea turtles through auditory injuries, stress, disturbance, and behavioral responses. However, HRG survey equipment produces less-intense noise and operates in smaller areas than other G&G survey equipment (e.g., seismic air guns). Sound levels produced by HRG survey equipment are not expected to cause hearing damage in sea turtles, though behavioral effects could occur (BOEM 2014). Atlantic Shores has proposed the establishment and monitoring of protection zones (e.g., clearance zone, shutdown zone) to create sufficient opportunity to modify or halt Project activities, such as HRG surveys, potentially harmful to protected species (SEA-03; Appendix G, Table G-1). These zones would be visually monitored by NMFS-approved PSOs, which would alert Project personnel to the presence of protected species within these zones and would be equipped with night vision devices for monitoring during low-visibility conditions (SEA-04, Appendix G, Table G-1). Additionally, Atlantic Shores has proposed the implementation of equipment operating procedures to control the noise generated by survey equipment to prevent exposure of harmful sound levels to protected marine life, including ramp-up and ramp-down procedures (SEA-06; Appendix G, Table G-1). BOEM expects any noise impacts associated with HRG surveys would be minor.

Noise: Impact and vibratory pile driving. The loudest source of underwater noise associated with the Proposed Action would be impact pile driving during construction and installation. As noted above, underwater sound propagation modeling for impact pile driving was conducted in support of the COP (see COP Volume II, Appendix II-L1; Atlantic Shores 2023).

PTS thresholds developed by Finneran et al. (2017) were used to estimate acoustic ranges ($R_{95\%}$), radial distances that encompass 95% of the areas exposed to SELs above recommended sea turtle injury thresholds for impact pile driving (Table 3.5.7-6). For 49-foot (15-meter) monopiles (i.e., the maximum foundation pile diameter modeled), impact pile-driving sound levels could exceed recommended sea turtle injury thresholds up to 2.2 miles (3.5 kilometers) away, without sound mitigation (Table 3.5.7-5). Assuming 10 dB of noise attenuation due to noise-mitigating technology, the level of attenuation generally expected to be achievable by a single noise attenuation system (Bellman et al. 2020) and required for mitigation for the Proposed Action's LOA, recommended sea turtle injury thresholds could be exceeded within 0.8 mile (1.3 kilometers) of pile driving (Table 3.5.7-5). Exposure ranges ($ER_{95\%}$) were estimated from modeled sea turtle movements in the Offshore Project area. These ranges represent the radial distance from a pile-driving noise source which encompassed the closest point of approach for 95 percent of simulated animals (animats) exposed above relevant cumulate SEL injury thresholds. Taking expected sea turtle movements in the Offshore Project area into account, the injury exposure ranges are modeled to be up to 0.9 mile (1.5 kilometers) without mitigation and up to 0.11 miles (0.18 kilometers) with 10 dB of noise attenuation (see COP Volume II, Appendix II-L1, Table 23; Atlantic Shores 2023).

Table 3.5.7-5. Acoustic Ranges ($R_{95\%}$), in kilometers to cumulative SEL injury thresholds for one 15-meter monopile using a Menck MHU4400S hammer at two selected modeling locations

	Threshold (dB)	Attenuation Level (dB)	
		0	10
Sea turtles	204	3.50	1.30

Source: Summarized from COP Volume II, Appendix II-L1, Table F-90; Atlantic Shores 2023.

To estimate exposure ranges for behavioral reactions to impact pile driving, the behavioral threshold developed by McCauley et al. (2000) was used (Table 3.5.7-6). Without mitigation, exposure ranges for sea turtle behavioral thresholds were modeled to be up to 1.8 miles (3.0 kilometers). Assuming 10 dB of noise attenuation due to noise-mitigating technology, exposure ranges for behavioral thresholds were modeled to be up to 0.9 mile (1.4 kilometers).

Table 3.5.7-6. Recommended sea turtle acoustic thresholds for impulsive noise sources

PTS Onset		Behavior
Lpk[1]	SEL[2]	Lrms[3]
232	204	175

Sources: Finneran et al. 2017; McCauley et al. 2000.
[1] Lpk = peak sound pressure level in decibels referenced to 1 microPascal.
[2] SEL = sound exposure level in decibels referenced to 1 microPascal squared second.
[3] Lrms = root-mean-square sound pressure level in decibels referenced to 1 microPascal.

Sea turtle noise exposure was modeled with and without noise mitigation for three construction schedules. The construction schedules included a seasonal pile driving restriction (January–April) to mitigate effects on NARW. Construction Schedule 3 (Table 3.5.7-7), which assumes a 1-year buildout, resulted in the highest number of sea turtle exposures[2] assuming 10 dB of noise attenuation. Without mitigation, an estimated 2 green sea turtles, 42 Kemp's ridley sea turtles, 14 leatherback sea turtles, and 299 loggerhead sea turtles are expected to be exposed to sound levels exceeding recommended injury thresholds (Table 3.5.7-8). An estimated 4 green sea turtles, 137 Kemp's ridley sea turtles, 73 leatherback sea turtles, and 2,944 loggerhead sea turtles could be exposed to sound levels exceeding recommended behavioral thresholds. Assuming 10 dB of noise attenuation, 1 green sea turtle, 3 Kemp's ridley sea turtles, and 2 leatherback sea turtles, and 15 loggerhead sea turtles are expected to be exposed to sound levels exceeding recommended injury thresholds; an estimated 2 green sea turtles, 51 Kemp's ridley sea turtles, 24 leatherback sea turtles, and 915 loggerhead sea turtles could be exposed to sound levels exceeding recommended behavioral thresholds (Table 3.5.7-8).

Table 3.5.7-7. Days of pile driving for each pile type, hammer type, and driving schedule under Construction Schedule 3

Construction Month	Number of Days		
	WTG Monopile 15-Meter Diameter MHU4400S (1 pile/day)	WTG Monopile 15-Meter Diameter IHCS2500 (2 piles/day)	OSS Jacket 5-Meter Diameter IHCS2500 (4 piles/day)
May	9	3	0
Jun	8	16	6
Jul	10	15	6
Aug	0	25	6
Sep	1	12	6
Oct	13	6	0
Nov	3	1	0
Dec	1	0	0
Total # of Days	45	78	24

Source: Summarized from COP Volume II, Appendix II-L1, Table 3; Atlantic Shores 2023.
Note: Construction Schedule 3 is presented as it resulted in the highest number of sea turtle exposures among the construction schedules modeled.

[2] Each exposure represents an individual animal exposed to sound levels exceeding the recommended acoustic thresholds.

Table 3.5.7-8. Number of sea turtles estimated to be exposed to behavioral and injury thresholds with and without noise mitigation

Species	0 dB Attenuation		10 dB Attenuation	
	Behavioral	Injury	Behavioral	Injury
Green	4	2	2	1
Kemp's ridley	137	42	51	3
Leatherback	73	14	24	2
Loggerhead	2,944	299	915	15

Source: Summarized from COP Volume II, Appendix II-L1, Table 21; Atlantic Shores 2023.

As described in Section 3.5.7.3, pile driving can result in behavioral and physiological effects on sea turtles. Atlantic Shores has proposed measures to avoid, minimize, and mitigate impacts of pile-driving noise on sea turtles, including utilization of protected species observers to monitor and enforce appropriate monitoring and exclusion zones (SEA-03, SEA-04; Appendix G, Table G-1), noise-reducing technologies and potential use of soft starts (SEA-06; Appendix G, Table G-1), and scheduling pile driving to avoid completion after dark when sea turtles are difficult to observe (SEA-05; Appendix G, Table G-1). When nighttime pile driving cannot be avoided, or when inclement weather limits visibility, night vision devices such as night vision binoculars and/or infrared cameras would be used to monitor for sea turtle presence in the monitoring and exclusion zones (SEA-04; Appendix G, Table G-1). With these measures in place, no significant injuries to sea turtles are expected. Temporary behavioral and physiological effects are expected to occur, but stock- or population-level effects are unlikely.

Vibratory pile driving would be used for installation of temporary offshore cofferdams at the exit point of HDD for each of the export cable landfalls. Non-impulsive noise associated with vibratory pile driving has the potential to result in physiological or behavioral effects in sea turtles. Sound measurements by Illingworth and Rodkin (2017) were used to conduct underwater sound propagation modeling for vibratory pile driving of the temporary cofferdams to support Atlantic Shores' LOA application. The maximum root mean squared sound pressure level recorded in the Illingworth and Rodkin (2017) study was 170 dB re 1 µPa, which is below the recommended behavioral threshold for non-impulsive sounds (i.e., 175 dB re 1 µPa). Therefore, it is extremely unlikely that sea turtles would be exposed to sound levels exceeding their recommended behavioral or physiological thresholds during vibratory pile driving of the temporary cofferdams. Additionally, vibratory pile driving would not occur between Memorial Day and Labor Day and would therefore occur outside of the peak sea turtle density period. Given the relatively low anticipated source levels associated with vibratory pile driving of cofferdams and the seasonal restriction on this activity, noise impacts associated with vibratory pile driving of cofferdams are unlikely to occur.

Noise: Operational WTGs. As discussed in Section 3.5.7.3, operating WTGs generate non-impulsive underwater noise that is audible to sea turtles. However, maximum noise levels anticipated from operating WTGs are below recommended thresholds for sea turtle injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. WTGs associated with the Proposed Action are expected to be larger than WTGs operating currently (maximum of 6.15 MW) and may therefore produce higher noise levels. As the best available data indicates that sound levels produced by operating WTGs would be below sea turtle behavior and injury thresholds, WTG noise impacts on sea turtles associated with the Proposed Action are expected to be minimal. However, if the larger WTGs installed for the Proposed Action produce sound levels that exceed recommended thresholds, WTG noise may result in minor impacts on sea turtles.

Noise: **Cable laying.** As described in Section 3.5.7.3, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and cable protection installation. Underwater noise levels associated with cable-laying activities are expected to exceed 120 dB re 1 μPa in a 98,842-acre (40,000-hectare) area surrounding the source (Nedwell and Howell 2004; Taormina et al. 2018). The incremental contribution of the Proposed Action would be noise-producing activities associated with an additional 1,025 miles (1,650 kilometers) of export, interlink, and interarray cables. The incremental impacts of the Proposed Action are not expected to exceed the noise impacts of cable-laying activities under Alternative A, which are not expected to result in adverse effects on sea turtles given the limited duration of noise exposure based on the mobile nature of the ensonified area.

Noise: Vessels. As described in Section 3.5.7.3, vessels associated with the Proposed Action would generate low-frequency (generally 10 to 500 Hz), non-impulsive noise that could elicit behavioral or stress responses in sea turtles (NSF and USGS 2011; Samuel et al. 2005). It is estimated that up to 51 vessels could be utilized during construction and installation of the Proposed Action, though a maximum of 16 vessels are expected to operate at one time for a given construction activity. Project vessel traffic may result in behavioral responses in sea turtles, but these responses would dissipate once the vessel leaves the area. Therefore, effects of vessel noise on individual sea turtles are expected to be short term and localized.

Presence of structures: The Proposed Action would include construction of up to 200 WTGs, up to 10 OSSs, and 1 permanent met tower, and installation of up to 289 acres (117 hectares) of hard scour protection around the foundations, and up to 595 acres (241 hectares) of hard cable protection (294 and 301 acres [119 and 122 hectares] around the export and interarray cables, respectively) (Appendix D, Table D.A2-2; COP Volume I, Table 4.4-2; Atlantic Shores 2023). As described in Section 3.5.7.3, the installation of WTGs, OSSs, and hard protection could result in hydrodynamic changes, entanglement or ingestion of lost fishing gear, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption.

The presence of WTGs, OSSs, and the met tower could alter local hydrodynamic patterns at a fine scale, which could have localized impacts on prey distribution and abundance. However, these localized impacts may not translate to impacts on sea turtle prey species.

The presence of structures may have an artificial reef effect, resulting in increased recreational fishing activity in the vicinity of the WTGs and OSSs. An increase in fishing activity would increase risk of entanglement or ingestion of lost fishing gear, which can lead to sea turtle injury or death. Atlantic Shores has proposed the removal of marine debris caught on Offshore Project structures, when safe and practicable, to reduce the risk of sea turtle entanglement (SEA-02; Appendix G, Table G-1). The artificial reef effect could also result in beneficial impacts on sea turtles due to prey aggregation. The aggregation of prey species would increase sea turtle foraging opportunities around offshore wind facility structures, potentially leading to increased residence times around the WTGs. However, the artificial reef effect could also attract sea turtle predators (i.e., sharks) (Paxton et al. 2020). Predator attraction may result in increased risk of predation for sea turtles.

The presence of offshore wind facility structures could result in sea turtle avoidance and displacement, which could potentially move sea turtles into areas with lower habitat value or with a higher risk of vessel collision or fisheries interactions. Any avoidance or displacement is expected to be short term. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of wind energy facilities or result in gear shifts. Risk of interaction with fishing vessels is not expected to be greater than current risk, but gear shifts that result in an increased number of vertical lines in the water would increase the risk of sea turtle interactions with fishing gear. Disruption of normal behaviors, such as foraging and migration, could occur due to the presence of offshore structures. Although migrations could be temporarily interrupted as sea turtles stop to forage or rest around structures, the presence of structures is not expected to result in measurable changes in sea turtle migratory patterns.

Traffic: Construction and installation, O&M, and decommissioning of the Proposed Action would result in increased vessel traffic due to Project vessels transiting to and from the Offshore Project area. As described in Section 3.5.7.3, vessel strikes are an increasing concern for sea turtles and could result in injury or death of individual sea turtles. Risk of injury or death would be highest for loggerheads, which have the highest density in the Project area. Vessel strike is most likely to occur when Project vessels are transiting to and from the Project area.

Atlantic Shores expects up to 51 vessels to be used during construction and installation of the Project, though a maximum of 16 vessels are expected to operate at one time for a given construction activity. Impacts associated with Project traffic during the O&M phase of the Project would be lower due to less simultaneous vessel activity. Atlantic Shores generally expects 5 to 11 vessels to operate at a given time, though up to 22 vessels may be required in some repair scenarios. The increase in traffic due to the Proposed Action would only represent a small, incremental increase in overall traffic in the geographic analysis area. Atlantic Shores has proposed vessel strike avoidance procedures, including adherence to marine wildlife viewing and safe boating guidelines (GARFO 2021) and training for vessel crew on sea turtle spotting and identification, observation reporting protocol, and vessel strike avoidance procedures (SEA-01; Appendix G, Table G-1). Additionally, Atlantic Shores would comply with the Project Design Criteria and Best Management Practices developed to mitigate effects on protected species during offshore wind data collection (BOEM 2021b), including avoiding transiting through areas of visible jellyfish aggregations or floating vegetation during times of year when sea turtles are known to occur in the area or slowing to 4 knots (7 kilometers per hour) if such areas cannot be avoided due to operational safety concerns. Atlantic Shores has proposed additional measures to avoid, minimize, and mitigate impacts on marine mammals associated with vessel traffic that would also minimize impacts on sea turtles (MAR-04; Appendix G, Table G-1). Given the small, incremental increase in vessel traffic compared to existing traffic, the measures that would be taken to minimize vessel traffic impacts, and the patchy distribution of sea turtles in the Project area, the increased collision risk associated with the incremental increase in vessel traffic due to Project vessels may affect individual sea turtles but would not be expected to have stock- or population-level impacts on sea turtles.

Impacts of Alternative B – Proposed Action on ESA-Listed Sea Turtles

All sea turtle species that are likely to occur in the Offshore Project area are listed under the ESA. Therefore, the impacts of the Proposed Action on ESA-listed sea turtle species are identical to the impacts previously described for construction and installation, O&M, and decommissioning activities associated with the Proposed Action.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). Installation of a new bulkhead and maintenance dredging, conducted in coordination with Atlantic City's dredging of the adjacent berths, have been proposed in Atlantic City's Inlet Marina, where the Atlantic City O&M facility would be located. Bulkhead installation and dredging may affect sea turtles. These activities in Atlantic City's Inlet Marina would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead and dredging activities are considered to be a connected action under NEPA and are evaluated in this section. BOEM expects the connected action to affect sea turtles through the following primary IPFs.

Noise: Underwater anthropogenic noise sources associated with the connected action would include vibratory pile driving and vessels during construction. As described in Section 3.5.7.3, these noise sources have the potential to affect sea turtles through behavioral or physiological effects. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

The connected action would include installation of approximately sixty 16-inch (0.4-meter) steel or composite vinyl sheet piles. The total length for the proposed bulkhead is 356 feet (109 meters). Sheet piles would be installed using a vibratory hammer. Vibratory hammers generate non-impulsive noise that can result in behavioral effects in sea turtles. Bulkhead work would be conducted under USACE Nationwide Permit 3 or Nationwide Permit 13, which would not authorize any activities that are likely to directly or indirectly jeopardize the continued existence of any ESA-listed species, including sea turtles.

As described in Section 3.5.7.3, vessels associated with the connected action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in sea turtles. During dredging three vessels are expected to be used: a dredge vessel, a tug, and a scow. Any effects of vessel noise on individual sea turtles are expected to be temporary and localized. Based on the small volume of vessel traffic associated with the connected action, vessel noise impacts would be extremely unlikely to occur.

Port utilization: In-water activities for the connected action include dredging, which may affect sea turtles through physical interactions with the dredge and increased suspended sediments, as described in Section 3.5.7.3. Habitat disturbance and modification associated with dredging may also affect benthic prey species.

Dredging for the connected action could affect sea turtles through physical interactions (i.e., impingement, entrainment, or capture). Dredging in the Atlantic City Inlet Marina would primarily utilize a hydraulic cutterhead dredge, though a mechanical dredge may be used to access small marina, canal, or lagoon areas. As noted in the evaluation of impacts for the Proposed Action, neither cutterhead nor mechanical dredging is expected to capture, injure, or kill sea turtles (NMFS 2018; USACE 2020). Additionally, sea turtles are unlikely to occur within Atlantic City Inlet Marina. Therefore, effects of physical interactions with the dredge are not expected to occur.

Dredging for the connected action would result in temporary increases in suspended sediment concentrations in the associated area. As described in Section 3.5.7.3, increased suspended sediment concentrations could result in behavioral effects on sea turtles or physiological effects on sea turtle prey species. Any behavioral effects would be too small to be detected (NMFS 2020a), and no effects are anticipated if sea turtles swim through the area of elevated suspended sediment. Increased suspended sediment concentrations could also affect prey species. However, any effects on sea turtles or their prey species would be localized and short term, as described in Section 3.5.7.3. Given the localized and temporary or short-term nature of the effects and the unlikely presence of sea turtles, any effects of increased suspended sediments on sea turtles would be negligible.

Habitat disturbance and modification associated with dredging could result in short-term reductions in foraging habitat or short-term effects on prey availability for some sea turtle species. Benthic communities would be expected to recover within 1 year of disturbance (NMFS 2017). Maintenance dredging for the connection action is not expected to have a substantial impact on benthic community composition following recolonization of the dredge area or to alter the sediment composition compared to the existing substrate in the dredge area. Although habitat disturbance and modification may result in reductions in foraging habitat availability or prey availability, these reductions would be short term, and there would be no changes in the benthic community composition. Additionally, sea turtle foraging in the Project area for the connected action is extremely unlikely, and the affected area would be very small relative to available sea turtle foraging habitat. Therefore, any effects on sea turtles due to habitat disturbance and modification would be negligible.

Traffic: The connected action would result in increased vessel traffic during installation of the new bulkhead and maintenance dredging. As described in Section 3.5.7.3, vessel strikes could result in injury or death of sea turtles.

Only a small number of vessels (i.e., three) would be used for maintenance dredging. All construction vessels would be operating at slow speeds (i.e., 10 knots [19 kilometers per hour] when transiting in the action area for the connection action and 4 knots [7 kilometers per hour] when dredging). Additionally, sea turtles are not generally found in the Project area for the connected action. Based on the low volume of traffic and unlikely sea turtle presence in the Project area for the connected action, vessel strikes associated with Project traffic for the connected action would be extremely unlikely to occur.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; and onshore development activities. The connected action would involve installation of a new bulkhead and maintenance dredging at Atlantic City Inlet Marina. Ongoing and planned offshore wind activities in the geographic analysis area for sea turtles include the construction and installation, O&M, and decommissioning of 33 planned offshore wind projects.

Accidental releases: The cumulative impacts on sea turtles related to exposure to accidental releases from ongoing and planned activities would likely be undetectable. The incremental impacts of the Proposed Action would not increase the risk of accidental releases beyond that described under the No Action Alternative.

Cable emplacement and maintenance: The 3,884 acres (1,572 hectares) of seabed disturbance associated with the Proposed Action represents 9.3 percent of the 41,901 acres (16,957 hectares) of seabed expected to be disturbed on the OCS due to existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D.A2-1). Additionally, Project dredging is expected to represent a small proportion of dredging that would occur for ongoing and planned activities, including the Proposed Action. The incremental contributions of the construction and installation of the Proposed Action to the combined impacts of cable emplacement and maintenance associated with ongoing and planned activities would be noticeable.

Electric and magnetic fields and cable heat: The 988 miles (1,590 kilometers) of submarine cables associated with the Proposed Action represent 7 percent of the 14,052 miles (22,615 kilometers) of subsea cables anticipated for existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D.A2-1). The incremental contributions of the Proposed Action to the combined EMFs and cable heat generated by ongoing and planned activities would be noticeable given the small area that would be affected by the Project.

Gear utilization: The incremental contributions of the Proposed Action to gear utilization on the OCS associated with ongoing and planned activities would be noticeable.

Lighting: The incremental contributions of the Proposed Action to light on the OCS associated with ongoing and planned activities would be undetectable given the large volume of existing vessel traffic, and any artificial light penetrating the sea surface is expected to be localized and minimal.

Noise: The loudest sources of noise are expected to be pile driving, assuming piled foundations are selected, followed by vessels. The up-to-211 structures for the Proposed Action represent less than 7 percent of the 3,226 offshore wind structures anticipated on the OCS in 2028 and beyond for existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D-3), although some foundations for the Project and at other planned wind farms may be installed without impact pile driving. The incremental contributions of construction and installation and O&M of the Proposed Action to the cumulative noise impacts associated with ongoing and planned activities would be noticeable given the magnitude of ongoing and planned activities.

Port utilization: As port expansion is not proposed for the Project, the Proposed Action would not contribute to the cumulative impacts of port utilization associated with ongoing and planned activities in the geographic analysis area.

Presence of structures: The up-to-211 structures for the Proposed Action represent less than 7 percent of the 3,226 offshore wind structures anticipated on the OCS in 2028 and beyond for existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D-3). The incremental contributions of the Proposed Action to the cumulative impacts due to the presence of structures associated with ongoing and planned activities would be noticeable.

Traffic: The incremental contributions of the Proposed Action to the combined impacts of vessel traffic associated with ongoing and planned activities would be undetectable given the large volume of existing vessel traffic in the geographic analysis area.

Conclusions

Impacts of Alternative B – Proposed Action. Construction, operation, and decommissioning of the Proposed Action would result in **negligible** to **minor** adverse impacts on sea turtles and could include **minor beneficial** impacts. Adverse impacts would result mainly from pile-driving noise. Beneficial impacts could result from the presence of structures. Impact determinations for each IPF are provided in the following paragraphs.

Adverse impacts associated with accidental releases, EMF, aircraft noise, G&G survey noise, WTG noise, cable-laying noise, entanglement or ingestion of fishing gear associated with the presence of structures, avoidance or displacement associated with the presence of structures, behavioral disruptions associated with the presence of structures, and potentially WTG noise would be negligible due to being unlikely to occur or too small to be measured.

Adverse impacts associated with light, cable emplacement and maintenance, vessel noise, displacement into higher-risk areas associated with the presence of structures, vessel traffic, and potentially WTG noise would be minor. These impacts are generally expected to be localized and short term, although some may be long term. Adverse effects on individual sea turtles may occur due to these impacts, but no stock- or population-level effects are anticipated.

Adverse impacts associated with pile-driving noise would be minor. Despite potential impacts on individual sea turtles, the number of affected individuals is expected to be small, and no stock- or population-level effects are anticipated.

Habitat conversion and prey aggregation associated with the presence of structures could result in **minor beneficial** impacts due to increased foraging opportunities for sea turtles. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. These effects would be localized and are not expected to affect individual fitness.

BOEM expects that the connected action alone would have negligible impacts on sea turtles.

Cumulative Impacts of Alternative B – Proposed Action. Cumulative impacts on sea turtles from ongoing and planned activities, including the Proposed Action, would range from **negligible** to **minor** adverse and would also include **minor beneficial** impacts. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Considering all IPFs together, BOEM anticipates that the cumulative impacts would result in **minor** impacts on sea turtles due to the impacts being detectable and measurable but not resulting in population-level impacts. The main drivers for this impact rating are impact pile-driving noise, vessel noise, the presence of structures, and vessel traffic. The Proposed Action would contribute to the overall impact rating primarily through impact pile-driving noise, vessel noise, and the presence of structures.

3.5.7.6 Impacts of Alternative C on Sea Turtles

Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) would avoid or minimize impacts on two AOCs identified by NMFS within the Lease Area that have pronounced bottom features (e.g., ridges, swales) and produce valuable habitats.

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternative C would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.7.5).

Offshore Activities and Facilities

Offshore activities would not differ between the Proposed Action and Alternative C. However, the location of interarray and export cable routes may differ somewhat. Differences in location would be minor but would avoid one or, in the case of Alternative C4 or the combination of Alternatives C1 and C2, both AOCs. The avoidance or minimization of impacts on these valuable habitat areas would potentially benefit benthic foraging sea turtle species. Though avoidance or minimization of impacts on these valuable habitats may benefit some sea turtle species, this benefit would not measurably reduce construction and installation impacts on sea turtles.

The number of WTG and OSS facilities may also differ under Alternative C. Under Alternative C, up to 29 WTGs and 1 OSS may be removed, which may also reduce the length of the interarray cables. A reduction in the number of WTGs and OSSs, and a reduction in the length of interarray cable, would reduce impacts due to cable emplacement and maintenance, EMF, noise, and the presence of structures. Although impacts would be reduced, BOEM anticipates that O&M impacts on sea turtles under Alternative C would not be measurably different from those anticipated under the Proposed Action.

Impacts of Alternative C on ESA-Listed Sea Turtles

All sea turtle species that are likely to occur in the Offshore Project area are listed under the ESA. Therefore, the impacts of Alternative C on ESA-listed sea turtle species are identical to the impacts previously described for construction and installation, O&M, and decommissioning activities associated with Alternative C.

Cumulative Impacts of Alternative C

The contribution of Alternative C to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternative C would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternative C. Impacts of Alternative C would not be measurably different than the impacts of the Proposed Action. Therefore, construction, operation, and decommissioning of Alternative C would result in **negligible** to **minor** adverse impacts on sea turtles due primarily to pile-driving noise and could include **minor beneficial** impacts due to the presence of structures and increased feeding potential. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Cumulative Impacts of Alternative C. The cumulative impacts on sea turtles from ongoing and planned activities, including Alternative C, would range from **negligible** to **minor** adverse and would also include **minor beneficial** impacts. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative C, would result in **minor** impacts on sea turtles due to the impacts being detectable and measurable but not resulting in population-level impacts.

3.5.7.7 Impacts of Alternatives D and E on Sea Turtles

Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) would include an alteration in WTG layout and number to minimize visual impacts. Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would include modifications to WTG layout to minimize impacts on existing ocean uses by creating a 0.81-nautical mile (1,500-meter) to 1.08-nautical mile (2,000-meter) setback between Atlantic Shores South and Ocean Wind 1 (OCS-A 0498).

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternatives D and E would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.7.5).

Offshore Activities and Facilities

Offshore activities would not differ between the Proposed Action and Alternatives D and E. However, the location or number of WTGs would differ under Alternatives D and E. Under Alternative D, up to 31 WTGs may be removed. Under Alternative E, up to 5 WTGs may be removed or microsited. Any reduction in the number of WTGs may also reduce the length of the interarray cable. A reduction in the number of WTGs, and a reduction in the length of interarray cable, would reduce cable emplacement and noise impacts. Reduction in the number of WTGs may also reduce impacts due to EMFs, light, O&M-related noise, and the presence of structures. Although impacts would be reduced, BOEM anticipates that construction and installation impacts on sea turtles under Alternatives D and E would not be measurably different from those anticipated under the Proposed Action.

Impacts of Alternatives D and E on ESA-Listed Sea Turtles

All sea turtle species that are likely to occur in the Offshore Project area are listed under the ESA. Therefore, the impacts of Alternatives D and E on ESA-listed sea turtle species are identical to the impacts previously described for construction and installation, O&M, and decommissioning activities associated with Alternatives D and E.

Cumulative Impacts of Alternatives D and E

The contribution of Alternatives D and E to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternatives D and E would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternatives D and E. Impacts of Alternatives D and E would not be measurably different than the impacts of the Proposed Action. Therefore, construction, operation, and decommissioning of Alternatives D and E would result in **negligible** to **minor** adverse impacts on sea turtles due primarily to pile-driving noise and could include **minor beneficial** impacts due to the presence of structures. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Cumulative Impacts of Alternatives D and E. Cumulative impacts on sea turtles from ongoing and planned activities, including Alternative D or E, would range from **negligible** to **minor** adverse and would also include **minor beneficial** impacts. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative D or E, would result in **minor** impacts on sea turtles due to the impacts being detectable and measurable but not resulting in population-level impacts.

3.5.7.8 Impacts of Alternative F on Sea Turtles

Under the Proposed Action, a variety of foundation types may be used for the Project. Alternative F (Foundation Structures) allows for an evaluation of impacts associated with specific foundation types. Under Alternative F1, monopiles and piled jacked foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (monopile or piled jacket), up to 5 medium OSSs (piled jacket), or up to 4 large OSSs (piled jacket) for Project 1 and Project 2. Under Alternative F2, mono-bucket, suction bucket jacket, and suction bucket tetrahedron base foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (mono-bucket or suction bucket jacket), up to 5 medium OSSs (suction bucket jacket), or up to 4 large OSSs (suction bucket jacket), for Project 1 and Project 2. Under Alternative F3, gravity-pad tetrahedron and GBS foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs, up to 5 medium OSSs, or up to 4 large OSSs, with GBS for Project 1 and Project 2.

Onshore Activities and Facilities

Impacts associated with onshore activities and facilities for Alternative F would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.7.5).

Offshore Activities and Facilities

Though all potential offshore activities under Alternative F were evaluated under the Proposed Action, sub-alternatives of Alternative F may exclude some activities evaluated under the Proposed Action. Activities would not differ between the Proposed Action and Alternative F1. Under Alternatives F2 and F3, no impact pile driving would be conducted. Therefore, there would be no underwater noise impacts on sea turtles due to impact pile driving. The avoidance of impact pile-driving noise effects would reduce overall construction and installation impacts on sea turtles under Alternatives F2 and F3 compared to the Proposed Action.

Offshore impacts under some sub-alternatives may be reduced due to reductions in habitat conversion associated with some foundation types. Suction bucket foundations, Alternative F2, would result in the greatest area of habitat conversion due to scour protection, and these foundations were evaluated under the Proposed Action. Alternatives F1 and F3 would result in a reduction in scour protection compared to the Proposed Action and Alternative F2. Such reductions would reduce O&M impacts due to the presence of structures. Less scour protection would result in loss of less soft-bottom habitat, which could benefit Kemp's ridley sea turtles as they forage in this type of habitat. It would also result in a lower artificial reef effect, which may reduce foraging opportunities compared to the Proposed Action and Alternative F2, but may also reduce risk of entanglement in lost recreational fishing gear. Given that Alternatives F1 and F3 could result in reductions in both adverse and beneficial impacts, impacts on sea turtles under these alternatives are not expected to be measurably different from those anticipated under the Proposed Action. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Impacts of Alternative F on ESA-Listed Sea Turtles

All sea turtle species that are likely to occur in the Offshore Project area are listed under the ESA. Therefore, the impacts of Alternative F on ESA-listed sea turtle species are identical to the impacts previously described for construction and installation, O&M, and decommissioning activities associated with Alternative F.

Cumulative Impacts of Alternative F

The contribution of Alternative F to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternative F would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternative F. Impacts of Alternative F1 would not be measurably different than the impacts of the Proposed Action. Therefore, construction, operation, and decommissioning of Alternative F1 would result in **negligible** to **minor** adverse impacts on sea turtles due primarily to pile-driving noise and could include **minor beneficial** impacts due to the presence of structures. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Impacts of Alternatives F2 and F3 would be measurably different from the impacts of the Proposed Action due to the avoidance of impact pile-driving noise effects. However, this difference would not result in a lower impact determination. Therefore, construction, operation, and decommissioning of Alternatives F2 and F3 would result in **negligible** to **minor** adverse impacts on sea turtles due primarily to vessel noise, displacement into higher-risk areas associated with the presence of structures, and vessel traffic and could include **minor beneficial** impacts due to the presence of structures. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Cumulative Impacts of Alternative F. Cumulative impacts on sea turtles from ongoing and planned activities, including Alternative F1, F2, or F3, would range from **negligible** to **minor** adverse and would also include **minor beneficial** impacts. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative F, would result in **minor** impacts on sea turtles due to the impacts being detectable and measurable but not resulting in population-level impacts.

3.5.7.9 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of federal permitting, or through agency-to-agency negotiations, are described in Appendix G, Table G-2 and addressed in more detail in Table 3.5.7-9. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.5.7-9. Proposed mitigation measures – sea turtles

Measure	Description	Effect
Marine debris awareness training	Vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP must complete marine trash and debris awareness training annually. Atlantic Shores must submit an annual report describing its marine trash and debris awareness training process and certify that the training process was followed for the previous calendar year.	Marine debris and trash awareness training would minimize the risk of sea turtle ingestion of or entanglement in marine debris. While adoption of this measure would decrease risk to sea turtles under the Proposed Action, it would not alter the impact determination of negligible for accidental spills and releases.
Pile Driving Monitoring Plan	Atlantic Shores must prepare and submit a Pile Driving Monitoring Plan detailing all plans and procedures for sound attenuation as well as for monitoring ESA-listed sea turtles during all impact and vibratory pile driving.	The development and implementation of a Pile Driving Monitoring Plan would increase the accountability of underwater noise mitigation during pile driving. While adoption of this measure would increase accountability during this construction activity under the Proposed Action, it would not alter the impact determination of minor for impact pile driving noise.
PSO coverage	PSO coverage must be sufficient to reliably detect sea turtles at the surface in clearance and shutdown zones to execute any pile driving delays or shutdown requirements.	PSO coverage would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. While adoption of this measure would decrease risk to sea turtles during impact pile driving under the Proposed Action, it would not alter the impact determination of minor for impact pile driving noise.
Sound field verification	If the clearance and/or shutdown zones are expanded due to the verification of sound fields from Project activities, PSO coverage must be sufficient to reliably monitor the expanded clearance and/or shutdown zones.	Sound field verification would increase the accountability of underwater noise mitigation during pile driving. While adoption of this measure would increase accountability during this construction activity under the Proposed Action, it would not alter the impact determination of minor for impact pile driving noise.
Shutdown zones	BOEM and USACE may consider reductions in the shutdown zones based upon sound field verification of a minimum of three piles. However, BOEM/USACE would ensure	Shutdown zones would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. While adoption of

Measure	Description	Effect
	that the shutdown zone is not reduced to less than 984 feet (500 meters) for ESA-listed sea turtles.	this measure would decrease risk to sea turtles during impact pile driving under the Proposed Action, it would not alter the impact determination of minor for impact pile driving noise.
Monitoring zones for sea turtles	Atlantic Shores must monitor the full extent of the area where noise would exceed the 175 dB rms threshold for ESA-listed sea turtles for the full duration of all pile-driving activities and for 30 minutes following the cessation of pile-driving activities and record all observations in order to ensure that all take that occurs is documented.	Monitoring zones for sea turtles would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. While adoption of this measure would decrease risk to sea turtles during impact pile driving under the Proposed Action, it would not alter the impact determination of minor for impact pile driving noise.
Alternative Monitoring Plan for pile driving	Atlantic Shores must develop an Alternative Monitoring Plan for pile-driving operations during low-visibility conditions (e.g., darkness, inclement weather) that prevent visual monitoring of the full extent of the clearance and shutdown zones. This plan must include identification of any night vision devices proposed for detection of protected species during low visibility conditions; a demonstration of the capability of the proposed monitoring methodology to detect protected species within the full extent of the clearance and shutdown zones with the same effectiveness as daytime visual monitoring; a discussion of the efficacy of each device proposed for low visibility monitoring; and reporting procedures, contacts, and timeframes.	The development and implementation of an Alternative Monitoring Plan for pile driving would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. While adoption of this measure would decrease risk to sea turtles during impact pile driving under the Proposed Action, it would not alter the impact determination of minor for impact pile driving noise.
Look out for sea turtles and reporting	Project vessels must adhere to the following vessel strike avoidance measures: vessels operating north of the Virginia/North Carolina border between June 1 and November 30 must have a trained lookout posted to observe for sea turtles; vessels operating south of the Virginia/North Carolina border must have a trained lookout posted year-round to observe for sea turtles; lookouts will review https://seaturtlesightings.org before each trip and report sea turtle observations in the vicinity of the planned transit to all vessel operators/captains and lookouts; lookout will monitor a 984-foot (500-meter) vessel strike avoidance zone; vessel operator will slow down to 4 knots (7 kilometers per	Measures to minimize vessel interactions would reduce risk of vessel strike. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination of minor for vessel traffic.

Measure	Description	Effect
	hour) if a sea turtle is sighted within 328 feet (100 meters) of the vessel's forward path then proceed away from the sea turtle at that speed until a 328-foot (100-meter) separation distance is established; vessel operator must shift to neutral if a sea turtle is sighted within 164 feet (50 meters) of the vessel's forward path then proceed away from the turtle at 4 knots (7 kilometers per hour); vessel operators must avoid transiting through areas of visible jellyfish aggregations of floating sargassum lines or mats; all crew members must be briefed on identification of sea turtles, applicable regulations, and best practices for avoiding vessel collisions with sea turtles; vessel transits to and from the wind farm area that require PSOs will maintain a speed commensurate with weather conditions and effectively detecting sea turtles prior to reaching the 328-foot (100-meter) avoidance measure.	
Sampling gear	All sampling gear must be hauled at least once every 30 days, and all gear must be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	The regular hauling of sampling gear would reduce risk of entanglement or effects of entanglement in fisheries survey gear. While adoption of this measure would reduce risk under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in Project surveys must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long (0.9-meter-long) strip of black and white duct tape within 2 fathoms of a buoy attachment. In addition, three additional marks must be placed on the top, middle and bottom of the line using black and white paint or duct tape.	Gear identification would improve accountability in the case of gear loss. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Lost survey gear	All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost survey gear must be reported to NMFS and BSEE.	Recovering lost survey gear would improve accountability in the case of gear loss. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Survey training	For any vessel trips where gear is set or hauled for trawl or ventless trap surveys, at least one of the survey staff onboard must	Survey staff training would reduce risk of entanglement or effects of entanglement in fisheries survey gear. While adoption

Measure	Description	Effect
	have completed Northeast Fisheries Observer Program observer training within the last 5 years or completed other equivalent training in protected species identification and safe handling. Appropriate reference materials must be on board each survey vessel. Atlantic Shores must prepare a training plan that addresses how these survey requirements will be met.	of this measure would reduce risk under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) must have adequate disentanglement equipment onboard, such as a knife and boathook. Any disentanglement must occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580).	Sea turtle disentanglement would reduce effects of entanglement in fisheries survey gear. While adoption of this measure would reduce effects under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Sea turtle identification and data collection	Any sea turtles caught or retrieved in any fisheries survey gear must first be identified to species or species group. Each ESA-listed species caught or retrieved must then be documented using appropriate equipment and data collection forms. Live, uninjured animals must be returned to the water as quickly as possible after completing the required handling and documentation.	Sea turtle identification and data collection would improve accountability for documenting take associated with fisheries surveys. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Sea turtle handling and resuscitation guidelines	Any sea turtles caught and retrieved in gear used in fisheries surveys must be handled and resuscitated (if unresponsive) according to established protocols provided at-sea conditions are safe for those handling and resuscitating the animal(s) to do so.	Sea turtle handling and resuscitation guidelines would reduce effects of entanglement in fisheries survey gear. While adoption of this measure would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Take notification	The Greater Atlantic Regional Fisheries Office Protected Resources Division must be notified as soon as possible of all observed takes of sea turtles occurring as a result of any fisheries survey.	Sea turtle take notification would improve accountability for documenting take associated with fisheries surveys. While adoption of this measure would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
Monthly/annual reporting requirements	To document the amount or extent of take that occurs during all phases of the Proposed Action, Atlantic Shores must submit monthly reports during the construction phase and during the first year	Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action. While adoption of this measure would improve accountability, it would not alter the

Measure	Description	Effect
	of operation and must submit annual reports beginning in year 2 of operation.	overall impact determination of minor for the Proposed Action.
Meeting requirements for sea turtle documentation	BOEM, BSEE, and NMFS will meet twice in the first year of operation to review sea turtle observation records and any incidental take. The agencies will meet annually following the first year of operation.	Meeting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action. While adoption of this measure would improve accountability, it would not alter the overall impact determination of minor for the Proposed Action.
Data collection BA BMPs	All Project Design Criteria and Best Management Practices incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance and operations of the Atlantic Shores Wind project as applicable.	Compliance with Project Design Criteria and Best Management Practices for Protected Species would minimize risk to sea turtles during HRG surveys. While adoption of this measure would decrease risk to sea turtles under the Proposed Action, it would not alter the impact determination of negligible for HRG activities.
Periodic underwater surveys, reporting of monofilament and other fishing gear around WTG foundations	Atlantic Shores must monitor potential loss of fishing gear in the vicinity of WTG foundations by surveying at least 10 different WTGs in each Project 1 and Project 2 area annually. Survey design and effort may be modified based upon previous survey results after review and concurrence by BOEM. Atlantic Shores must conduct surveys by remotely operated vehicles, divers, or other means to determine the locations and amounts of marine debris.	Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination of minor associated with the presence of structures.
Operational Sound Field Verification Plan	Atlantic Shores must develop an operational sound field verification plan to determine the operational noises emitted from the offshore wind area.	The development of an Operational Sound Field Verification Plan would allow BOEM to confirm that noise impacts of operating WTGs do not exceed predicted impacts based on existing monitoring data and modeling efforts. While adoption of this measure would improve accountability of WTG operational noise under the Proposed Action, it would not alter the impact determination of negligible or minor for WTG noise.

3.5.7.10 Comparison of Alternatives

Construction, operation, and decommissioning of Alternatives C, D, E, F1, F2, and F3 would have the same **negligible** to **minor** adverse impacts and **minor beneficial** impacts on sea turtles as described under the Proposed Action. Alternative C would result in slightly less effects on benthic foraging sea turtles due to the avoidance and minimization of impacts on valuable habitats and the potential removal of up to 29 WTGs, 1 OSS, and associated interarray cables. The combination of Alternatives C1 and C2 would further reduce effects on benthic foraging sea turtles by avoiding impacts on both valuable habitat areas in the Lease Area. Alternatives D and E would result in slightly less effects on sea turtles due to the potential removal of up to 31 WTGs and associated interarray cables. Though Alternatives F2 and F3 would have measurably lower impacts due to avoidance of impact pile-driving noise effects on sea turtles, this reduction in impacts would not result in a lower impact determination.

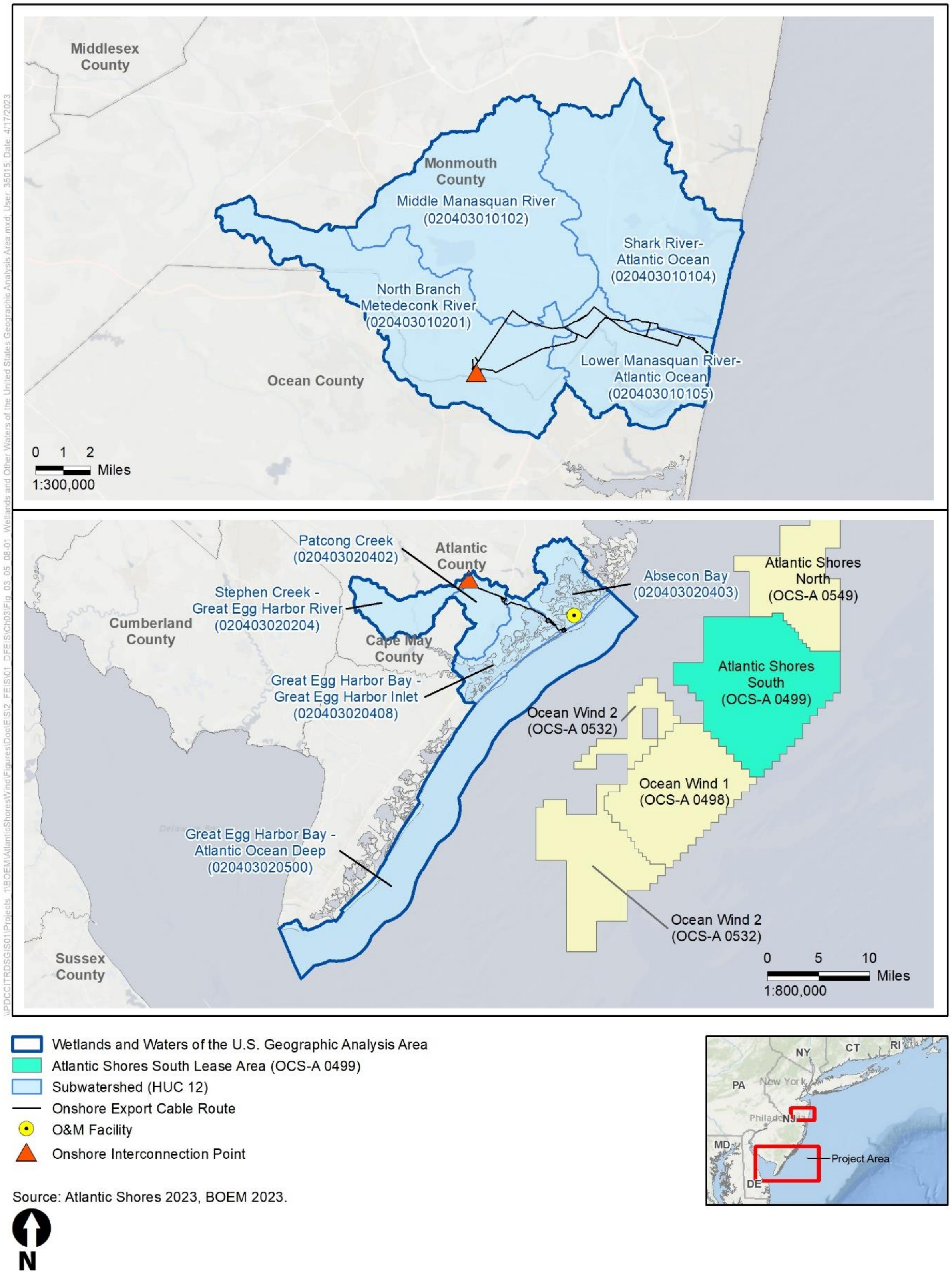
3.5.8 Wetlands

This section discusses potential impacts on wetlands from the proposed Project, alternatives, and ongoing and planned activities in the wetlands geographic analysis area. The wetlands geographic analysis area, as shown on Figure 3.5.8-1, includes all subwatersheds that intersect the Onshore Project area, which encompasses all wetlands and surface waters that are most likely to experience impacts from the proposed Project. See Section 3.4.2 for a discussion of impacts on water quality.

3.5.8.1 Description of the Affected Environment and Future Baseline Conditions

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3(c)(16)). Wetlands are important features in the landscape that provide numerous beneficial services or functions. Some of these include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, providing aesthetic value, ensuring biological productivity, filtering pollutant loads, and maintaining surface water flow during dry periods. The majority of the wetlands in the geographic analysis area are tidally influenced salt marshes, which provide shelter, food, and nursery grounds for coastal fisheries species, including shrimp, crab, and many finfish. Salt marshes also protect shorelines from erosion by creating a buffer against wave action and by trapping soils. In flood-prone areas, salt marshes reduce the flow of flood waters and absorb rainwater. Tidal wetlands also serve as carbon sinks, holding carbon that would otherwise be released into the atmosphere and contribute to climate change. New Jersey's coastal wetlands, including those in the geographic analysis area, protect coastal water quality by acting as a sink for land-derived nutrients and contaminants, constitute an important component of coastal food webs, provide valuable wildlife habitat, and protect upland and shoreline areas from flooding and erosion.

The National Wetlands Inventory (NWI) and NJDEP wetland data were used to determine the potential presence of wetlands. NWI information is provided in Appendix B, *Supplemental Information and Additional Figures and Tables*, and NJDEP information is provided in this section. NWI and NJDEP data rely on trained image analysts to identify potential wetlands. Tidal wetlands are areas where the Atlantic Ocean and estuaries meet land, are found below the spring high tide line, and are subject to regular flooding by the tides. Tidal wetlands are typically categorized into two zones, high marsh and low marsh. Non-tidal wetlands, otherwise referred to as freshwater wetlands, are not influenced directly by tides and are typically categorized based on their hydrology and predominant vegetation.



Source: Atlantic Shores 2023, BOEM 2023.

Figure 3.5.8-1. Wetlands geographic analysis area

The Cardiff Onshore Project area and the O&M facility in Atlantic City, New Jersey, lie within five watersheds: Absecon Bay (hydrologic unit code [HUC] 12 No. 020403020403), Patcong Creek (HUC 12 No. 020403020402), Stephen Creek-Great Egg Harbor River (HUC 12 No. 020403020204), Great Egg Harbor Bay-Atlantic Ocean Deep (HUC 12 No. 020403020500), and Great Egg Harbor Bay-Great Egg Harbor Inlet (HUC 12 No. 020403020408). All of these watersheds are within the Great Egg Harbor Watershed Management Area. The major watercourses draining these watersheds into the bays include Absecon Creek, Patcong Creek, and the Great Egg Harbor. According to NJDEP wetland data, estuarine wetlands within the Cardiff Onshore Project area are dominated by swaths of tidal marshes (COP Volume II, Appendix II-D1; Atlantic Shores 2023). Tidal wetlands are limited to areas adjacent to Lakes Bay and Absecon Bay shoreline along the interconnection cable route. Freshwater wetlands, dominated by forested/shrub wetland communities, are mapped along Cedar Branch, Mill Branch, and Maple Run within the Cardiff Onshore Project area boundary.

The Larrabee Onshore Project area lies within four watersheds: Shark River-Atlantic Ocean (HUC 12 No. 020403010104), Middle Manasquan River (HUC 12 No. 020403010102), North Branch Metedeconk River (HUC 12 No. 020403010201) and Lower Manasquan River-Atlantic Ocean (HUC 12 No. 020403010105). The Larrabee Onshore Project area lies within both the Barnegat Bay Watershed Management Area and the Monmouth Watershed Management Area. Wetlands in and around Barnegat Bay provide flood protection during storm events, and function to sequester a significant amount of the nitrogen and phosphorous loading to the bay. These coastal wetlands can remove (through deposition and plant growth) approximately 85 percent of the nitrogen and 54 percent of the phosphorus entering the bay from upland sources (NJDEP 2021). The Manasquan River and the Metedeconk River are the major river systems within this area. Based on the NJDEP wetland data, freshwater wetlands are found within the Larrabee Onshore Project area (COP Volume II, Appendix II-D2; Atlantic Shores 2023). According to NJDEP wetland data, freshwater forested/scrub and emergent wetlands are concentrated along the Manasquan River and North Branch Metedeconk River, and their tributaries. Freshwater forested/shrub wetland communities are the dominant community types mapped within the Larrabee Onshore Project area.

As explained in Section 3.4.2, *Water Quality,* the Barnegat Bay Partnership's Comprehensive Conservation and Management Plan aims to protect and restore clean water and healthy living resources in Barnegat Bay and its watershed bay and its watershed. Though Barnegat Bay is within the geographic analysis area, the proposed Project would not cross the Barnegat Bay-Little Egg Harbor estuary and would not affect achievement of goals identified in the plan.

The geographic analysis area contains 50,849 acres (20,578 hectares) of wetlands, according to NJDEP wetland data (NJDEP 2015). Table 3.5.8-1 displays the wetland communities within the geographic analysis area based on NJDEP wetland data.

Table 3.5.8-1. Wetland communities in the geographic analysis area

Wetland Community	Acres	Percent of Total
Freshwater		
Agricultural Wetlands (Modified)	1,091	2.1
Atlantic White Cedar Wetlands	482	0.9
Coniferous Scrub/Shrub Wetlands	180	0.4
Coniferous Wooded Wetlands	3,316	6.5
Deciduous Scrub/Shrub Wetlands	1,102	2.2
Deciduous Wooded Wetlands	12,968	25.5
Disturbed Wetlands (Modified)	342	0.7
Former Agricultural Wetland (Becoming Shrubby, Not Built-Up)	23	0.0
Herbaceous Wetlands	289	0.6
Managed Wetland in Built-Up Maintained Rec Area	277	0.5
Managed Wetland in Maintained Lawn Greenspace	113	0.2
Mixed Scrub/Shrub Wetlands (Coniferous Dominate)	257	0.5
Mixed Scrub/Shrub Wetlands (Deciduous Dominate)	516	1.0
Mixed Wooded Wetlands (Coniferous Dominate)	5,058	9.9
Mixed Wooded Wetlands (Deciduous Dominate)	3,893	7.7
Phragmites Dominate Interior Wetlands	224	0.4
Phragmites Dominate Urban Area	9	0.0
Wetland Rights-of-Way	587	1.2
Tidal		
Saline Marsh (High Marsh)	318	0.6
Saline Marsh (Low Marsh)	17,751	34.9
Disturbed Tidal Wetlands	22	0.0
Phragmites Dominate Coastal Wetlands	935	1.8
Freshwater Tidal Marsh	2	0.0
Vegetated Dune Communities	1,094	2.2
Total	**50,849**	**100.0**

Source: NJDEP 2015.

3.5.8.2 Impact Level Definitions for Wetlands

As described in Section 3.3, *Definitions of Impact Levels,* this Draft EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. The definitions of potential adverse impact levels for wetlands are provided in Table 3.5.8-2. There are no beneficial impacts on wetlands. USACE and NJDEP would define wetland impacts differently than BOEM due to requirements under CWA Section 404 and the New Jersey Freshwater Protection Act (as summarized below).

Table 3.5.8-2. Definitions of impact levels for wetlands

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

New Jersey Administrative Code 7:7A, Freshwater Wetlands Protection Act Rules, defines temporary disturbance as a regulated activity that occupies, persists, or occurs on a site for no more than 6 months. Impacts on wetlands that persist longer than 6 months are considered permanent. USACE defines temporary impacts as those that occur when fill or cut impacts occur in wetlands that are restored to preconstruction contours when construction activities are complete. (e.g., stockpile, temporary access). Conversion of a wetland type is also considered a permanent impact.

All earth disturbances from construction activities would be conducted in compliance with the New Jersey Pollutant Discharge Elimination System (PDES) General Permit for Stormwater Discharges Associated with Construction Activities and the approved SWPPP for the Project. Any work in wetlands would require a CWA Section 404 permit from USACE or NJDEP (or both) and a Section 401 Water Quality Certification from NJDEP; any wetlands permanently lost would require compensatory mitigation.

3.5.8.3 Impacts of Alternative A – No Action on Wetlands

When analyzing the impacts of the No Action Alternative on wetlands, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for wetlands. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D*, Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for wetlands described in Section 3.5.8.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that may contribute to impacts on wetlands are associated with onshore development activities (see Section

D.2 in Appendix D for a description of ongoing and planned activities). Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect wetlands through activities that can have permanent (e.g., fill placement) and short-term (e.g., vegetation removal) impacts on wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss. Climate change–induced sea level rise in the geographic analysis area is also anticipated to continue to affect wetlands. Inundation and rising water levels would result in the conversion of vegetated areas into areas of open water, with a consequent loss of wetland functions associated with the loss of vegetated wetlands. Wetlands have very specific water elevation tolerances; if water is not deep enough, it is no longer a wetland. Slowly rising waters on a gentle, continuously rising surface can result in wetlands migrating landward. In areas where slopes are not gradual or where there are other features blocking flow (e.g., bulkhead or surrounding developed landscape), wetland migration would be slowed or impeded. Rising coastal waters would also continue to cause saltwater intrusion, which occurs when saltwater starts to move farther inland and creeps into freshwater/non-tidal areas. Saltwater intrusion would continue to change wetland plant communities and habitat (i.e., freshwater species to saltwater species) and overall wetland functions. See Appendix D, Table D.A1-24 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for wetlands. There are no ongoing offshore wind activities within the geographic analysis area for wetlands.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect wetlands would primarily include onshore development activities (see Section D.2 in Appendix D for a complete description of ongoing and planned activities). These activities could permanently (e.g., permanent fill placement) and temporarily (e.g., temporary fill placement or vegetation clearing) affect wetlands or areas near wetlands. All projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated for projects to compensate for lost wetlands. See Table D.A1-24 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for wetlands

Impacts on wetlands from planned offshore wind projects may occur if onshore activity from these projects overlaps with the geographic analysis area. The Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects are within the geographic analysis area. The Ocean Wind 1 BL England interconnection cable corridor intersects the Atlantic Shores South Cardiff geographic analysis area. BOEM expects that this planned offshore wind activity would have impacts on wetlands that are similar to impacts described for the Proposed Action, including impacts related to accidental releases and land disturbance.

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on wetlands during construction, O&M, and decommissioning of the projects. BOEM expects planned offshore wind development activities to affect wetlands through the following primary IPFs.

Accidental releases: During onshore construction of offshore wind projects in the geographic analysis area, oil leaks and accidental spills from construction equipment are potential sources of wetland water contamination. While many wetlands act to filter out contaminants, any significant increase in contaminant loading could exceed the capacity of a wetland to perform its normal water quality functions. Although degradation of water quality in wetlands could occur during construction, decommissioning, and to a lesser extent O&M, due to the small volumes of spilled material anticipated, these impacts would all be short-term, until the source of the contamination is removed. Compliance with applicable state and federal regulations related to oil spills and waste handling would minimize potential impacts from accidental releases. These include the Resource Conservation and Recovery Act, Department of Transportation Hazardous Material regulations, and implementation of a Spill Prevention, Control, and Countermeasure Plan. Impacts from accidental releases on wetlands would be minor because accidental releases would be small and localized, and compliance with state and federal regulations would avoid or minimize potential impacts to wetland quality or functions.

Land disturbance: Construction of onshore components (e.g., interconnection cables, onshore substation) for Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North are anticipated to require clearing, excavating, trenching, fill, and grading, which could result in the loss or alteration of wetlands, causing adverse effects on wetland habitat, water quality, and flood and storage capacity functions. Ocean Wind 1 has estimated that up to 1 acre (0.4 hectare) of permanent disturbance would occur within wooded wetlands and approximately 0.53 and 11.92 acres (0.21 and 4.82 hectares) of temporary wetland impacts could potentially occur as a result of interconnection cable burial at BL England and Oyster Creek, respectively (Ocean Wind 2022).

Fill material permanently placed in wetlands during construction would result in the permanent loss of wetlands, including any habitat, flood and storage capacity, and water quality functions that the wetlands may provide. If a wetland were partially filled and fragmented or if wetland vegetation were trimmed, cleared, or converted to a different vegetation type (e.g., forest to herbaceous), habitat would be altered and degraded (affecting wildlife use) and water quality and flood/storage capacity functions would be reduced by changing natural hydrologic flows and reducing the wetland's ability to impede and retain stormwater and floodwater. On a watershed level, any permanent wetland loss or alteration could reduce the capacity of regional wetlands to provide wetland functions.

Temporary wetland impacts may occur from a construction activity that crosses or is adjacent to wetlands, such as rutting, compaction, and mixing of topsoil and subsoil. Where construction leads to unvegetated or otherwise unstable soils, precipitation events could erode soils, resulting in sedimentation that could affect water quality in nearby wetlands, as well as alter wetland functions if sediment loads are high (e.g., adverse habitat impacts from burying vegetation). The extent of wetland impacts would depend on specific construction activities and their proximity to wetlands. These impacts would occur primarily during construction and decommissioning; impacts during O&M would only occur if new ground disturbance was required, such as to repair a buried component.

BOEM anticipates that onshore project components from other offshore wind projects would likely be sited in disturbed areas (e.g., along existing roadways), which would avoid and minimize wetland impacts. In addition, BOEM expects the offshore wind projects would be designed to avoid wetlands to the extent feasible. Offshore wind projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. Impacts from land disturbance on wetlands would be moderate because permanent wetland impacts would likely occur and compensatory mitigation would be required.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, wetlands would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Land disturbance from onshore construction periodically would cause temporary and permanent loss of wetlands. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands. BOEM anticipates that the wetland impacts, especially land disturbance, as a result of ongoing activities associated with the No Action Alternative would be **moderate**. Impacts from land disturbance on wetlands would be moderate because permanent wetland impacts would likely occur and compensatory mitigation would be required.

Cumulative Impacts of Alternative A – No Action. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and wetlands would continue to be affected by land disturbance. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on wetlands. Planned activities other than offshore wind primarily include increasing onshore construction. BOEM anticipates that the overall impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would be **moderate** given that any activity would be required to comply with federal, state, and local regulations related to the protection of wetlands and mitigation of impacts. BOEM expects the combination of ongoing activities and planned activities other than offshore wind to result in **moderate** impacts on wetlands, primarily driven by land disturbance.

Planned offshore wind activities, such as the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects, could cause impacts that would be similar to the impacts of the proposed Atlantic Shores South Project alone. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands, thereby avoiding or minimizing impacts. If impacts would not be entirely avoided, compensatory mitigation would be anticipated for projects that result in permanent impacts, resulting in overall **moderate** impacts.

Considering the IPFs and regulatory requirements for avoiding, minimizing, and mitigating impacts on wetlands, BOEM anticipates that the overall impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in **moderate** impacts, primarily through land disturbance. Planned offshore wind activities are expected to contribute to the impacts through land disturbance, although the majority of this IPF would be attributable to ongoing non-offshore wind activities.

3.5.8.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in similar or lesser impacts than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on wetlands.

- The routing variants within the selected onshore landfall locations and interconnection cable routes.

An onshore interconnection cable route(s) with less wetlands within or adjacent to the ROW would have less potential for direct and indirect impacts on wetlands.

3.5.8.5 Impacts of Alternative B – Proposed Action on Wetlands

The Cardiff and Larrabee Onshore Project areas have been sited to maximize the use of existing linear infrastructure, such as roadway, electric utility, and pedestrian/bike lane ROWs. The landfall sites and onshore substations have also been intentionally located in disturbed or developed areas to avoid and minimize potential impacts on wetlands (WET-01; Appendix G, Table G-1). In addition, the onshore interconnection cables would be installed underground using trenchless construction techniques such as jack-and-bore and HDD at all wetland and waterbody crossings, where feasible, to further avoid impacts on these resources (WET-02, GEO-15; Appendix G, Table G-1). As a result, the only potential IPF on wetlands would be the result of land disturbance, including soil erosion and sedimentation, and stormwater runoff during construction and installation (COP Volume II, Section 4.1.5; Atlantic Shores 2023).

In order to confirm the extent and presence of regulated wetlands, a preliminary field delineation was conducted by Atlantic Shores in June and December 2020, September 2021, June 2022, and February 2023 to identify wetlands under the jurisdiction of USACE and the NJDEP. The wetland delineation study encompassed the Cardiff and Larrabee Onshore Project areas in an effort to verify the presence of mapped NWI and NJDEP wetland data and to assess the potential presence of unmapped wetlands. The onshore Project study areas included the interconnection cable routes ROW, substations, landfall sites, and the O&M facility. The width of the study area varied depending on the location and property boundaries. The onshore interconnection cable routes ROW study area width was approximately 150 feet (45.7 meters) wide with the anticipated cable alignment being the center; however, in areas such as Atlantic City the study area was narrower.

The Cardiff Onshore Project study area field delineation identified 24 wetlands totaling 14.7 acres (5.94 hectares) and 8 watercourses totaling 8,903 linear feet (2,714 meters). One watercourse, the Clam Creek portion of Absecon Inlet located at the proposed O&M facility, totaling approximately 165 linear feet (50 meters), has been delineated via desktop aerial imagery and has not been field verified. Wetlands identified consist of the following three community types: estuarine emergent (EEM), palustrine emergent (PEM), and palustrine forested (PFO). Wetland acreage within the onshore interconnection cable route includes 12 EEM wetlands totaling 11.13 acres (4.5 hectares), 10 PEM wetlands totaling 3.39 acres (1.37 hectares), and 3 PFO wetlands totaling 0.18 acre (0.07 hectare). Approximately 13.6 acres (5.5 hectares) of wetlands assessed are considered to have NJDEP exceptional resource value due to their tidal influence and importance to the tidal ecosystem (COP Volume II, Appendix II-D1; Atlantic Shores 2023). Delineated wetlands are largely adjacent to roadways, railroads, electric utility lines, and other developed areas along the Cardiff onshore interconnection cable route. Watercourses within the study area are classified as tidal riverine (8,714 linear feet [2,656 meters]), perennial (89 linear feet [27 meters]) and ephemeral (100 linear feet [31 meters]) streams. The delineated tidal streams and inlets and estuarine wetlands have direct connections to the Great Thoroughfare that is part of the intra-coastal waterway and provides a direct connection to the Atlantic Ocean. Freshwater, non-tidal wetlands are associated with perennial watercourses Mill Branch and Cedar Branch that occur outside of the Cardiff Onshore Project area and ultimately flow south to the Great Egg Harbor River (COP Volume II, Section 4.1.2; Atlantic Shores 2023).

The Larrabee Onshore Project study area field delineation identified 27wetlands totaling 15.61 acres (6.31 hectares) and 19 watercourses totaling 4,063 linear feet (1,238 meters). Wetlands identified consist of the following three community types: PEM, palustrine scrub-shrub (PSS), and PFO. Wetland acreage within the onshore interconnection cable route includes: 4 PEM wetlands totaling 1.86 acres (0.75 hectare), 2 PSS wetlands totaling 0.23 acre (0.09 hectare), and 20 PFO wetlands totaling 13.52 acres (5.47 hectares). Freshwater, non-tidal wetlands are associated with the Manasquan River, its tributaries, and other streams or drainages within the Larrabee Onshore Project area. Approximately 12.2 acres (4.93 hectares) of wetlands assessed are considered to have NJDEP exceptional resource value due to their proximity and connection to the dune system on the beach or the documented presence of federal and state protected species (COP Volume II, Appendix II-D2; Atlantic Shores 2023). Watercourses within the study area are classified as ephemeral (180 linear feet [55 meters]), intermittent (376 linear feet [115 meters]) and perennial (3,507 linear feet [1,069 meters]) riverine systems and are associated with the Metedeconk River, Manasquan River, and their tributaries. These features are located within deciduous and mixed forest habitats along the onshore interconnection cable routes and cross via culvert under existing paved roads and pedestrian/bike lanes (COP Volume II, Section 4.1.3; Atlantic Shores 2023). None of the wetlands or watercourses are tidal or are within 1,000 feet (305 meters) of the head of tide. As such, all delineated wetlands and watercourses are expected to be under the jurisdiction of the NJDEP under the New Jersey Freshwater Wetlands Protection Act.

Authorization from USACE and NJDEP is required prior to dredge or fill of jurisdictional wetlands, pursuant to CWA Section 404, and CWA Section 401 and the New Jersey Freshwater Wetlands Protection Act of 1987, respectively. CWA Section 404 requires that all appropriate and practicable steps be taken first to avoid and minimize impacts on jurisdictional wetlands; for unavoidable impacts, compensatory mitigation is required to replace the loss of wetlands and associated functions.

Accidental releases: Onshore construction activities would require heavy equipment use and HDD activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Atlantic Shores would develop and implement a Spill Prevention, Control, and Countermeasure Plan to minimize impacts on water quality (prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). In addition, all wastes generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates the Proposed Action alone would result in minor and short-term impacts on wetlands as a result of releases from heavy equipment during construction and other cable installation activities.

Land disturbance: Construction impacts on wetlands and related functions would be similar to those described for the No Action Alternative. The primary wetland impacts under the Proposed Action would be excavation, rutting, compaction, mixing of topsoil and subsoil, and potential alteration due to clearing at HDD entry pit locations. These impacts would be mostly temporary in non-wooded wetlands, as restoration would be conducted in accordance with applicable NJDEP permit requirements. Following installation of interconnection cables within wetlands, topography would be restored and soils would be decompacted to avoid long-term impacts on soils and hydrology. Long-term changes from wooded to herbaceous wetlands could occur if clearing is required in wooded wetlands. Loss of wetland could occur if permanent placement of fill is required in wetlands. Placement of fill within a wetland or permanent conversion of wooded wetlands to herbaceous or shrub/scrub wetlands within the permanent easement would constitute a permanent impact on wetlands. Other long-term impacts on wetlands would include clearing wooded wetlands within the temporary workspace. While these would be allowed to revert to forested wetland condition, the recovery could take decades or longer. Atlantic Shores has estimated that approximately 0.54 acre (0.21 hectare) of temporary and 0.59 acre (0.23 hectare) of permanent disturbance in wetlands may occur as a result of Project interconnection cable installation. Approximately 47 percent of the proposed wetland impacts are temporary and would occur in both emergent and forested wetlands. Following construction, temporary disturbance areas would be restored to pre-existing conditions and revegetated.

The onshore interconnection cables for both Cardiff and Larrabee have the potential to cross several wetland features. At these locations, the onshore interconnection cables would be installed using trenchless technology (e.g., jack-and-bore, pipe jacking, or HDD) beneath wetlands where crossing is necessary to minimize direct impacts on these resources. Entry/exit work areas will be in disturbed upland areas to further avoid impacts to wetlands. Approximately 2.21 acres (0.89 hectare) of wetland along portions of the Cardiff and Larrabee onshore interconnection cable routes would be avoided by trenchless technology methods. Table 3.5.8-3 provides a summary of the potential temporary and permanent impacts resulting from construction of the Atlantic Shores South Project as well as impacts avoided using trenchless installation technologies (COP Volume II, Section 4.1.6; Atlantic Shores 2023). Based on the wetland delineation reports (COP Volume II, Appendix II-D1 and D2; Atlantic Shores 2023), Atlantic Shores has confirmed no presence of wetlands at the Atlantic or Monmouth landfall locations or the Cardiff and Larrabee POIs (COP Volume II, Section 4.1.6; Atlantic Shores 2023). Wetlands also do not occur shoreward of the bulkhead at the proposed O&M facility Project area, and therefore wetlands would not be impacted as a result of construction of the proposed O&M facility (COP Volume II, Section 4.1.6; Atlantic Shores 2023).

NJDEP–regulated adjacent transition areas may also be affected by clearing and soil disturbance. Water quality within wetlands could be affected by sedimentation from nearby exposed soils. To prevent indirect impacts on wetlands and waterbodies, such as soil erosion and sedimentation from land-disturbing construction activities, Atlantic Shores would comply with an approved Soil Erosion and Sediment Control Plan, and would obtain coverage under a New Jersey PDES General Permit, and prepare a SWPPP for the Project. In accordance with these plans, all Monmouth, Ocean, and Atlantic County Soil Conservation District BMPs including, but not limited to dust abatement, installation of silt fencing, filter socks, and inlet filters, would be implemented to minimize or avoid potential effects (WET-03; Appendix G, Table G-1). Atlantic Shores would also provide Environmental/Construction Monitor(s) with applicable erosion and sedimentation and stormwater management control plans and permit conditions, to ensure that BMPs are functional (WET-05; Appendix G, Table G-1). Additionally, once construction is completed, areas of temporary disturbance would be returned to preconstruction conditions, and at the onshore substations land would be appropriately graded, graveled, or revegetated to prevent future erosion (WET-04; Appendix G, Table G-1).

Impacts on wetlands would be avoided and minimized by locating the substations and/or converter stations, cable routes, and work areas for the Cardiff and Larrabee onshore cable corridors within upland areas. Atlantic Shores will identify compensatory mitigation based on the requirements of USACE and NJDEP. Mitigation would likely include a combination of onsite restoration of wetlands temporarily impacted during construction, and wetland enhancement or mitigation banking credit purchase. In summary, potential adverse impacts on wetlands would be temporary and permanent, and localized. The impacts of land disturbance on wetlands resulting from the Proposed Action would be moderate because, although impacts on wetlands would be minimized, compensatory mitigation would likely be necessary due to unavoidable permanent impacts.

Table 3.5.8-3. Wetlands and waterbodies direct impact summary

Wetland/Waterbody Type	Potential Project Area Impacts (acres)		Impacts Avoided by Using Trenchless Installation (acres)
	Temporary	Permanent	
Estuarine Emergent Wetland	0.0	0.0	1.39
Palustrine Emergent Wetland	0.06	0.5	0.26
Palustrine Forested Wetland	0.48	0.09	0.56
Palustrine Scrub Shrub	0.0	0.0	0.001
Tidal/Riverine	0.0	0.0	6.64
Non-tidal/Perennial	0.01	0.0	0.17
Non-tidal/Intermittent	0.001	0.0005	0.0

Source: COP Volume II, Section 4.1-6; Atlantic Shores 2023.

Impacts of the Connected Action

No wetlands are located within the portion of the O&M facility study area, where the connected action activities would occur. However, a 0.06-acre (0.02-hectare) estuarine, emergent wetland is located between a paved parking lot and Clam Creek within the O&M facility study area. The maintenance dredging area within the Clam Creek portion of Absecon inlet is classified as a tidal waterbody. The bulkhead site and dredging activities would be conducted within an approximately 20.61-acre (8.3-hectare) site within Atlantic City's Inlet Marina area. The connected action could affect adjacent estuarine, emergent wetlands through the following IPFs: discharges/intakes and presence of structures.

Discharges/Intakes: Localized increases in TSS resulting in localized turbidity would be expected during Clam Creek dredging and during removal and installation of the bulkhead and piles. BMPs used during construction would minimize TSS increases in the water column. These measures include use of turbidity curtains during dredging in the basins, use of an environmental bucket, and slow withdrawal of the bucket through the water column. Pile driving would result in minimal and localized increases in turbidity (i.e., 5 to 10 mg/L above ambient within 300 feet [91 meters] of the activity). Turbidity associated with the Project activities would be minimal and temporary in nature and would have negligible impacts on any adjacent estuarine wetlands, as resuspended sediments would dissipate relatively quickly with the tidal currents.

Presence of structures: Wetlands and waterbodies do not occur shoreward of the bulkhead at the proposed O&M facility Project area and would not be impacted as a result of construction of the proposed O&M facility. The existing bulkhead is an approximately 250-foot (76-meter) structure consisting of deteriorated steel sheet piles, timbers, and concrete. The existing bulkhead is missing sections, leading it to become unstable and increasing the potential for erosion. Repair and/or replacement of the existing bulkhead is required in order to stabilize the shoreline and prevent additional erosion and would be necessary regardless of whether the Proposed Action is implemented. Atlantic Shores proposes to remove the existing bulkhead and construct a new 356-foot (109-meter) bulkhead composed of steel or composite vinyl sheet piles. It is anticipated that the new bulkhead would be supported by anchor piles. Any impacts on nearby estuarine wetlands as a result of bulkhead construction would be negligible.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities, and the connected action. Ongoing and planned non-offshore wind activities related to tidal energy projects, marine minerals extraction, port expansions, military use, oil and gas activities, and onshore development activities would contribute to impacts on wetlands through the primary IPFs of accidental releases and land disturbance. The connected action could affect nearby wetlands through discharges/intakes and presence of structures; however, anticipated impacts are negligible.

Accidental releases: The Proposed Action would contribute an undetectable increment to the cumulative accidental release impacts on wetlands from ongoing and planned activities including offshore wind. Impacts would likely be short term and minor due to the low risk and localized nature of the most likely spills, the use of an OSRP for projects, and regulatory requirements for the protection of wetlands. These impacts would occur primarily during construction, but also during operation and decommissioning to a lesser degree. Given the low probability of these spills occurring, BOEM does not expect ongoing and planned activities, including offshore wind, to contribute to impacts on wetlands resulting from accidental releases.

Land disturbance: The Proposed Action would contribute noticeable incremental impacts to the cumulative land disturbance impacts from ongoing and planned activities including offshore wind. Impacts would likely be temporary to permanent and moderate due to the permanent wetland impacts that would require compensatory mitigation. Impacts due to onshore land use changes are expected to include a gradually increasing amount of wetland alteration and loss. The future extent of land disturbance from ongoing and planned non-offshore wind activities over the next 34 years is not known with as much certainty as the extent of land disturbance that would be caused by the Proposed Action, but based on regional trends is anticipated to be similar to or greater than that of the Proposed Action. The Ocean Wind 1 project, which has a similar geographic analysis area as the Atlantic Shores South Project, would result in approximately 1 acre (0.4 hectare) of permanent disturbance and approximately 12.45 acres (5.03 hectares) of temporary wetland (Ocean Wind 2022).

If other planned projects were to overlap the geographic analysis area or even be co-located (partly or completely) within the same ROW corridor that the Proposed Action would use, then the impacts of those projects on wetlands would be of the same type as those of the Proposed Action alone; the degree of impacts may increase, although the location and timing of future activities would influence this. For example, repeated construction in a single corridor would be expected to have less impact on tidal wetlands than construction in an equivalent area of undisturbed wetland. Any work in wetlands would require a CWA Section 404 permit from USACE or NJDEP (or both) and a Section 401 Water Quality Certification from NJDEP; any wetlands permanently lost would require compensatory mitigation.

BOEM would not expect normal O&M activities to involve further wetland alteration. The onshore cable routes and associated substation/converter station facilities and POIs generally have no maintenance needs unless a fault or failure occurs; therefore, O&M is not expected to affect wetlands. In the event of a fault or failure, impacts would be expected to be temporary and negligible. Vehicle and equipment use would occur along roads using the manholes within the splice vaults and transition vaults for access and within previously developed areas such as onshore substations. Decommissioning of the Onshore Project components would have similar impacts as construction.

Conclusions

Impacts of Alternative B – Proposed Action. In summary, the activities associated with the proposed Atlantic Shores South Project may affect wetlands through temporary disturbance and permanent impacts from activities within or adjacent to these resources. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), construction of the Proposed Action would likely have **moderate** impacts on wetlands. The connected action activities would have negligible impacts on emergent, vegetated wetlands due to the lack of that type of wetland in the area where activities are proposed.

Cumulative Impacts of Alternative B – Proposed Action. The incremental impacts contributed by the Proposed Action to the cumulative impacts on wetlands would be noticeable. BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with the impacts on wetlands from ongoing and planned activities including offshore wind would likely be **moderate**. The Proposed Action would contribute to the overall impact rating primarily through temporary and permanent impacts on wetlands from cable installation and onshore construction activities. Measurable impacts would be relatively small, and the resource would likely recover completely when the affecting agent (e.g., temporary construction activity) is gone and remedial or mitigating action is taken.

3.5.8.6 Impacts of Alternatives C, D, E, and F on Wetlands

Impacts of Alternatives C, D, E, and F. The impacts on wetlands of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would be the same as those of the Proposed Action because these alternatives would differ only with respect to offshore components, and offshore components of the proposed Project have no potential impacts on wetlands. The impacts resulting from the land disturbance IPF associated with onshore construction under Alternatives C through F on wetlands are expected to be moderate and would be the same as those of the Proposed Action.

Cumulative Impacts of Alternatives C, D, E, and F. The contribution of Alternatives C through F to the impacts of ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on wetlands from ongoing and planned activities in combination with each of these alternatives would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternatives C, D, E, and F. Alternatives C through F would have the same **moderate** impacts on wetlands as the Proposed Action. The overall impacts on wetlands would not be significantly different because onshore components would remain the same for all alternatives.

Cumulative Impacts of Alternatives C, D, E, and F. The contribution of Alternatives C through F to the impacts on wetlands would be the same as that of the Proposed Action: noticeable. BOEM anticipates that the cumulative impacts associated with Alternatives C through F, when combined with ongoing and planned activities, would likely be **moderate**.

3.5.8.7 Proposed Mitigation Measures

No measures to mitigate impacts on wetlands have been proposed for analysis.

3.5.8.8 Comparison of Alternatives

None of the other action alternatives would affect the types, placement, or areal extent of the onshore components of the Project. All of the other action alternatives would therefore have the same impacts to wetlands as for the Proposed Action.

3.6 Socioeconomic Conditions and Cultural Resources

3.6.1 Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial and for-hire recreational fisheries resources from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area for commercial and for-hire recreational fisheries, as shown on Figure 3.6.1-1, spans more than 200 million acres and includes waters within the Greater Atlantic Region managed by the NEFMC and MAFMC for federal fisheries within the U.S. Exclusive Economic Zone (from 3 to 200 nautical miles [5.6 to 370.4 kilometers] from the coastline), plus the state waters within the Greater Atlantic Region (from 0 to 3 nautical miles [5.6 kilometers] from the coastline) extending from Maine through Cape Hatteras, North Carolina. The Project area includes the Lease Area, which is in federal waters, and offshore export cable corridors, which are in federal and state waters. The boundaries for the geographic analysis area were developed to consider impacts on federally permitted vessels operating in all fisheries in state and U.S. Exclusive Economic Zone waters surrounding the proposed Project.

Due to size of the geographic analysis area, the analysis for this Draft EIS focuses on the commercial fisheries and for-hire recreational fishing that would likely occur in the Project area or be affected by Project-related activities, while providing context within the larger geographic analysis area.

3.6.1.1 Description of the Affected Environment and Future Baseline Conditions

Most fisheries resources in federal waters of the New England and Mid-Atlantic regions are managed under the MSA (16 USC 1801 et seq.) through two Regional Fishery Management Councils, NEFMC and MAFMC. The Regional Fishery Management Councils develop species-specific Fisheries Management Plans (FMP), which establish fishing quotas, seasons, and closure areas, as well as establishing protections for EFH. The Regional Fishery Management Councils work with NMFS to assess and predict the status of fish stocks, set catch limits, promote compliance with fisheries regulations, and reduce bycatch.

Within the New Jersey state waters of the Project area, commercial and recreational fisheries are further managed by state regulatory agencies under various ocean management plans developed at the state level or at the regional level (MAFMC) and by the Atlantic States Marine Fisheries Commission (ASMFC), a deliberative body of the Atlantic coastal states that coordinates the conservation and management of 27 nearshore, migratory fish species. Each coastal state has its own structure of agencies and plans that govern fisheries resources. In New Jersey, NJDEP's Bureau of Marine Fisheries administers all laws relating to marine fisheries (Part 7:25, Subchapter 18 – Marine Fisheries) and is responsible for the development and enforcement of state and federal regulations pertaining to marine fish and fisheries in New Jersey state waters, including the management of diadromous species (e.g., American eel, striped bass, river herring, sturgeon).

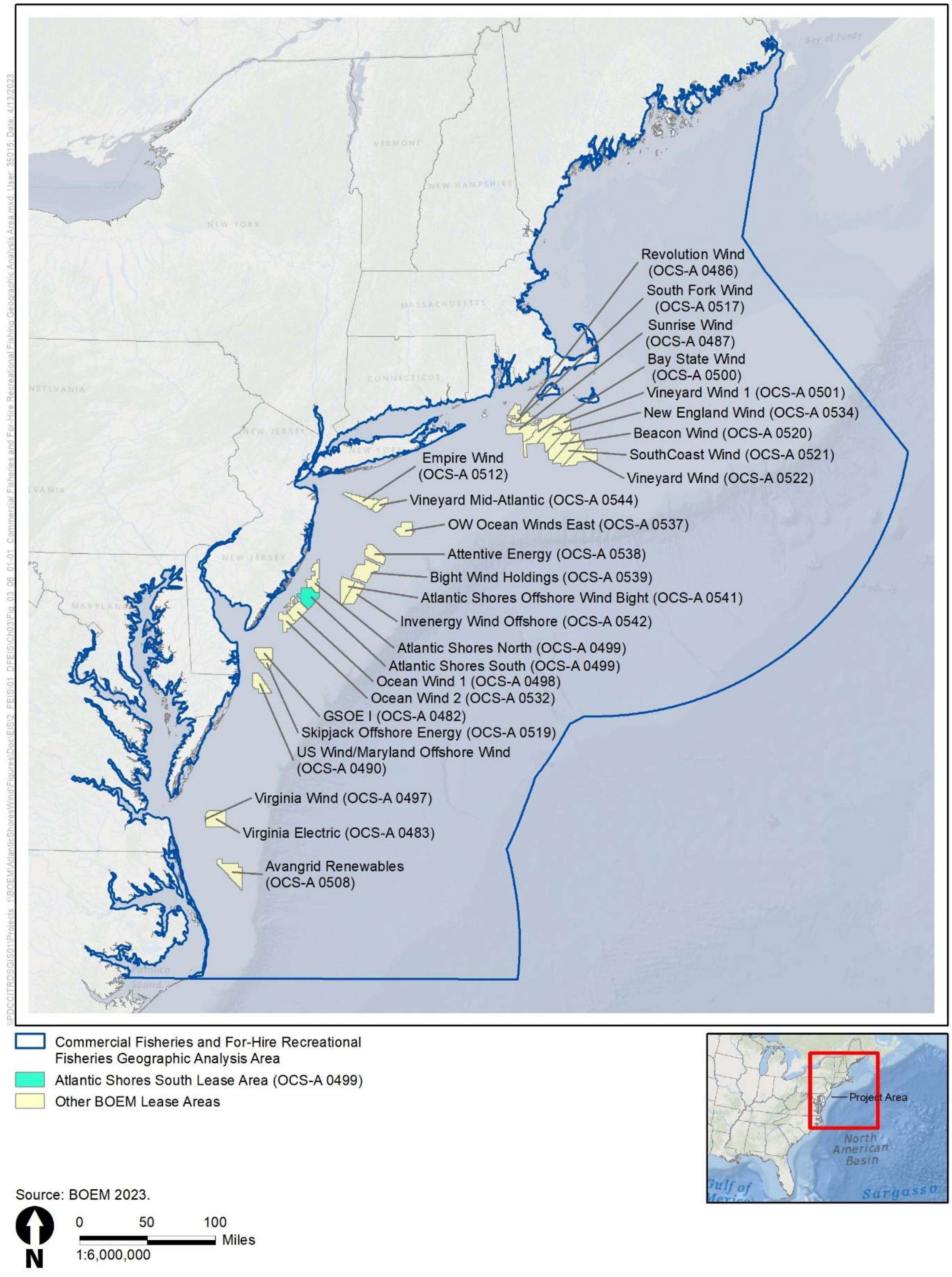


Figure 3.6.1-1. Commercial fisheries and for-hire recreational fishing geographic analysis area

Commercial Fisheries

The primary source of data used to describe commercial fisheries in the geographic analysis area for the purposes of this assessment was the NMFS commercial fisheries statistics database (NMFS 2022a), which summarizes commercial fisheries landings and ex-vessel revenue data for fish and shellfish that are landed and sold in the United States. The primary source of data used to describe the commercial fisheries in the Lease Area was NMFS' Socioeconomics Impacts of Atlantic Offshore Wind Development reports, which summarize fisheries effort and landings within wind energy lease areas (NMFS 2022b). These reports are based on combined data from Vessel Trip Reports and dealer reports submitted by those issued a permit for managed species in federal waters. In addition, figures developed by BOEM based on NMFS Vessel Monitoring System (VMS) data provided by NMFS (2019) are included in the commercial fisheries analysis.

Regional Setting

Commercial fisheries in federal waters of the New England and Mid-Atlantic regions harvest a variety of finfish and shellfish species, including clams, crabs, groundfish, herring, lobster, squid, scallops, and skates. These species are harvested with a variety of fishing gear, including mobile gear (e.g., bottom trawl, midwater trawl, dredge) and fixed gear (e.g., demersal gillnet, lobster trap, crab trap, pots). The fishery resources are managed under numerous FMPs, including the Atlantic Herring FMP, Monkfish FMP, Northeast Multispecies (large- and small-mesh) FMP,[1] Red Crab FMP, Sea Scallop FMP, and Skate FMP (NEFMC 2022); Bluefish FMP, Mackerel/Squid/Butterfish FMP, Spiny Dogfish FMP, Summer Flounder/Scup/Black Sea Bass FMP, Surfclam/Ocean Quahog FMP, and Tilefish FMP (MAFMC 2022); Highly Migratory Species FMP (NMFS 2006); and Atlantic Menhaden FMP, Lobster FMP, and Jonah Crab FMP (ASMFC 2022).

The predominant commercial fish and shellfish species in the geographic analysis area based on landed weight and ex-vessel revenue are summarized by species for the years 2011 through 2020 in Table 3.6.1-1 and Table 3.6.1-2, respectively. During this period, the species with the highest average annual landed weight included Atlantic menhaden, which represented 34 percent of the average landed weight, American lobster, Atlantic herring, blue crab, sea scallop, and surfclam. The most valuable species over this period were sea scallop and American lobster, which together represented 59 percent of the average annual ex-vessel revenue. Other valuable species harvested in state and federal waters included Atlantic herring, Atlantic menhaden, Atlantic surfclam, longfin and northern shortfin squid, summer flounder, and monkfish.

[1] The Northeast Multispecies (large-mesh) FMP includes Acadian redfish, American plaice, Atlantic cod, Atlantic haddock, Atlantic halibut, Atlantic wolffish, ocean pout, pollock, white hake, witch flounder, windowpane flounder, winter flounder, and yellowtail flounder. The Northeast Multispecies small-mesh FMP includes offshore hake, red hake, and silver hake.

Table 3.6.1-1. Commercial fishing landings of the top 20 species by landed weight within the geographic analysis area (New England and Mid-Atlantic), 2011–2020

Species	FMP Fishery	Peak Annual Landing (millions of lbs.)	Average Annual Landing (millions of lbs.)
Atlantic menhaden	Atlantic Menhaden	497.1	419.0
Atlantic lobster	American Lobster	159.4	141.3
Atlantic herring	Atlantic Herring	206.1	134.0
Blue crab	No federal FMP	104.4	66.7
Sea scallop	Sea Scallop	60.5	48.5
Atlantic surfclam	Surfclam and Ocean Quahog	44.6	35.1
Skates	Skate	36.3	32.2
Shortfin squid	Mackerel, Squid, and Butterfish	61.4	30.6
Longfin squid	Mackerel, Squid, and Butterfish	40.1	25.9
Monkfish	Monkfish	23.9	20.5
Spiny dogfish	Spiny Dogfish	24.1	17.1
Jonah crab	Jonah Crab	20.1	15.3
Scup	Summer Flounder, Scup, and Black Sea Bass	17.8	15.1
Silver hake	Northeast Multispecies (small-mesh)	17.1	13.7
Atlantic mackerel	Mackerel, Squid, and Butterfish	19.2	12.3
Haddock	Northeast Multispecies (large-mesh)	22.4	12.2
Ocean quahog	Surfclam and Ocean Quahog	19.1	11.9
Acadian redfish	Northeast Multispecies (large-mesh)	12.9	9.6
Pollock	Northeast Multispecies (large-mesh)	15.9	9.3
Summer flounder	Summer Flounder, Scup, and Black Sea Bass	13	8.0
All species[1]		**1,454.1[2]**	**1,243.8**

Source: NMFS 2022a.

[1] Includes 250 species and taxonomic groups (e.g., drums, skates) for which there were recorded landings. For comparison, the sum of the average annual landings of all individual species listed in the table is 1,078 million pounds.

[2] Reflects a single year in which the sum of landings across all species was highest.

Table 3.6.1-2. Commercial fishing revenue of the top 20 species by revenue within the geographic analysis area (New England and Mid-Atlantic), 2011–2020

Species	FMP Fishery	Peak Annual Revenue (millions of dollars)	Average Annual Revenue (millions of dollars)
American lobster	American Lobster	$670.4	$553.3
Sea scallop	Sea Scallop	$580.6	$504.8
Blue crab	No federal FMP	$108.1	$92.7
Eastern oyster[1]	No federal FMP	$102.6	$74.8
Northern quahog[1]	No federal FMP	$57.2	$45.2
Atlantic menhaden	Atlantic Menhaden	$92.1	$44.7
Longfin squid	Mackerel, Squid, and Butterfish	$50.1	$32.2
Atlantic surfclam	Surfclam and Ocean Quahog	$32.2	$27.3
Soft-shell clam	No federal FMP	$31.0	$24.1
Atlantic Herring	Atlantic Herring	$31.8	$23.4
Summer flounder	Summer Flounder, Scup, and Black Sea Bass	$27.4	$23.1

Species	FMP Fishery	Peak Annual Revenue (millions of dollars)	Average Annual Revenue (millions of dollars)
Monkfish	Monkfish	$27.1	$18.7
Striped bass	No federal FMP	$22.0	$17.8
Haddock	Northeast Multispecies (large-mesh)	$22.4	$13.3
Shortfin squid	Mackerel, Squid, and Butterfish	$27.3	$13.3
Jonah crab	Jonah Crab	$18.5	$12.3
American eel	No federal FMP	$39.6	$11.2
Atlantic Cod	Northeast Multispecies (large-mesh)	$32.6	$10.5
Silver hake	Northeast Multispecies (small-mesh)	$11.2	$9.9
Scup	Summer Flounder, Scup, and Black Sea Bass	$11.2	$9.7
All species[2]		**$2,020.0[3]**	**$1,805.5**

Source: NMFS 2022a.

[1] Farmed.

[2] Includes 250 species and taxonomic groups (e.g., drums, skates) for which there were recorded landings.

[3] Reflects a single year in which the sum of revenue across all species was highest.

Commercial fisheries provide economic benefits to the coastal communities of New England and the Mid-Atlantic region by contributing to the income of vessel crews and owners and by creating demand for dockside services to process seafood products and maintain vessels. Table 3.6.1-3 summarizes the average annual revenue by port of landing from 2011 through 2020 for ports in the geographic analysis area. Landings in New Bedford, Massachusetts, represented approximately 32 percent of the average annual commercial fishing revenue in this area. The ports with the next highest revenues—Cape May, New Jersey, and the Hampton Roads area, Virginia—represented 6 percent and 5 percent, respectively.

Table 3.6.1-3. Commercial fishing landings and revenue for the top 30 highest revenue ports in the geographic analysis area (New England and Mid-Atlantic), 2011–2020

Port and State	Peak Annual Landings (millions lbs.)	Average Annual Landings (millions lbs.)	Peak Annual Revenue (millions dollars)	Average Annual Revenue (millions dollars)
New Bedford, Massachusetts	143.0	121.5	$450.8	$378.4
Cape May, New Jersey	103.7	66.2	$102.7	$75.5
Hampton Roads Area, Virginia	18.3	14.8	$88.3	$59.3
Stonington, Maine	25.4	18.7	$68.0	$54.5
Point Judith, Rhode Island	57.3	48.1	$65.9	$51.6
Gloucester, Massachusetts	82.6	63.6	$60.7	$51.6
Reedville, Virginia	413.9	345.5	$63.9	$36.5
Vinalhaven, Maine	13.4	9.9	$42.3	$34.0
Portland, Maine	62.4	48.0	$38.1	$30.9
Point Pleasant, New Jersey	43.3	27.8	$35.7	$30.3
Provincetown-Chatham, Massachusetts	26.5	20.1	$34.8	$30.3
Barnegat Light, New Jersey	8.9	7.2	$33.8	$26.2
Wanchese-Stumpy Point, North Carolina	24.6	17.8	$26.6	$22.3
Friendship, Maine	9.1	6.1	$24.6	$19.9
Beals Island, Maine	8.1	6.6	$23.5	$19.9
Newington, New Hampshire	4.7	4.0	$26.6	$19.2

Port and State	Peak Annual Landings (millions lbs.)	Average Annual Landings (millions lbs.)	Peak Annual Revenue (millions dollars)	Average Annual Revenue (millions dollars)
Atlantic City, New Jersey	29.9	24.8	$22.1	$18.8
Montauk, New York	14.8	11.9	$21.2	$17.1
Boston, Massachusetts	20.2	15.8	$19.3	$17.1
Rockland, Maine	40.6	27.3	$23.5	$16.0
Fairhaven, Massachusetts	7.5	5.0	$25.2	$15.4
Spruce Head, Maine	4.6	4.2	$18.7	$14.6
Jonesport, Maine	35.7	12.5	$24.6	$14.1
North Kingstown, Rhode Island	27.0	20.9	$17.7	$13.4
Accomac, Virginia	9.9	7.7	$20.1	$13.2
Owls Head, Maine	3.3	2.7	$14.2	$12.1
Cundys Harbor, Maine	2.9	2.7	$12.3	$12.0
Bass Harbor, Maine	3.5	2.8	$13.5	$11.8
Milbridge, Maine	3.2	2.9	$13.0	$11.4
Cushing, Maine	2.1	2.1	$11.2	$11.2
All New England and Mid-Atlantic ports[1]	1,073.72	1,014.0	$1,384.1[2]	$1,180.0

Source: NMFS 2022a.

[1] Includes 54 ports within the New England and Mid-Atlantic regions.

[2] Reflects a single year in which the sum of landings or revenue across all ports was highest.

Project Area

The Project area contains spawning habitat for species that are valued in commercial and recreational fisheries. Species that have designated EFH for eggs in the Project area, indicative of having spawning habitat there, include Atlantic butterfish, Atlantic cod, Atlantic sea scallop, Atlantic mackerel, bluefish, longfin inshore squid, monkfish, ocean pout, red hake, silver hake, summer flounder, windowpane flounder, winter flounder, witch flounder, and yellowtail flounder (COP Volume II, Appendix J; Atlantic Shores 2023).

Commercial fishing effort in the Project 1 and Project 2 WTAs[2] varies among species, fishing ports, and fishing gear types. Fishing effort within the WTAs from 2011–2020 is summarized by species for Project 1 and Project 2 in Table 3.6.1-4, by species for both WTAs combined in Table 3.6.1-5, by port for Project 1 and Project 2 in Table 3.6.1-6, by port for both WTAs combined in Table 3.6.1-7, by gear type for Project 1 and 2 in Table 3.6.1-8, and by gear type for both WTAs combined in Table 3.6.1-9. Annualized commercial fishing effort in the WTAs by species, port, and gear type is provided in Table B.3-1 through Table B.3-18 in Appendix B, *Supplemental Information and Additional Figures and Tables*. The species with the highest number of vessel trips to each WTA was Atlantic surfclam, which accounted for 16 percent of trips to the combined WTAs. Other species that were commonly targeted in both WTAs included black sea bass, summer flounder, sea scallop, longfin squid, monkfish, and American lobster. Fishing effort in the WTAs is broadly distributed across ports ranging from North Carolina to

[2] The Project 1 and Project 2 WTAs each include the area of overlap between the two projects.

Massachusetts, although the majority of the fishing effort comes from New Jersey ports. Fishing effort by port was similar between the Project 1 and Project 2 WTAs, with an annual average of 112 vessels making 439 trips to the Project 1 WTA and 113 vessels making 461 trips to the Project 2 WTA, although it should be noted that many of these vessels probably visited both WTAs. The fishing port with the highest number of vessel trips to each WTA was Atlantic City, New Jersey, which accounted for 60 percent of trips to the combined WTAs. Other fishing ports that accounted for a large share of trips to both WTAs included Cape May and Barnegat, New Jersey; Point Judith, Rhode Island; New Bedford, Massachusetts; and Newport News and Hampton, Virginia. Cape May, New Jersey accounted for the highest number of vessels that fished in the WTAs. The distribution of fishing effort among the different types of fishing gears was similar between the Project 1 and Project 2 WTAs. The fishing gears that had the highest number of vessel trips to each of the WTAs were the clam dredge and bottom trawl, which collectively accounted for 73 percent of vessel trips to the combined WTAs. The fishing gears that had the highest number of vessels that fished in each of the WTAs were the bottom trawl and scallop dredge, which collectively accounted for 79 percent of vessels that fished in the combined WTAs.

Table 3.6.1-4. Annual average number of commercial fishing vessel trips and commercial fishing vessels in the Project 1 and Project 2 WTAs by species, 2011–2020

Project 1			Project 2		
Species[1]	Vessel Trips	Number of Vessels	Species[1]	Vessel Trips	Number of Vessels
Surfclam	166	14	Surfclam	175	13
Black sea bass	101	37	Black sea bass	100	40
Summer flounder	87	48	Sea scallop	97	51
Longfin squid	85	40	Monkfish	95	52
Monkfish	84	48	Longfin squid	88	43
Sea scallop	81	49	Summer flounder	88	52
American lobster	62	9	American lobster	53	9
Channeled whelk	48	6	Bluefish	45	29
Bluefish	43	28	Scup	40	28
Butterfish	37	19	Butterfish	35	20
Scup	34	24	Shortfin squid	28	8
Shortfin squid	29	8	Channeled whelk	26	3
Jonah crab	25	5	Silver hake	22	15
John dory	21	10	John dory	21	10
Silver hake	20	14	Jonah crab	20	4
Skates	18	8	Atlantic mackerel	12	8
Smooth dogfish	16	7	Skates	12	8
Atlantic mackerel	13	9	Smooth dogfish	10	7
Atlantic croaker	12	6	Atlantic croaker	9	6
Spiny dogfish	8	2	Conger eel	7	4

Source: NMFS 2022b.

[1] Species are sorted by vessel trips in descending order.

[2] Includes 43 species that were caught in each of the Project 1 and 2 WTAs.

Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Table 3.6.1-5. Annual average number of commercial fishing vessel trips and commercial fishing vessels in the combined Project 1 and Project 2 WTAs by species, 2011–2020

Species[1]	Vessel Trips	Percentage of Total Trips to WTAs	Number of Vessels	Percentage of Total Vessels in WTAs
Surfclam	188	16.23	14	3.05
Black sea bass	103	8.91	41	8.70
Sea scallop	97	8.42	52	11.19
Monkfish	95	8.20	52	11.09
Summer flounder	92	7.95	52	11.13
Longfin squid	88	7.63	43	9.20
American lobster	62	5.33	10	2.08
Channeled whelk	48	4.13	6	1.38
Bluefish	46	3.99	29	6.23
Scup	40	3.45	28	5.95
Butterfish	37	3.19	20	4.25
Shortfin squid	29	2.50	8	1.72
Jonah crab	26	2.25	5	1.07
Silver hake	22	1.92	15	3.27
John dory	21	1.82	11	2.28
Skates	19	1.62	9	1.85
Smooth dogfish	16	1.40	8	1.65
Atlantic mackerel	13	1.13	9	1.91
Atlantic croaker	12	1.00	6	1.31
Spiny dogfish	9	0.80	3	0.56

Source: NMFS 2022b.

[1] Species are sorted by vessel trips in descending order.

[2] Includes 45 species that were caught in the combined Project 1 and 2 WTAs.

Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Table 3.6.1-6. Annual average number of commercial fishing vessel trips and commercial fishing vessels in the Project 1 and Project 2 WTAs by fishing port, 2011–2020

Project 1			Project 2		
Port and State[1]	Vessel Trips	Number of Vessels	Port and State[1]	Vessel Trips	Number of Vessels
Atlantic City, New Jersey	260	18	Atlantic City, New Jersey	291	19
Cape May, New Jersey	65	32	Cape May, New Jersey	58	31
Barnegat, New Jersey	26	8	Barnegat, New Jersey	22	7
Point Judith, Rhode Island	16	9	Point Judith, Rhode Island	16	9
New Bedford, Massachusetts	16	11	New Bedford, Massachusetts	16	12
Newport News, Virginia	12	9	Newport News, Virginia	13	9
Hampton, Virginia	10	7	Hampton, Virginia	12	7
Sea Isle City, New Jersey	7	1	Point Pleasant, New Jersey	9	6
Beaufort, North Carolina	5	5	Beaufort, North Carolina	6	6
Point Pleasant, New Jersey	5	5	Ocean City, Maryland	4	2
Ocean City, Maryland	4	3	North Kingstown, Rhode Island	4	0
North Kingstown, Rhode Island	4	0	Davisville, Rhode Island	4	1
Davisville, Rhode Island	4	1	Wanchese, North Carolina	4	3
Wanchese, North Carolina	3	2	Chincoteague, Virginia	2	1
Chincoteague, Virginia	2	1	Oriental, North Carolina	< 1	< 1
Montauk, New York	< 1	< 1	Sea Isle City, New Jersey	< 1	< 1
Wildwood, New Jersey	< 1	< 1	Montauk, New York	< 1	< 1
All ports	**439**	**112**	Wildwood, New Jersey	< 1	< 1
			All ports	**461**	**113**

Source: NMFS 2022b.

[1] Ports are sorted by vessel trips in descending order.

Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Table 3.6.1-7. Annual average number of commercial fishing vessel trips and commercial fishing vessels in the combined Project 1 and Project 2 WTAs by fishing port, 2011–2020

Port and State	Vessel Trips	Percentage of Vessel Trips in Lease Area	Number of Vessels	Percentage of Vessels in Lease Area
Atlantic City, NJ	291	60.43	19	15.86
Cape May, NJ	65	13.47	32	27.09
Barnegat, NJ	27	5.58	8	6.67
Point Judith, RI	17	3.51	9	7.85
New Bedford, MA	16	3.36	12	10.13
Newport News, VA	13	2.76	10	8.02
Hampton, VA	12	2.51	7	6.16
Point Pleasant, NJ	9	1.89	6	5.32
Sea Isle City, NJ	7	1.41	1	0.84
Beaufort, NC	6	1.29	6	4.81
Ocean City, MD	5	0.98	3	2.36
North Kingstown, RI	4	0.79	0	0.25
Davisville, RI	4	0.73	1	0.59
Wanchese, NC	4	0.73	3	2.45
Chincoteague, VA	2	0.37	1	0.84
Oriental, NC	< 1	0.08	< 1	0.25
Montauk, NY	< 1	0.06	< 1	0.25
Wildwood, NJ	< 1	0.06	< 1	0.25
All ports	**482**		**119**	

Source: NMFS 2022b.

[1] Ports are sorted by vessel trips in descending order.

Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Table 3.6.1-8. Annual average number of commercial fishing vessel trips and commercial fishing vessels in the Project 1 and Project 2 WTAs by fishing gear, 2011–2020

Project 1			Project 2		
Gear Type[1]	Vessel Trips	Number of Vessels	Gear Type[1]	Vessel Trips	Number of Vessels
Dredge-clam	188	15	Dredge-clam	218	15
Trawl-bottom	130	56	Trawl-bottom	132	59
Pot-other	59	5	Dredge-scallop	54	34
Dredge-scallop	45	32	Pot-other	50	4
Gillnet-sink	12	3	Pot-lobster	4	2
Pot-lobster	5	3	Gillnet-sink	2	1
All gears	**439**	**113**	**All gears**	**459**	**116**

Source: NMFS 2022b.

[1] Gear types are sorted by vessel trips in descending order.

Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Table 3.6.1-9. Annual average number of commercial fishing vessel trips and commercial fishing vessels in the combined Project 1 and Project 2 WTAs by fishing gear, 2011–2020

Gear Type[1]	Vessel Trips	Percentage of Vessel Trips in Lease Area	Number of Vessels	Percentage of Vessels in Lease Area
Dredge-clam	218	45.04	15	12.88
Trawl-bottom	136	28.05	59	49.58
Pot-other	59	12.22	5	4.26
Dredge-scallop	54	11.17	35	29.01
Gillnet-sink	12	2.54	3	2.17
Pot-lobster	5	0.99	3	2.09
All gears	**485**		**120**	

Source: NMFS 2022b.

[1] Gear types are sorted by vessel trips in descending order.

Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Annual average commercial fishing landings and revenue within the WTAs from 2011–2020 are summarized by species for Project 1 and Project 2 in Table 3.6.1-10 and for both WTAs combined in Table 3.6.1-11. Annualized commercial fishing landings and revenue in the WTAs are summarized by species in Table B.3-19 through Table B.3-24 in Appendix B. Commercial fishing activity landed an annual average weight of 304,044 pounds in the Project 1 WTA and 315,471 pounds in the Project 2 WTA. The species with the highest landed weight in both the Project 1 and Project 2 WTAs was surfclam, which accounted for 78 percent of the landed weight in the combined Project 1 and Project 2 WTAs. Other species that had substantial landings in both WTAs included sea scallop, shortfin squid, longfin squid, and summer flounder. There were substantially higher landings of Atlantic herring, Atlantic menhaden, American lobster, and black sea bass in the Project 1 WTA compared to the Project 2 WTA. Species that were not harvested under a federal FMP also had substantial landings in both WTAs.

Commercial fishing activity, including both FMP and non-FMP fisheries, generated an average annual revenue of $264,926 in the Project 1 WTA and $244,696 in the Project 2 WTA. The species that generated the highest revenue in both WTAs were surfclam and sea scallop, which together accounted for 84 percent of the revenue generated in the combined Project 1 and Project 2 WTAs. Other species that generated substantial revenue in both WTAs included longfin squid, shortfin squid, and summer flounder. There was substantially higher revenue generated by American lobster, black sea bass, and channeled whelk in the Project 1 WTA compared to the Project 2 WTA. Species that were not harvested under a federal FMP also generated a substantial amount of revenue in both WTAs.

Annual average percentages of commercial landings and revenue in the geographic analysis area that were harvested within the Project 1 and Project 2 WTAs from 2011–2020 are summarized by species for Project 1 and Project 2 in Table 3.6.1-12 and for both WTAs combined in Table 3.6.1-13. Annualized percentages of commercial fishing landings and revenue from the Project 1 and Project 2 WTAs are summarized by species in Table B.3-25 through Table B.3-30 in Appendix B. The species with the highest percentages of landings and revenue harvested in the Project 1 WTA were surfclam (0.58 percent of landings, 0.44 percent of revenue), smooth dogfish (0.09 percent of landings, 0.11 percent of revenue), channeled welk (0.11 percent of landings and revenue), and black sea bass (0.12 percent of landings, 0.09 percent of revenue). The species with the highest percentages of landings and revenue harvested in the Project 2 WTA was surfclam (0.68 percent of landings, 0.50 percent of revenue); no other species had more than 0.05 percent of its revenue generated in the Project 2 WTA. There were substantial differences between the Project 1 and Project 2 WTAs in terms of the percentages of landings and revenue of species. In particular, the Project 1 WTA accounted for a much higher percentage of landings and revenue of smooth dogfish, channeled welk, black sea bass, and tautog, whereas the Project 2 WTA accounted for a higher percentage of landings and revenue of surfclam. Collectively, the combined Project 1 and Project 2 WTAs generated approximately 0.02 percent of the revenue of commercial fisheries in the geographic analysis area.

Table 3.6.1-10. Annual average commercial fishing landings and revenue in the Project 1 and Project 2 WTAs by species, 2011–2020

Species[1]	Project 1 Landings (pounds)	Project 1 Revenue (2019 dollars)	Species[1]	Project 2 Landings (pounds)	Project 2 Revenue (2019 dollars)
Surfclam	218,144	$133,624	Surfclam	255,346	$152,447
Sea scallop	7,075	$82,470	Sea scallop	5,471	$62,706
All others	53,126	$14,258	All others	40,196	$14,309
Channeled whelk	977	$7,348	Longfin squid	2,836	$3,542
Black sea bass	2,299	$5,875	Shortfin squid	4,909	$2,958
American lobster	995	$4,804	Summer flounder	979	$2,563
Longfin squid	3,783	$4,719	Black sea bass	658	$1,782
Shortfin squid	7,060	$4,229	American lobster	211	$1,027
Summer flounder	1,257	$3,360	Ocean quahog	758	$684
Smooth dogfish	780	$725	Channeled whelk	77	$652
Atlantic menhaden	3,005	$415	Atlantic mackerel	827	$351
Ocean quahog	487	$411	Atlantic croaker	564	$278
Atlantic mackerel	764	$336	Scup	503	$268
Scup	575	$323	Monkfish	111	$253
Atlantic croaker	604	$288	Smooth dogfish	259	$251
Jonah crab	379	$284	Skates	338	$138
Skates	534	$265	Atlantic menhaden	717	$114
Monkfish	113	$246	Silver hake	109	$75
Tautog	57	$184	Jonah crab	77	$61
Atlantic herring	1,019	$163	Butterfish	97	$56
All species[2]	**304,044**	**$264,926**	**All species**	**315,471**	**$244,696**

Source: NMFS 2022b.

[1] Species are sorted by revenue in descending order.

[2] Includes all 50 species that were landed in the WTAs.

Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Table 3.6.1-11. Annual average commercial fishing landings and revenue in the combined Project 1 and Project 2 WTAs by species, 2011–2020

Species[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
Surfclam	404,620	77.70	$244,380	56.02
Sea scallop	10,710	2.06	$124,087	28.45
All others	70,172	13.48	$23,301	5.34
Channeled whelk	1,023	0.20	$7,743	1.78
Longfin squid	5,641	1.08	$7,035	1.61
Black sea bass	2,665	0.51	$6,880	1.58
Shortfin squid	10,232	1.96	$6,149	1.41
American lobster	1,103	0.21	$5,332	1.22
Summer flounder	1,941	0.37	$5,167	1.18
Ocean quahog	1,141	0.22	$1,004	0.23
Smooth dogfish	899	0.17	$842	0.19
Atlantic mackerel	1,364	0.26	$591	0.14
Scup	920	0.18	$506	0.12
Atlantic menhaden	3,438	0.66	$483	0.11
Atlantic croaker	978	0.19	$471	0.11
Monkfish	195	0.04	$435	0.10
Skates	746	0.14	$337	0.08
Jonah crab	421	0.08	$318	0.07
Tautog	60	0.01	$198	0.05
Atlantic herring	1,019	0.20	$163	0.04
All species[2]	**520,752**		**$436,213**	

Source: NMFS 2022b.

[1] Species are sorted by annual average revenue in descending order.

[2] Includes all 50 species that were landed in the WTAs.

Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Table 3.6.1-12. Annual average commercial fishing landings and revenue in the Project 1 and Project 2 WTAs as a percentage of annual average landings and revenue in the geographic analysis area by species, 2011–2020

Project 1			Project 2		
Species[1]	Percentage of Landings	Percentage of Revenue	Species[1]	Percentage of Landings	Percentage of Revenue
Surfclam	0.581	0.443	Surfclam	0.678	0.504
Smooth dogfish	0.091	0.106	Smooth dogfish	0.031	0.037
Channeled whelk	0.105	0.105	Clearnose skate	0.061	0.036
Black sea bass	0.122	0.087	Black sea bass	0.034	0.026
Conger eel	0.088	0.076	Shortfin squid	0.014	0.018
Tautog	0.072	0.057	Sea scallop	0.012	0.012
Clearnose skate	0.045	0.032	Channeled whelk	0.012	0.012
Shortfin squid	0.021	0.026	Atlantic croaker	0.016	0.011
Sea scallop	0.016	0.016	Conger eel	0.012	0.011
American eel	0.152	0.015	Longfin squid	0.011	0.011
Triggerfish	0.015	0.015	Summer flounder	0.010	0.009
Longfin squid	0.015	0.014	Atlantic mackerel	0.005	0.009
Summer flounder	0.012	0.012	Tautog	0.007	0.007
Rock crab	0.013	0.012	Swordfish	0.005	0.005
Atlantic croaker	0.017	0.011	Other fish	0.002	0.004
Atlantic mackerel	0.005	0.009	Triggerfish	0.004	0.004
Atlantic menhaden	0.007	0.009	Bluefish	0.004	0.004
Bluefish	0.006	0.006	Scup	0.004	0.003
Swordfish	0.006	0.006	Ocean quahog	0.002	0.003
Other fish	0.003	0.005	Atlantic menhaden	0.002	0.003

Source: NMFS 2022b.

[1] Species are sorted by percentage of revenue in descending order.

Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Table 3.6.1-13. Annual average commercial fishing landings and revenue in the combined Project 1 and Project 2 WTAs as a percentage of annual average landings and revenue in the geographic analysis area by species, 2011–2020

Species[1]	Percentage of Landings	Percentage of Revenue
Surfclam	1.075	0.808
Smooth dogfish	0.105	0.123
Channeled whelk	0.112	0.112
Black sea bass	0.142	0.102
Conger eel	0.095	0.082
Tautog	0.076	0.061
Clearnose skate	0.093	0.061
Shortfin squid	0.030	0.037
Sea scallop	0.024	0.024
Longfin squid	0.023	0.021
Summer flounder	0.019	0.019
Atlantic croaker	0.027	0.018
Triggerfish	0.017	0.017
American eel	0.161	0.016
Atlantic mackerel	0.009	0.015
Rock crab	0.013	0.012
Atlantic menhaden	0.008	0.010
Swordfish	0.010	0.010
Bluefish	0.009	0.008
Other fish	0.004	0.008

Source: NMFS 2022b.
[1] Species are sorted by percentage of revenue in descending order.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Annual average commercial fishing landings and revenue within the WTAs from 2011–2020 are summarized by fishing port for Project 1 and Project 2 in Table 3.6.1-14 and for both WTAs combined in Table 3.6.1-15. Annualized commercial fishing landings and revenue in the WTAs are summarized by fishing port in Table B.3-31 through Table B.3-36 in Appendix B. The fishing port with the highest landed weight and revenue in both WTAs was Atlantic City, New Jersey by a wide margin. Atlantic City accounted for approximately 80 percent of the landed weight and 62 percent of revenue from the combined Project 1 and Project 2 WTAs. Other fishing ports that accounted for substantial landings and revenue in were similar in the Project 1 and Project 2 WTAs and included Cape May and Barnegat, New Jersey; New Bedford, Massachusetts; and Newport New, Virginia. Although overall landings and revenue were similar between the Project 1 and Project 2 WTAs, there were some differences between these WTAs in terms of landings and revenue among ports. In particular, Atlantic City had higher landings and revenue from the Project 2 WTA, whereas Cape May, New Bedford, and Barnegat had higher landings and revenue from the Project 1 WTA.

Annual average commercial fishing landings and revenue within the WTAs from 2011–2020 are summarized by state for Project 1 and Project 2 in Table 3.6.1-16 and for both WTAs combined in Table 3.6.1-17. The state with the highest landings and revenue in both WTAs was New Jersey, which landed 492,802 pounds and generated $345,831 from the combined Project 1 and Project 2 WTAs annually.

New Jersey accounted for approximately 95 percent of landings and 79 percent of revenue in the combined Project 1 and Project 2 WTAs. Other states that accounted for substantial landings and revenue were similar in the Project 1 and Project 2 WTAs and included Massachusetts, Virginia, Rhode Island, North Carolina, and Maryland.

Annual average percentages of commercial revenue in the geographic analysis area that were harvested in the WTAs from 2011–2020 are summarized by fishing port for Project 1 and Project 2 in Table 3.6.1-18 and for both WTAs combined in Table 3.6.1-19. Annualized percentages of commercial fishing landings and revenue from the WTAs are summarized by fishing port in Table B.3-37 through Table B.3-42 in Appendix B. The fishing ports with the highest percentages of landings and revenue harvested in the Project 1 WTA were Atlantic City, New Jersey (0.88 percent of landings, 0.70 percent of revenue); Sea Isle City, New Jersey (0.05 percent of landings, 0.11 percent of revenue); and Cape May, New Jersey (0.08 percent of landings, 0.05 percent of revenue). The fishing port with the highest percentages of landings and revenue harvested in the Project 2 WTA was Atlantic City (1.05 percent of landings, 0.76 percent of revenue); no other port had more than 0.05 percent of its landings or revenue in the Project 2 WTA. There were some differences between the Project 1 and Project 2 WTA in terms of the percentages of landings and revenue of fishing ports. In particular, Atlantic City generated a higher percentage of its landings and revenue in the Project 2 WTA, whereas Sea Isle City, Cape May, and Barnegat generated a higher percentage of their landings and revenue from the Project 1 WTA.

Table 3.6.1-14. Annual average commercial fishing landings and revenue in the Project 1 and Project 2 WTAs by fishing port, 2011–2020

Project 1			Project 2		
Port and State[1]	Landings (pounds)	Revenue (2019 dollars)	Port and State[1]	Landings (pounds)	Revenue (2019 dollars)
Atlantic City, New Jersey	225,078	$151,671	Atlantic City, New Jersey	267,998	$163,939
Cape May, New Jersey	55,158	$35,336	All others	8,088	$23,434
All others	14,321	$28,958	Cape May, New Jersey	31,178	$23,005
New Bedford, Massachusetts	2,948	$27,029	New Bedford, Massachusetts	1,738	$14,513
Newport News, Virginia	1,006	$8,189	Newport News, Virginia	1,251	$11,146
Barnegat, New Jersey	2,235	$6,870	Barnegat, New Jersey	1,455	$3,572
Sea Isle City, New Jersey	396	$2,122	Point Pleasant, New Jersey	871	$1,315
Hampton, Virginia	568	$1,692	Hampton, Virginia	387	$1,218
Point Pleasant, New Jersey	329	$831	Ocean City, Maryland	738	$816
Point Judith, Rhode Island	625	$760	Point Judith, Rhode Island	532	$658
Ocean City, Maryland	377	$563	North Kingstown, Rhode Island	637	$457
Davisville, Rhode Island	622	$322	Davisville, Rhode Island	435	$225
Beaufort, North Carolina	78	$231	Beaufort, North Carolina	69	$192
North Kingstown, Rhode Island	214	$155	Wanchese, North Carolina	59	$101
Wanchese, North Carolina	59	$104	Wildwood, New Jersey	7	$56
Chincoteague, Virginia	36	$65	Chincoteague, Virginia	26	$48
Wildwood, New Jersey	5	$35	Montauk, New York	9	$9
Montauk, New York	11	$10	Oriental, North Carolina	2	$3
All ports	**304,066**	**$264,941**	Sea Isle City, New Jersey	1	$2
			All ports	**315,482**	**$244,709**

Source: NMFS 2022b.
[1] Fishing ports are sorted by revenue in descending order.
Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Table 3.6.1-15. Annual average commercial fishing landings and revenue in the combined Project 1 and Project 2 WTAs by fishing port, 2011–2020

Port and State[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
Atlantic City, New Jersey	420,941	80.83	$270,581	62.03
Cape May, New Jersey	64,914	12.46	$49,046	11.24
All others	19,716	3.79	$44,952	10.30
New Bedford, Massachusetts	4,011	0.77	$35,717	8.19
Newport News, Virginia	1,927	0.37	$16,437	3.77
Barnegat, New Jersey	3,137	0.60	$9,175	2.10
Hampton, Virginia	824	0.16	$2,485	0.57
Sea Isle City, New Jersey	396	0.08	$2,122	0.49
Point Pleasant, New Jersey	1,086	0.21	$1,674	0.38
Ocean City, Maryland	997	0.19	$1,206	0.28
Point Judith, Rhode Island	972	0.19	$1,189	0.27
Davisville, Rhode Island	915	0.18	$473	0.11
North Kingstown, Rhode Island	637	0.12	$457	0.10
Beaufort, North Carolina	125	0.02	$361	0.08
Wanchese, North Carolina	100	0.02	$177	0.04
Chincoteague, Virginia	53	0.01	$96	0.02
Wildwood, New Jersey	9	< 0.01	$69	0.02
Montauk, New York	17	< 0.01	$15	< 0.01
Oriental, North Carolina	2	< 0.01	$3	< 0.01
All ports	**520,780**		**$436,235**	

Source: NMFS 2022b.

[1] Fishing ports are sorted by revenue in descending order.

Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Table 3.6.1-16. Annual average commercial fishing landings and revenue in the Project 1 and Project 2 WTAs by state, 2011–2020

Project 1			Project 2		
State[1]	Landings (pounds)	Revenue (2019 dollars)	State[1]	Landings (pounds)	Revenue (2019 dollars)
New Jersey	285,023	$205,249	New Jersey	302,288	$198,549
Massachusetts	3,155	$27,613	Virginia	2,878	$24,783
Virginia	2,897	$23,017	Massachusetts	1,854	$14,770
Rhode Island	7,891	$5,742	Rhode Island	6,139	$4,391
All others	4,381	$2,008	Maryland	738	$816
North Carolina	354	$841	North Carolina	305	$749
Maryland	349	$452	All others	1,262	$626
New York	17	$21	New York	20	$28
All states	**304,067**	**$264,943**	**All states**	**315,484**	**$244,711**

Source: NMFS 2022b.
[1] States are sorted by revenue in descending order.
Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Table 3.6.1-17. Annual average commercial fishing landings and revenue in the combined Project 1 and Project 2 WTAs by state, 2011–2020

State[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
New Jersey	492,802	94.63	$345,831	79.28
Virginia	4,906	0.94	$40,373	9.25
Massachusetts	4,295	0.82	$36,477	8.36
Rhode Island	11,985	2.30	$8,651	1.98
All others	5,234	1.00	$2,420	0.55
North Carolina	559	0.11	$1,349	0.31
Maryland	969	0.19	$1,096	0.25
New York	32	0.01	$42	0.01
All states	**520,782**		**$436,237**	

Source: NMFS 2022b.
[1] States are sorted by revenue in descending order.
Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Table 3.6.1-18. Annual average percentage of commercial fishing landings and revenue in fishing ports that were derived from the Project 1 and Project 2 WTAs, 2011–2020

Project 1			Project 2		
Port and State[1]	Percentage of Landings	Percentage of Revenue	Port and State[1]	Percentage of Landings	Percentage of Revenue
Atlantic City, New Jersey	0.881	0.698	Atlantic City, New Jersey	1.052	0.760
Sea Isle City, New Jersey	0.050	0.107	Newport News, Virginia	0.027	0.039
Cape May, New Jersey	0.076	0.045	Cape May, New Jersey	0.043	0.030
Newport News, Virginia	0.022	0.030	Barnegat, New Jersey	0.026	0.014
Barnegat, New Jersey	0.039	0.028	Ocean City, Maryland	0.016	0.012
Hampton, Virginia	0.013	0.012	Hampton, Virginia	0.008	0.008
Ocean City, Maryland	0.007	0.009	Point Pleasant, New Jersey	0.005	0.004
New Bedford, Massachusetts	0.003	0.007	New Bedford, Massachusetts	0.002	0.004
Beaufort, North Carolina	0.004	0.004	Beaufort, North Carolina	0.004	0.003
Davisville, Rhode Island	0.004	0.003	North Kingstown, Rhode Island	0.003	0.003
Point Pleasant, New Jersey	0.002	0.003	Davisville, Rhode Island	0.003	0.002
Point Judith, Rhode Island	0.001	0.002	Wanchese, North Carolina	0.001	0.001
Wanchese, North Carolina	0.001	0.001	Point Judith, Rhode Island	0.001	0.001
Chincoteague, Virginia	0.001	0.001	Wildwood, New Jersey	0.001	0.001
North Kingstown, Rhode Island	0.001	0.001	Chincoteague, Virginia	0.001	0.001
Wildwood, New Jersey	0.001	0.001	Oriental, North Carolina	< 0.001	< 0.001
Montauk, New York	< 0.001	< 0.001	Sea Isle City, New Jersey	< 0.001	< 0.001
			Montauk, New York	< 0.001	< 0.001

Source: NMFS 2022b.

[1] Fishing ports are sorted by percentage of revenue in descending order.

Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Table 3.6.1-19. Annual average percentage of commercial fishing landings and revenue in fishing ports that were derived from the combined Project 1 and Project 2 WTAs, 2011–2020

Port and State[1]	Percentage of Landings	Percentage of Revenue
Atlantic City, New Jersey	1.648	1.247
Sea Isle City, New Jersey	0.050	0.107
Cape May, New Jersey	0.091	0.063
Newport News, Virginia	0.041	0.058
Barnegat, New Jersey	0.055	0.037
Ocean City, Maryland	0.020	0.018
Hampton, Virginia	0.018	0.017
New Bedford, Massachusetts	0.004	0.009
Beaufort, North Carolina	0.006	0.006
Davisville, Rhode Island	0.005	0.005
Point Pleasant, New Jersey	0.006	0.005
North Kingstown, Rhode Island	0.003	0.003
Point Judith, Rhode Island	0.002	0.003
Wanchese, North Carolina	0.002	0.002
Chincoteague, Virginia	0.002	0.002
Wildwood, New Jersey	0.001	0.001
Oriental, North Carolina	< 0.001	< 0.001
Montauk, New York	< 0.001	< 0.001

Source: NMFS 2022b.
[1] Fishing ports are sorted by percentage of revenue in descending order.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Annual average commercial fishing landings and revenue within the WTAs from 2011–2020 are summarized by fishing gear for Project 1 and Project 2 in Table 3.6.1-20 and for both WTAs combined in Table 3.6.1-21. Annualized commercial fishing landings and revenue in the WTAs are summarized by fishing gear in Table B.3-43 through Table B.3-48 in Appendix B. The gear type with the highest landed weight and revenue in both WTAs was the clam dredge, which accounted for approximately 80 percent of the landed weight and 58 percent of the revenue from the combined Project 1 and Project 2 WTAs. The category "all others", consisting of other types of fishing gears that were not classified, had the second highest landed weight in each WTA, whereas the scallop dredge generated the second highest revenue in each WTA. Although overall landings and revenue were similar between the Project 1 and Project 2 WTAs, there were some differences between these WTAs in terms of landings and revenue among gear types. In particular, the clam dredge had higher landings and revenue from the Project 2 WTA, whereas the scallop dredge, pot, and gillnet had higher landings and revenue from the Project 1 WTA. The percentage of landings in the combined Project 1 and Project 2 WTAs attributed to each gear type exhibited considerable interannual variation from 2011–2020, particularly for the clam dredge, which ranged from 59 percent in 2017 to 95 percent in 2016 (Figure 3.6.1-2); however, the allocation of landings among gear types has not exhibited persistent trends over that time period.

Annual average percentages of commercial landings and revenue in the geographic analysis area that were harvested in the WTAs from 2011–2020 are summarized by fishing gear for Project 1 and Project 2 in Table 3.6.1-22 and for both WTAs combined in Table 3.6.1-23. Annualized percentages of commercial fishing landings and revenue from the WTAs are summarized by fishing gear in Table B.3-49 through Table B.3-54 in Appendix B. The gear types with the highest percentages of landings and revenue harvested in the Project 1 WTA were pots other than lobster (0.49 percent of landings, 0.61 percent of revenue) and the clam dredge (0.32 percent of landings, 0.23 percent of revenue). The gear types with the highest percentages of landings and revenue harvested in the Project 2 WTA were the clam dredge (0.39 percent of landings, 0.27 percent of revenue) and pots other than lobster (0.09 percent of landings, 0.10 percent of revenue). There were some differences between the Project 1 and Project 2 WTAs in terms of the percentages of landings and revenue of gear types. In particular, the Project 1 WTA had a much higher percentage of landings and revenue from pots other than lobster, whereas the Project 2 WTA had higher percentages of landings and revenue attributed from the clam dredge.

Table 3.6.1-20. Annual average commercial fishing landings and revenue in the Project 1 and Project 2 WTAs by fishing gear, 2011–2020

Project 1			Project 2		
Gear Type[1]	Landings (pounds)	Revenue (2019 dollars)	Gear Type[1]	Landings (pounds)	Revenue (2019 dollars)
Dredge-clam	221,797	$136,148	Dredge-clam	268,401	$159,669
Dredge-scallop	7,020	$80,901	Dredge-scallop	5,399	$60,966
All others	54,051	$18,869	Trawl-bottom	12,298	$11,329
Trawl-bottom	16,353	$14,857	All others	28,490	$10,238
Pot-other	3,796	$12,953	Pot-other	687	$2,252
Pot-lobster	187	$650	Gillnet-sink	167	$134
Gillnet-sink	854	$564	Pot-lobster	35	$120
All gears	**304,058**	**$264,941**	**All gears**	**315,476**	**$244,709**

Source: NMFS 2022b.

[1] Gear types are sorted by revenue in descending order.

Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Table 3.6.1-21. Annual average commercial fishing landings and revenue in the combined Project 1 and Project 2 WTAs by fishing gear, 2011–2020

Gear Type[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
Dredge-clam	418,318	80.33	$252,464	57.87
Dredge-scallop	10,602	2.04	$121,260	27.80
All others	62,152	11.93	$24,771	5.68
Trawl-bottom	24,516	4.71	$22,464	5.15
Pot-other	4,098	0.79	$13,976	3.20
Pot-lobster	205	0.04	$706	0.16
Gillnet-sink	883	0.17	$594	0.14
All gears	**520,774**		**$436,235**	

Source: NMFS 2022b.

[1] Gear types are sorted by revenue in descending order.

Notes: Data are for vessels issued federal fishing permits by the Greater Atlantic Region. Differences in totals are the result of rounding.

Table 3.6.1-22. Annual average commercial fishing landings and revenue in the Project 1 and Project 2 WTAs as a percentage of annual average landings and revenue in the geographic analysis area by fishing gear, 2011–2020

	Project 1			Project 2	
Gear Type[1]	Percentage of Landings	Percentage of Revenue	Gear Type[1]	Percentage of Landings	Percentage of Revenue
Pot-other	0.491	0.607	Dredge-clam	0.392	0.266
Dredge-clam	0.324	0.228	Pot-other	0.090	0.104
Dredge-scallop	0.035	0.037	Dredge-scallop	0.023	0.024
Trawl-bottom	0.021	0.015	Trawl-bottom	0.016	0.012
Gillnet-sink	0.003	0.002	Gillnet-sink	< 0.001	< 0.001
Pot-lobster	0.001	0.001	Pot-lobster	< 0.001	< 0.001

Source: NMFS 2022b.
[1] Gear types are sorted by percentage of revenue in descending order.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

Table 3.6.1-23. Annual average commercial fishing landings and revenue in the combined Project 1 and Project 2 WTAs as a percentage of annual average landings and revenue in the geographic analysis area by fishing gear, 2011–2020

Gear Type[1]	Percentage of Landings	Percentage of Revenue
Pot-other	0.531	0.653
Dredge-clam	0.611	0.421
Dredge-scallop	0.050	0.053
Trawl-bottom	0.032	0.023
Gillnet-sink	0.003	0.002
Pot-lobster	0.001	0.001

Source: NMFS 2022b.
[1] Gear types are sorted by percentage of revenue in descending order.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.

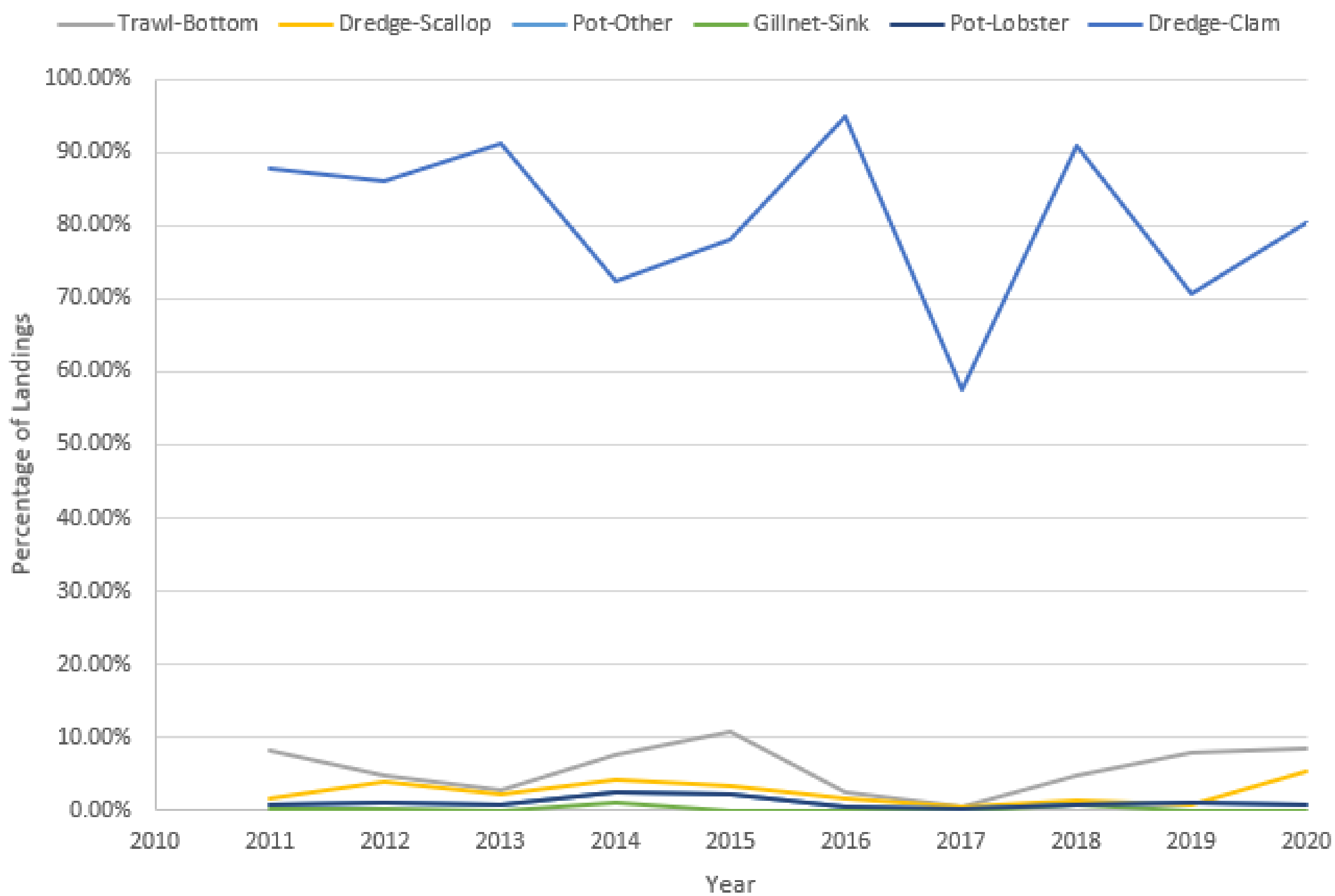


Figure 3.6.1-2. Summary of percentages of landings in the combined Projects 1 and 2 WTAs attributed to each gear type, 2011–2020

Indicators of commercial fishing engagement and reliance for fishing communities that generate the highest commercial fishing revenue in the Lease Area are summarized in Table 3.6.1-24. The most recent available indicators for these communities are for the year 2018 (NMFS 2022c). Each of the fishing communities has a medium to high level of fishing engagement but the amount of fishing reliance varies substantially among communities, with reliance ranging from low in Atlantic City, New Jersey and Newport News, Virginia, to high in Barnegat and Cape May, New Jersey. Fishing communities that have a high level of fishing engagement but a low level of fishing reliance (e.g., Atlantic City, New Jersey, and Newport News, Virginia) support valuable fisheries but also have other industries that produce a sufficient economic output to reduce reliance on the fishing industry. Social vulnerability indicators (i.e., personal disruption, population consumption, and poverty) and gentrification pressure indicators (i.e., retiree migration and urban sprawl) for each of these fishing communities are described in Section 3.6.3, *Demographics, Employment, and Economics*, and Section 3.6.4, *Environmental Justice*.

Table 3.6.1-24. Commercial fishing engagement and reliance indicators (2018) for fishing communities that generate the highest commercial fishing revenue in the Project 1 and Project 2 WTAs

Port and State	Average Annual Revenue from Combined WTAs (2011–2020)	Percentage of Revenue from Combined WTAs (2011–2020)	Commercial Fishing Engagement Indicator (2018)[1]	Commercial Fishing Reliance Indicator (2018)[2]
Atlantic City, New Jersey	$270,581	1.247	High	Low
Barnegat, New Jersey	$9,175	0.037	High	High
Cape May, New Jersey	$49,046	0.063	High	High
Newport News, Virginia	$16,437	0.058	High	Low
New Bedford, Massachusetts	$35,717	0.009	High	Medium
Sea Isle City, New Jersey	$2,122	0.107	Medium	Medium

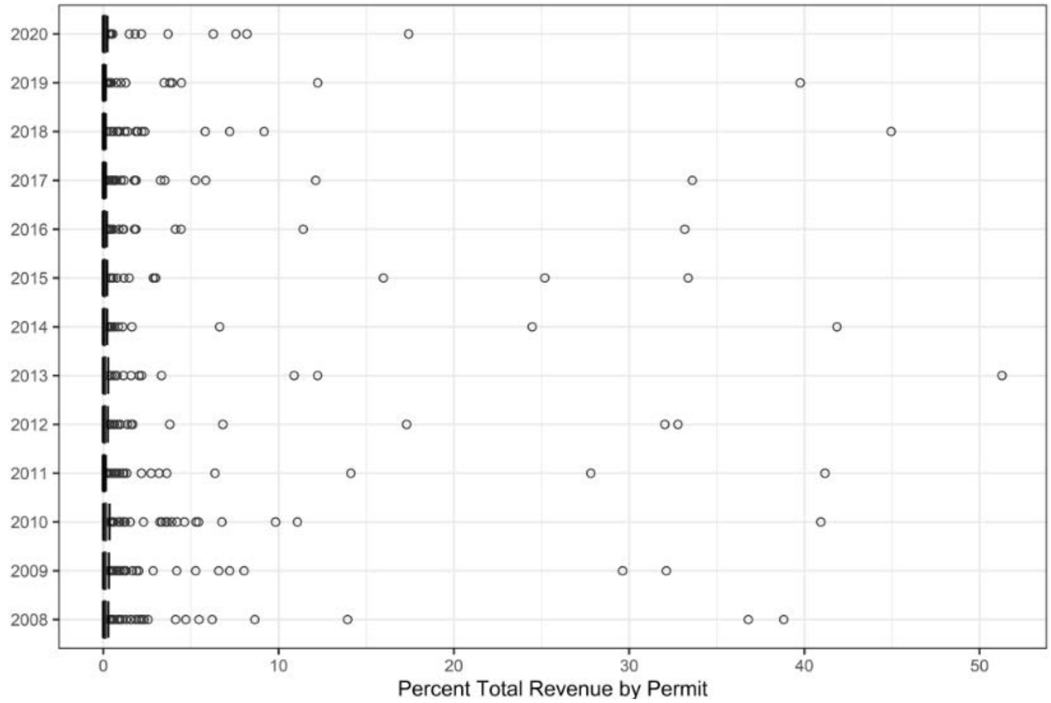
Sources: NMFS 2022a, 2022b, 2022c.

1 Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings.

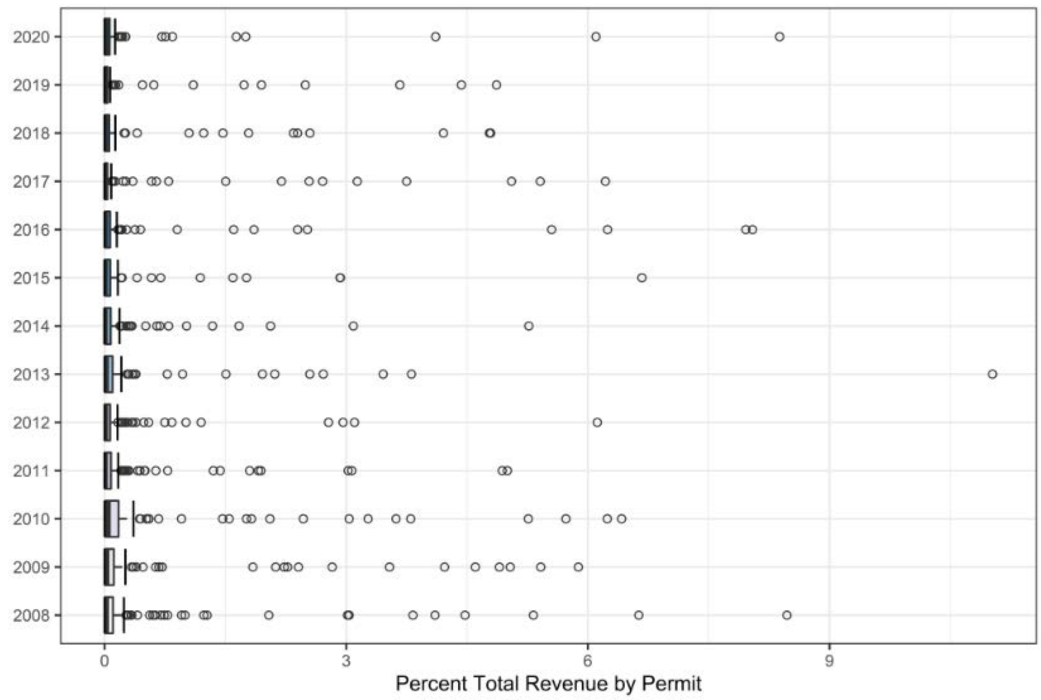
2 Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity.

To analyze differences in the economic importance of fishing grounds in the WTAs across the commercial fishing fleet, NMFS analyzed the percentage of each permit's total commercial fishing revenue attributed to catch within the WTAs from 2008 through 2020 (NMFS 2022b). The distribution of the vessel-level annual revenue percentages for the Project 1 and Project 2 WTAs is summarized in the boxplots in Figure 3.6.1-3. The points in these boxplots represent vessels that derived an exceptionally high proportion of their annual revenue from the WTA in comparison to other vessels that fished in the area. Although some vessels derived a high proportion of their annual revenue from the Project 1 and Project 2 WTAs in comparison to other vessels that fished in these areas, in any given year, the revenue percentage for the majority of vessels was below 10 percent. Therefore, while some vessels depended heavily on the WTAs for their commercial fishing revenue, most derived a small percentage of their total annual revenue from these areas.

Project 1 WTA



Project 2 WTA



Source: NMFS 2022b.

Figure 3.6.1-3. Percentage of commercial fisheries revenue harvested from the Project 1 and Project 2 WTAs by commercial fisheries permit holders, 2008–2020

Table 3.6.1-25 summarizes the minimum, first quartile, median, third quartile, and maximum values of the percentages of revenue of commercial permit holders harvested from the Project 1 and Project 2 WTAs from 2008 through 2020. A total of 75 percent (i.e., third quartile) of the permitted vessels that fished in the WTAs derived less than 0.10 percent and 0.09 percent of their total annual revenue from the Project 1 and Project 2 WTAs, respectively. The highest percentage of total annual revenue attributed to catch within the WTAs was 51 percent in the Project 1 WTA in 2013 and 11 percent in the Project 2 WTA in 2013.

Table 3.6.1-25. Summary of percentage of revenue harvested from the Project 1 and Project 2 WTAs by commercial fisheries permit holders, 2008–2019

WTA	Minimum Revenue Percentage Value	First Quartile	Median	Third Quartile	Maximum Revenue Percentage Value[1]
Project 1	0	0	0.03	0.10	51
Project 2	0	0	0.02	0.09	11

Source: NMFS 2022b.
[1] Maximum value is inclusive of outliers.

NMFS uses a VMS to monitor some fisheries under its jurisdiction. VMS data are useful for characterizing the spatial distribution of fishing activity. In 2018, there were 912 VMS-enabled vessels operating in the Northeast across all fisheries, which represented 20 percent of the 4,328 commercial fishing vessels that were permitted in the Northeast Region (BOEM 2022). VMS vessels generated a substantial percentage (71–87 percent) of landings of summer flounder, scup, black sea bass, and skate, and greater than 90 percent of landings of scallops, squid, monkfish, herring, mackerel, large-mesh multispecies, small-mesh multispecies, surfclams, and ocean quahogs. However, VMS vessels represented less than 20 percent of highly migratory species and 10 percent of lobster/Jonah crab landings. Of these vessels, approximately 67 percent fished or transited the WTAs and 10 percent fished or transited in the Lease Area in 2018.

Polar histograms depicting the orientation of VMS-enabled vessels actively fishing in and transiting through the Lease Area were developed using individual vessel position reports from January 2014 through August 2019 (BOEM 2022). Vessels moving at speeds of less than 5 knots were assumed to be actively fishing. The size of the bars in the polar histograms is proportional to the number of position reports showing fishing vessels moving in a certain direction within the Lease Area. The polar histograms differ with respect to their scales. Most of the 140 actively fishing VMS-enabled vessels followed either an east-west bearing or a slightly northeast-southwest bearing, whereas most of the 386 transiting vessels followed either a north-south bearing or a northwest-southeast bearing (Figure 3.6.1-4). Most of the actively fishing and transiting non-VMS-enabled vessels followed a northeast-southwest bearing (Figure 3.6.1-5). Vessels fishing under the Surfclam and Ocean Quahog FMP and Sea Scallop FMP fished extensively in the Lease Area. Scallop vessels generally followed either a north or northwest bearing when fishing and a north-south bearing when transiting (Figure 3.6.1-6). Clam vessels generally followed a northeast-southwest bearing when fishing and a northwest-southeast bearing when transiting (Figure 3.6.1-7). Squid and finfish vessels primarily used the Lease Area for transiting and followed a northeast-southwest bearing when fishing and transiting (Figure 3.6.1-8 through Figure 3.6.1-11).

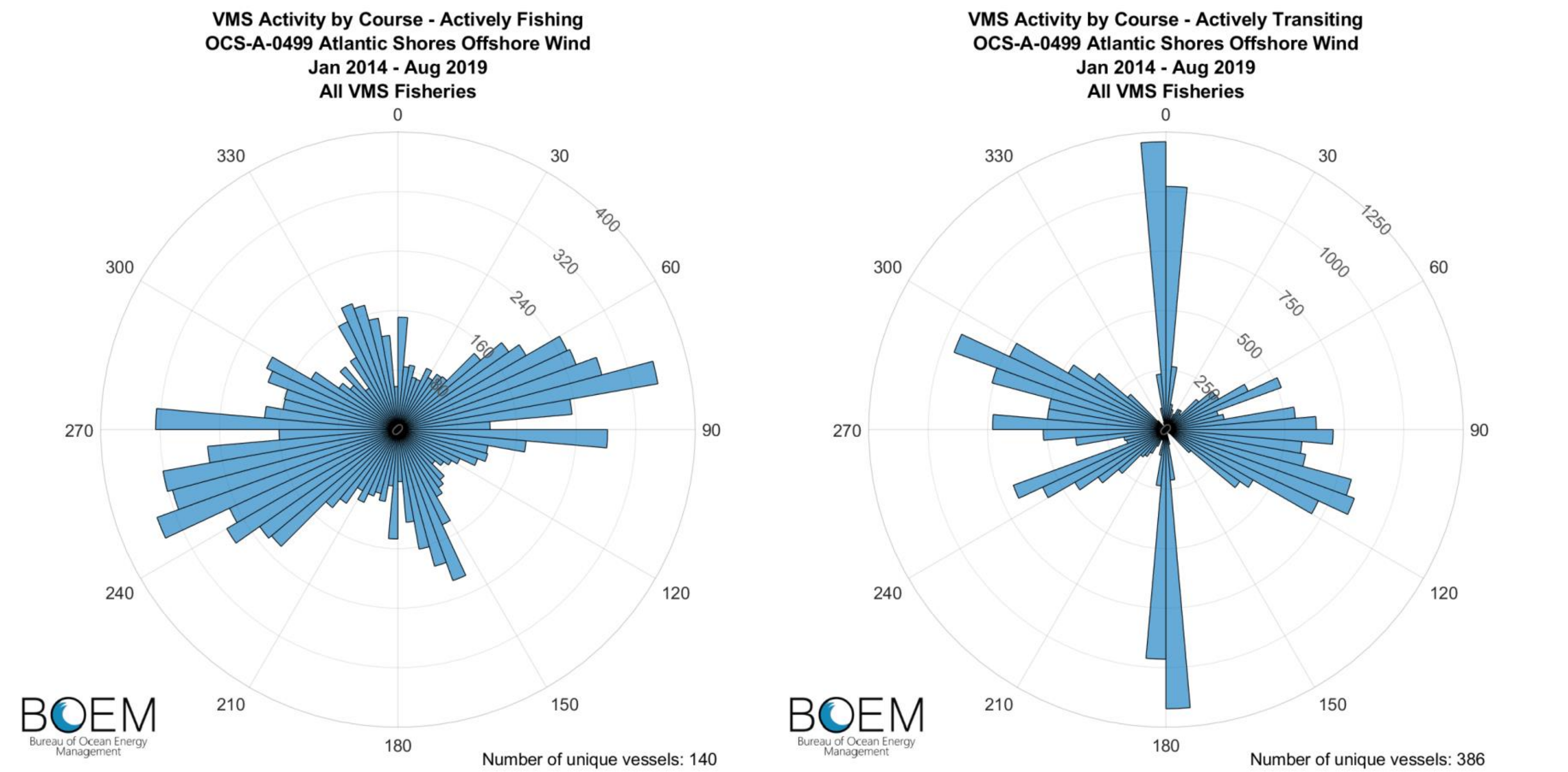


Figure 3.6.1-4. Bearings of all VMS-enabled vessels actively fishing and transiting in the Lease Area, January 2014 through August 2019

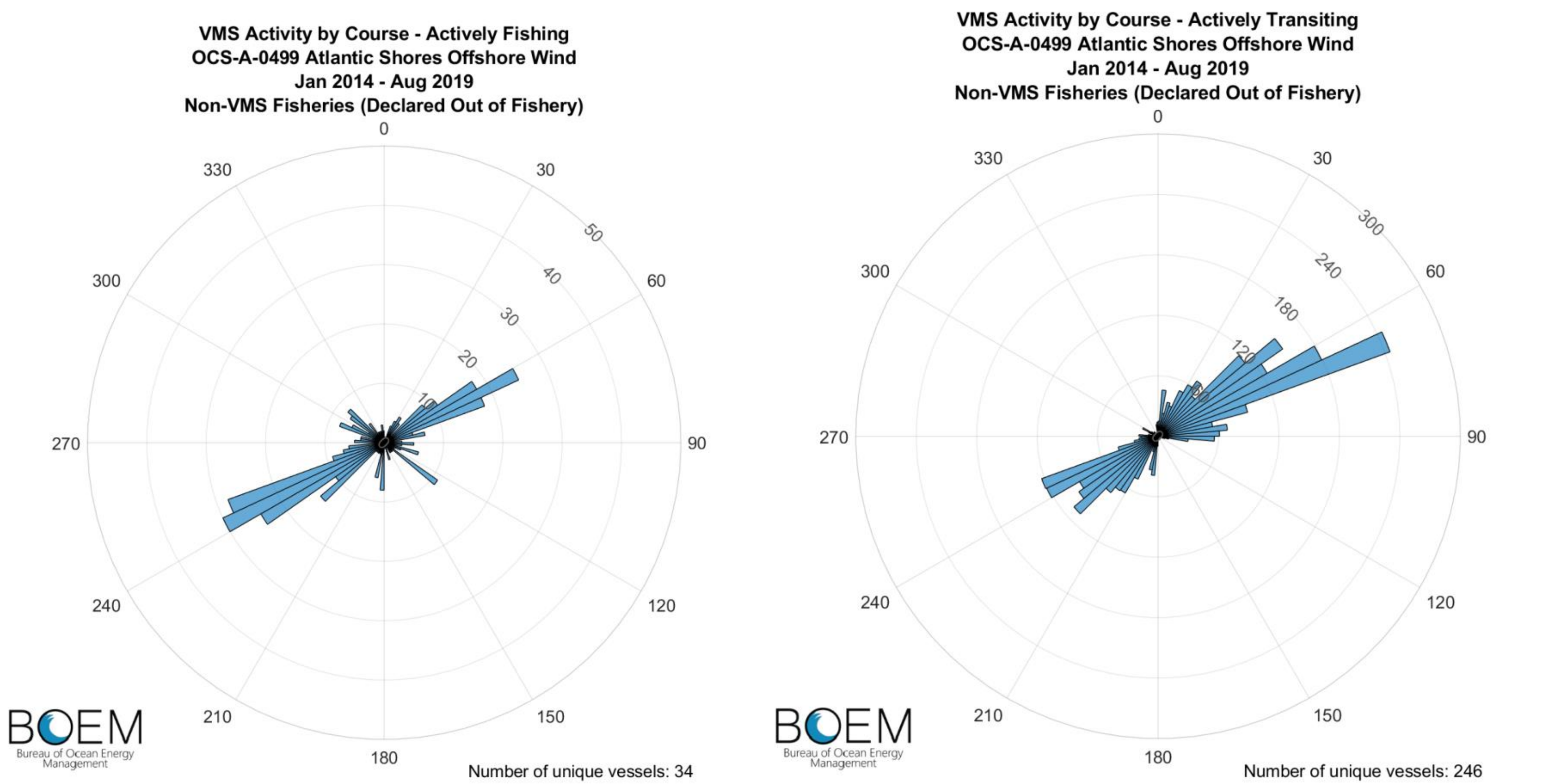


Figure 3.6.1-5. Bearings of non-VMS-enabled vessels actively fishing and transiting in the Lease Area: Non-VMS fisheries, January 2014 through August 2019

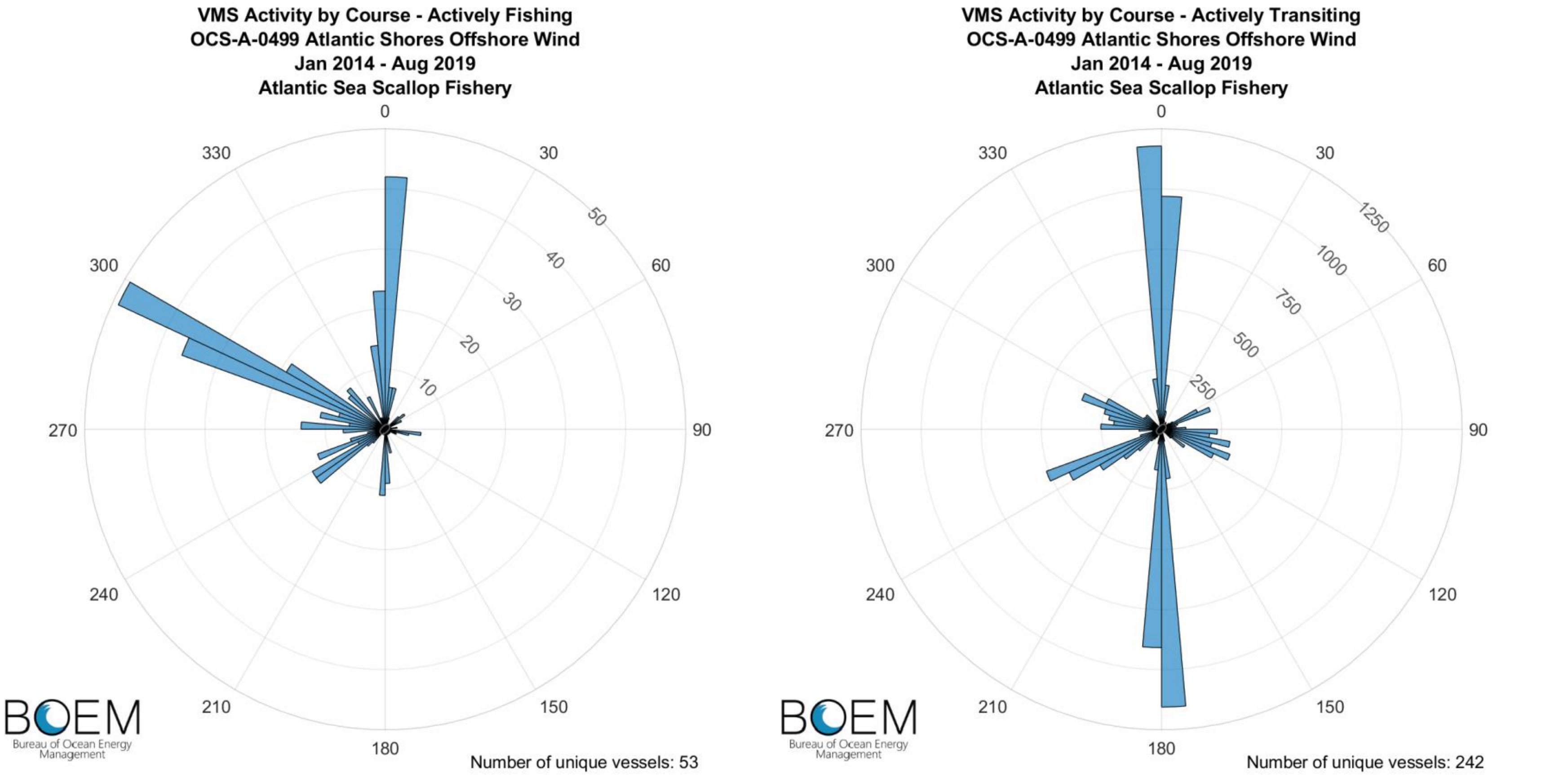


Figure 3.6.1-6. Bearings of VMS-enabled vessels actively fishing and transiting in the Lease Area: Sea Scallop FMP, January 2014 through August 2019

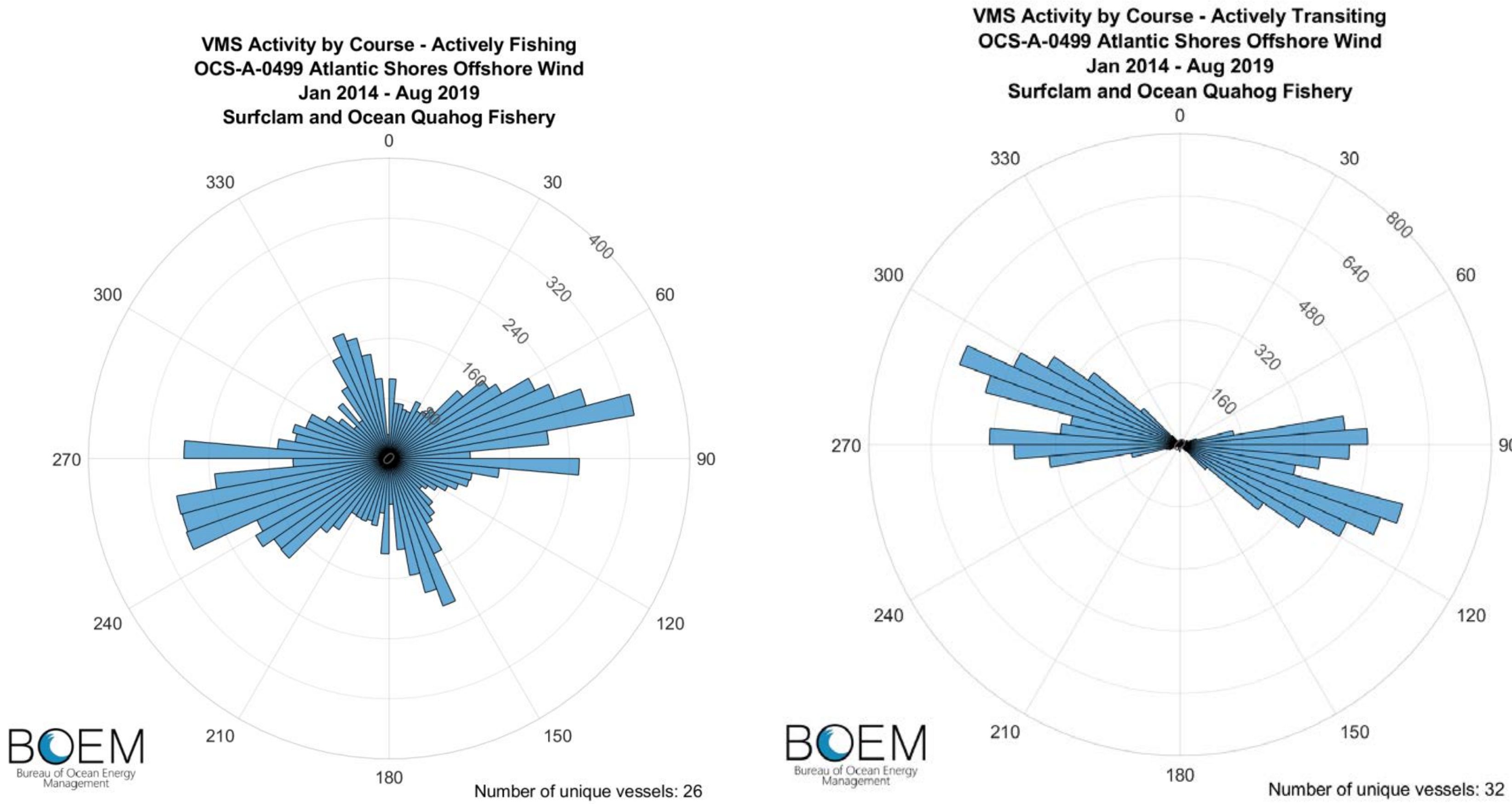
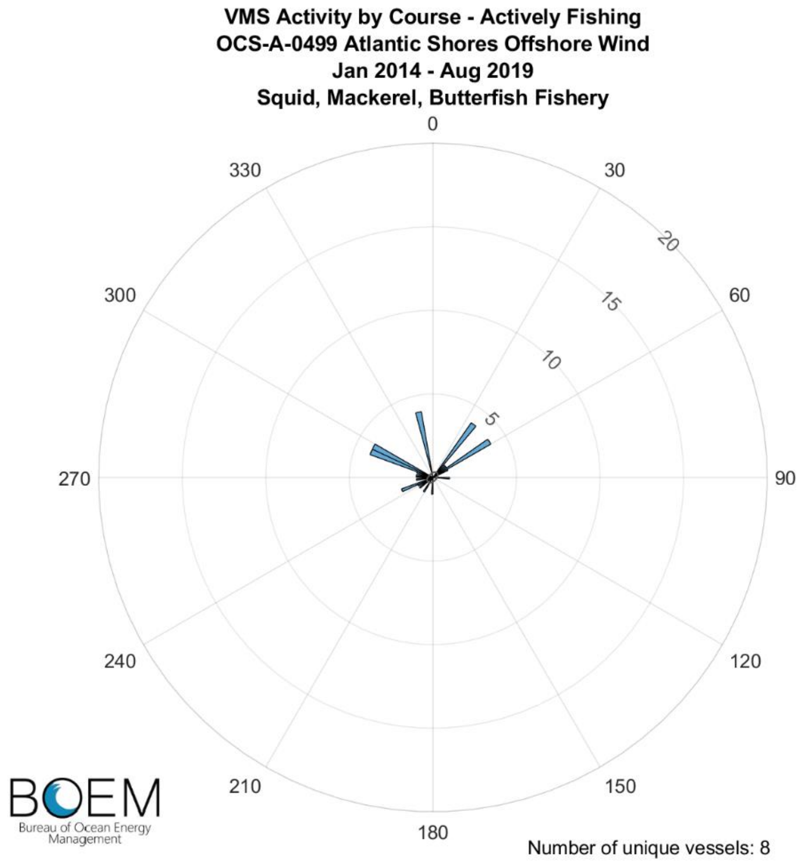


Figure 3.6.1-7. Bearings of VMS-enabled vessels actively fishing and transiting in the Lease Area: Surfclam and Ocean Quahog FMP, January 2014 through August 2019



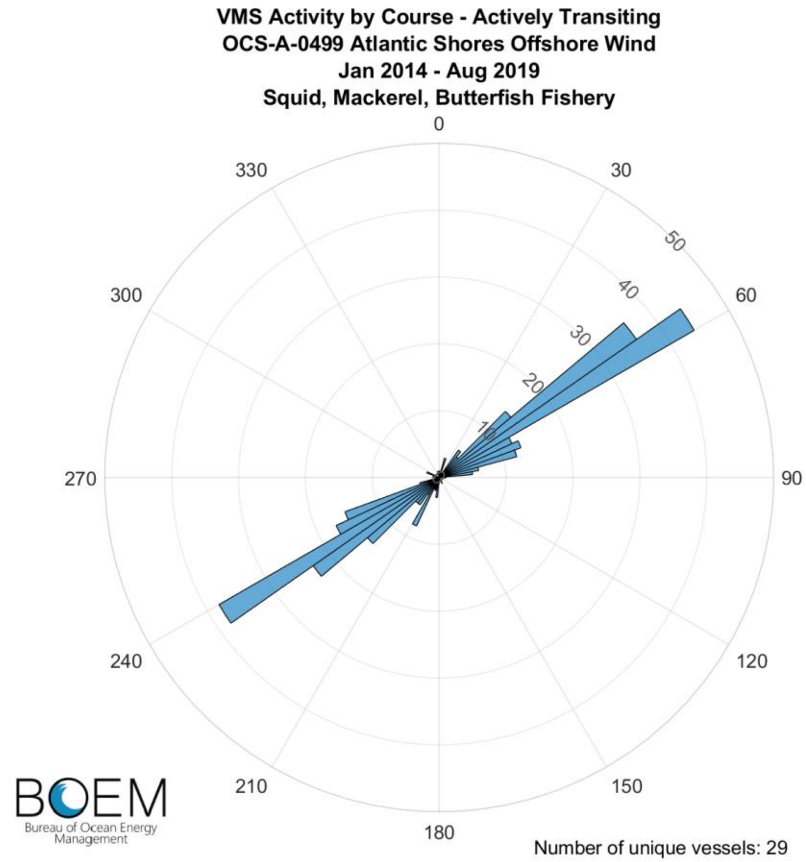


Figure 3.6.1-8. Bearings of VMS-enabled vessels actively fishing and transiting in the Lease Area: Squid, Mackerel, Butterfish FMP, January 2014 through August 2019

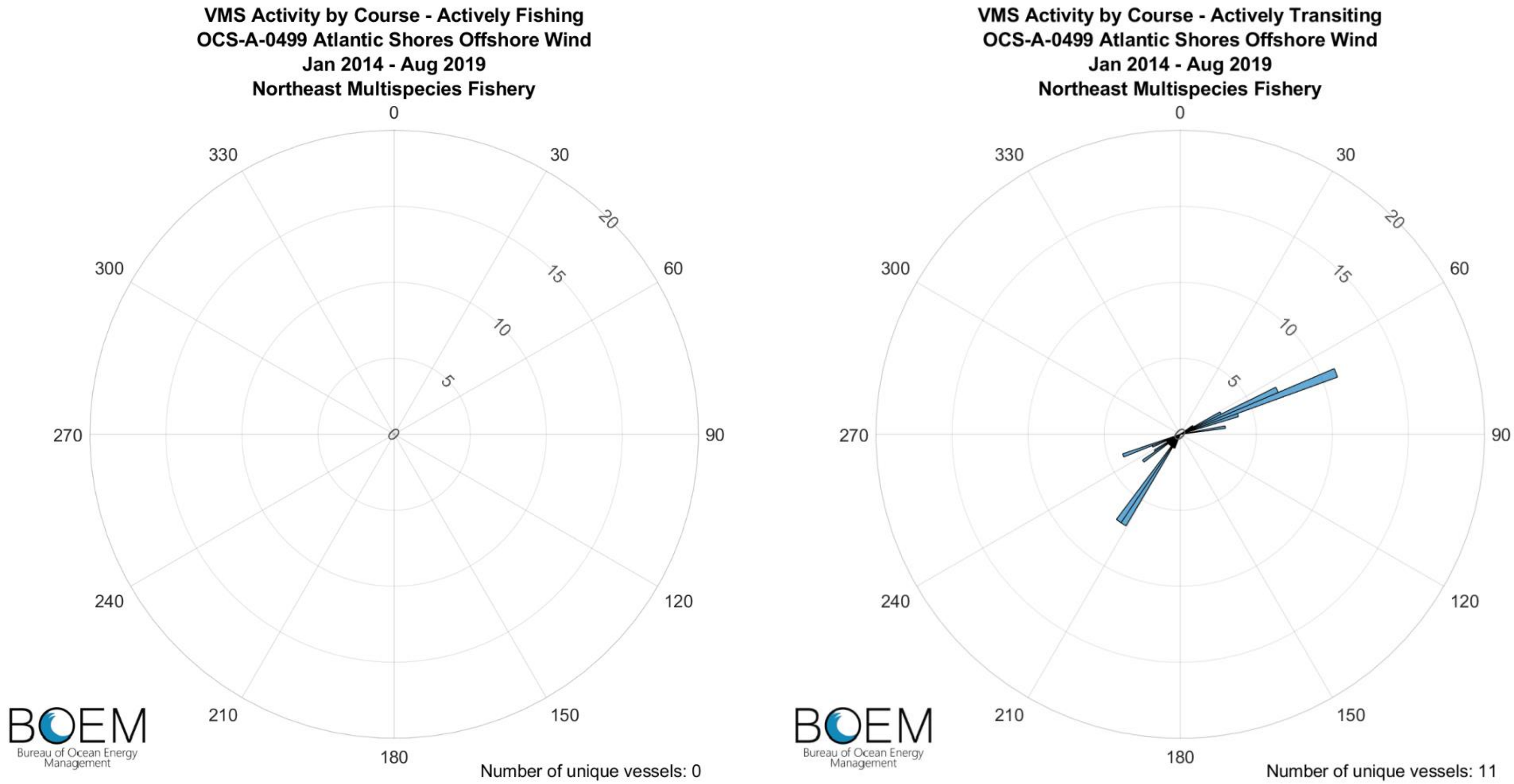


Figure 3.6.1-9. Bearings of VMS-enabled vessels actively fishing and transiting in the Lease Area: Northeast Multispecies FMP, January 2014 through August 2019

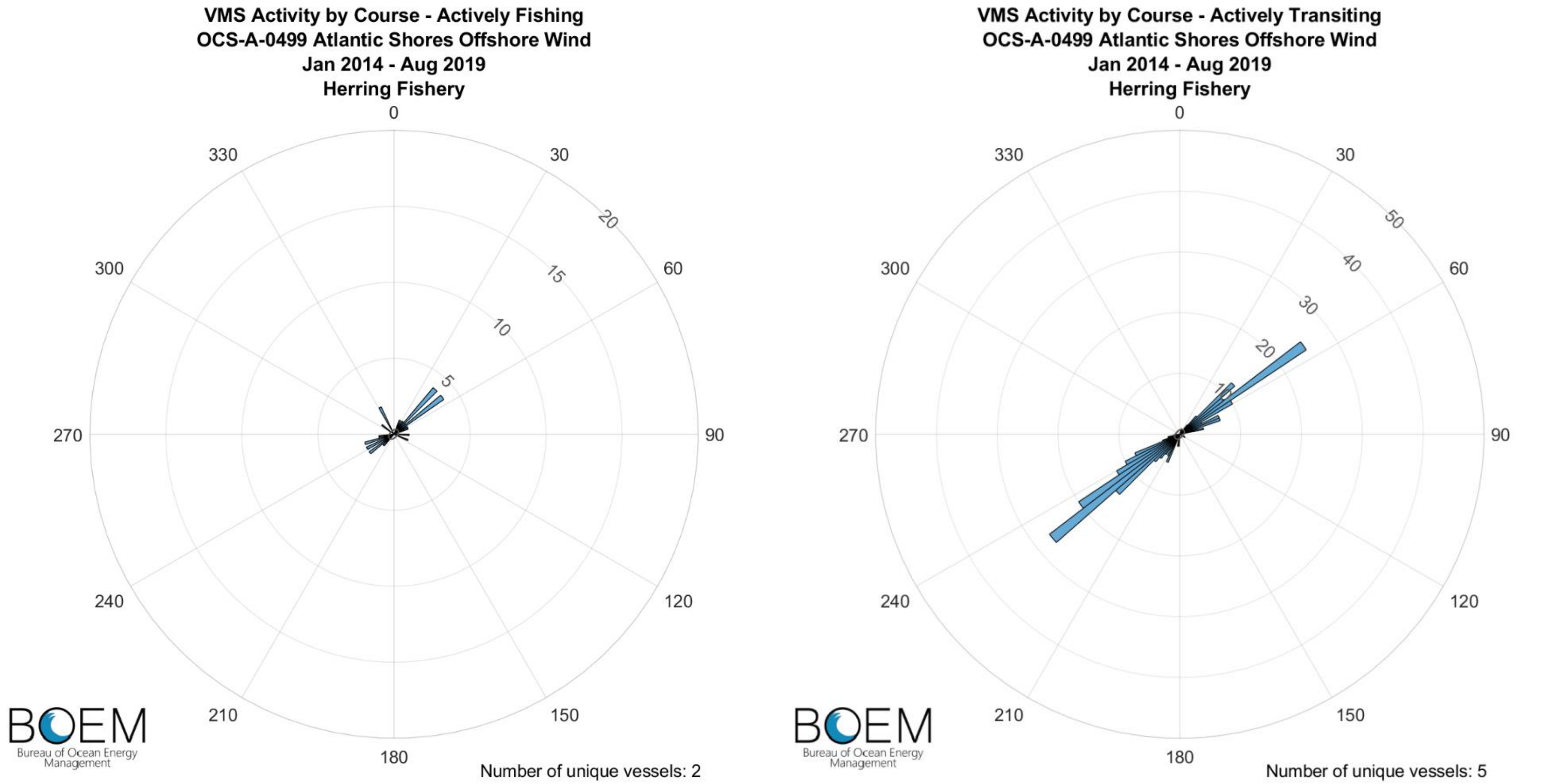


Figure 3.6.1-10. Bearings of VMS-enabled vessels actively fishing and transiting in the Lease Area: Atlantic Herring FMP, January 2014 through August 2019

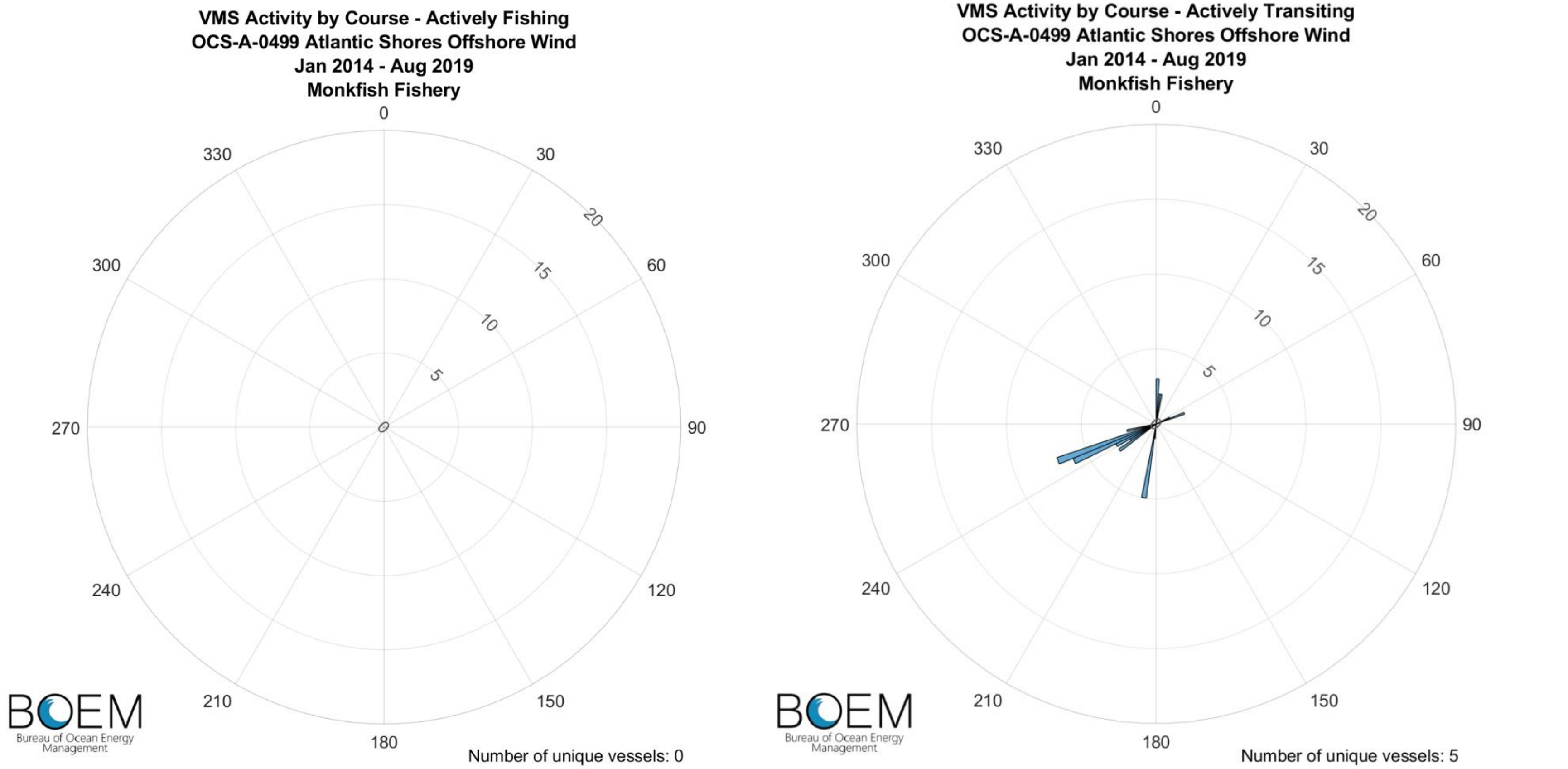


Figure 3.6.1-11. Bearings of VMS-enabled vessels actively fishing and transiting in the Lease Area: Monkfish FMP, January 2014 through August 2019

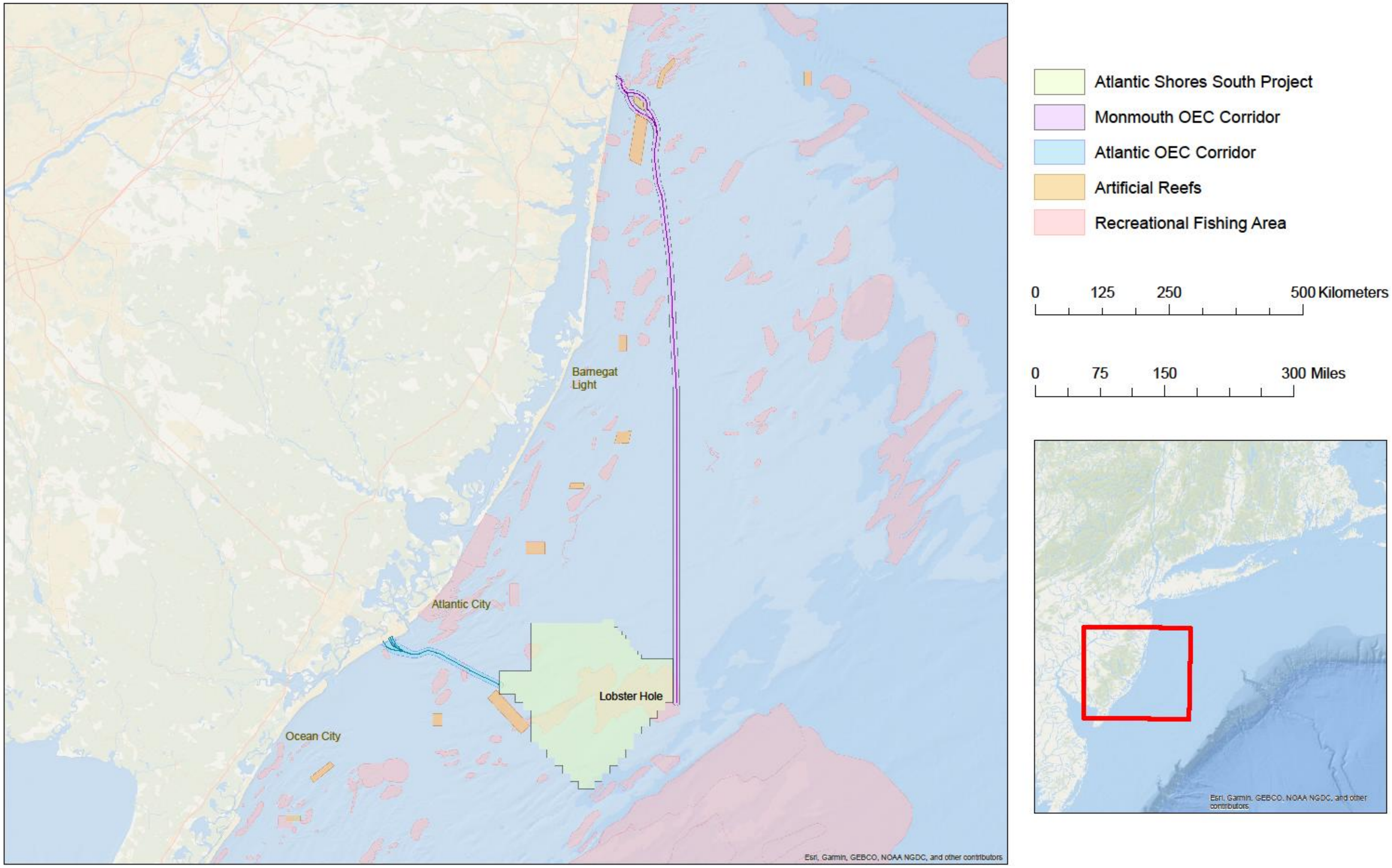
For-Hire Recreational Fishing

For-hire recreational fishing boats are operated by licensed captains for businesses that sell recreational fishing trips to anglers. These boats include both party (head) boats, defined as boats on which fishing space and privileges are provided for a fee, and charter boats, defined as boats operating under charter for a price, time, etc. and the participants are part of a preformed group of anglers. The primary sources of data used to describe the for-hire recreational fisheries in the Lease Area were NMFS Socioeconomics Impacts of Atlantic Offshore Wind Development reports summarizing fisheries effort and landings within wind energy lease areas (NMFS 2022b). For-hire recreational fisheries revenue data in New York and New Jersey were also taken from Fisheries Economics of the United States reports (NMFS 2022d).

For-hire recreational fishing vessels fish in or traverse the Lease Area and offshore export cable corridors while targeting several different fisheries. For-hire recreational fishing vessels that fish in the waters of the Project area are likely to originate from various ports on the coast of New Jersey. For-hire recreational fisheries in the waters of New Jersey catch a variety of finfish species, including black sea bass, bluefish, red hake, scup, sea robins, summer flounder, and tautog. Recreational saltwater fishing in the region occurs year-round but is most intensive from May through October, with a peak in the months of July and August (NMFS 2022e).

There are several known recreational fishing areas within and surrounding the Project area, including a large recreational fishing area known as Lobster Hole that is almost entirely overlapped by the Lease Area and a large expanse of several recreational fishing areas southeast of the Lease Area (Figure 3.6.1-12). There are also several locations near the Project area where artificial reefs have been established as productive recreational fishing areas (Figure 3.6.1-12). NJDEP maintains 17 artificial reef sites 2 to 25 miles (3 to 40 kilometers) off the coast (NJDEP 2019). While none of these areas are within the Project area, fishermen targeting these areas for sportfish may transit through or fish within the Project area. Recreational fishing for highly migratory species also occurs in the Lease Area and along the Atlantic and Monmouth OEC corridors. Based on the NMFS Large Pelagics Survey, an intercept survey that includes both for-hire and private fishing, the level of recreational fishing effort for highly migratory species from 2002-2019 ranged from low to moderate in the Project area, with the highest levels of effort occurring north of the Lease Area, within the Monmouth OEC corridor (Figure 3.9-13).

Annual average for-hire recreational angler trips and vessel trips from 2011–2020 are summarized by fishing port for the Project 1 and Project 2 WTAs in Table 3.6.1-26 and for both WTAs combined in Table 3.6.1-27. Annualized for-hire recreational fisheries angler trips and vessel trips in the WTAs are summarized by fishing port in Table B.3-55 and Table B.3-56 in Appendix B. For-hire fishing vessels originating from Atlantic City, New Jersey, accounted for the highest level of fishing effort in the Project 1 WTA with an annual average of 75 angler trips and 12 vessel trips. For-hire fishing vessels originating from other ports in New Jersey accounted for all of fishing effort in the Project 2 WTA with an annual average of 26 angler trips and 2 vessel trips. Ports in New Jersey accounted for nearly all of the fishing effort in the Project 1 and 2 WTAs. The annual average number of angler trips and vessel trips to the WTAs from Maryland and New York, the only other states with trips to the WTAs, was less than one.



Source: NJDEP 2019.

Figure 3.6.1-12. Offshore and coastal features associated with for-hire recreational fishing

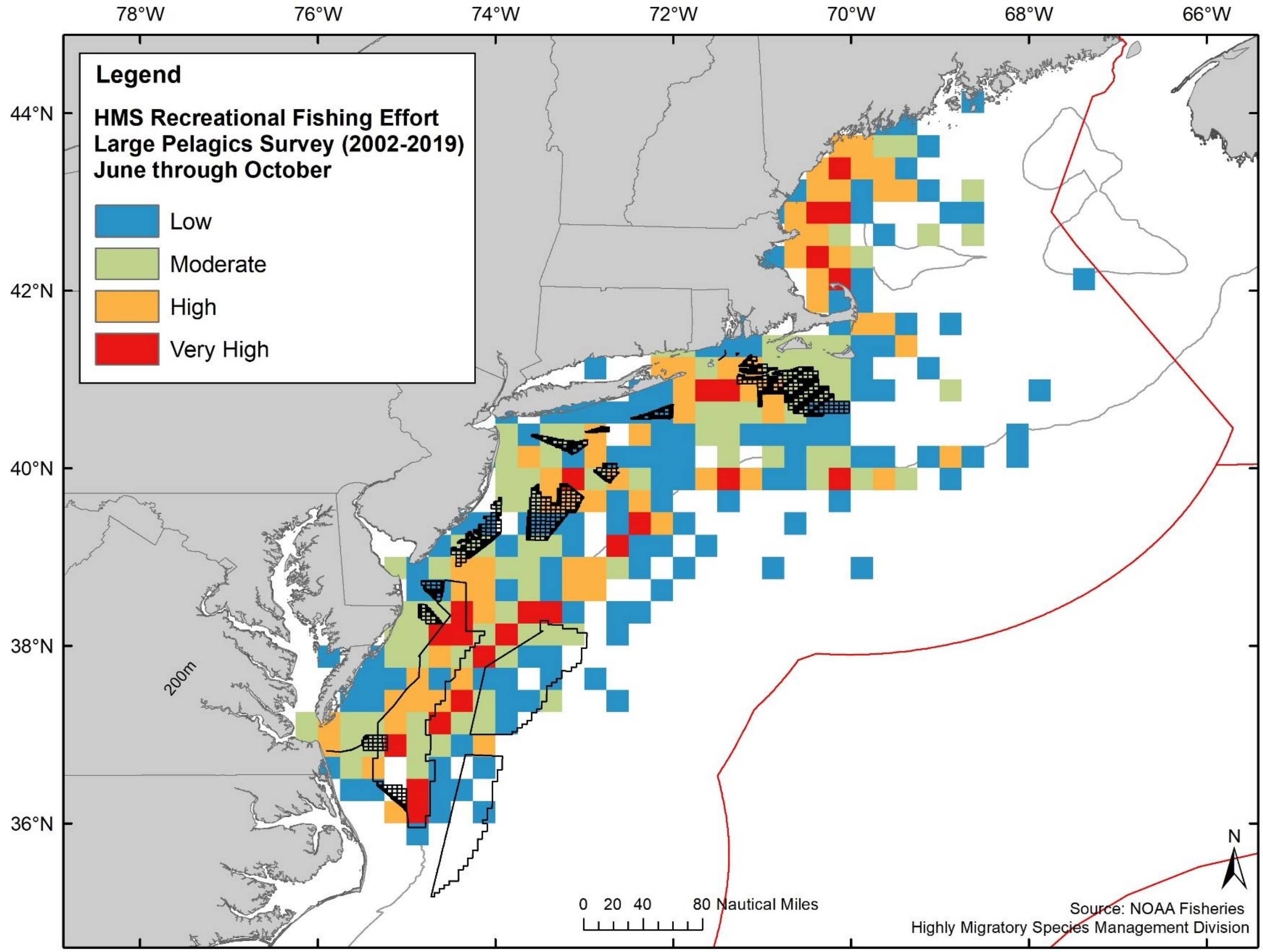


Figure 3.6.1-13. Fishing effort for highly migratory species in the Greater Atlantic

Note: Data are based on intercept surveys and include both for-hire and private fishing for highly migratory species

Table 3.6.1-26. Annual average number of for-hire recreational angler trips and vessel trips to the Project 1 and Project 2 WTAs by fishing port, 2011–2020

Port[1]	Project 1 Angler Trips[2]	Project 1 Vessel Trips	Port[1]	Project 2 Angler Trips[2]	Project 2 Vessel Trips
Atlantic City, NJ	75	12	Other Ports, NJ	26	2
Other Ports, NJ	92	11			
Long Beach, NJ	4	1			
Other Ports, MD	< 1	< 1			
Other Ports, NY	< 1	< 1			
Total	**171**	**23**			

Source: NMFS 2022b.
[1] Fishing ports are sorted by vessel trips in descending order.
[2] Angler trips is the number of passengers reported on Vessel Trip Reports for party and charter vessels.
Note: Differences in totals are the result of rounding.

Table 3.6.1-27. Annual average number of for-hire recreational angler trips and vessel trips to the combined Project 1 and Project 2 WTAs by fishing port, 2011–2020

Port[1]	Vessel Trips	Percentage of Total Vessel Trips to WTAs	Angler Trips[2]	Percentage of Total Angler Trips to WTAs
Other Ports, NJ	12	50.20	107	57.27
Atlantic City, NJ	12	47.77	75	40.42
Long Beach, NJ	1	2.02	4	2.31
Other Ports, MD	< 1	< 0.01	< 1	< 0.01
Other Ports, NY	< 1	< 0.01	< 1	< 0.01
Total	**25**		**186**	

Source: NMFS 2022b.
[1] Fishing ports are sorted by vessel trips in descending order.
[2] Angler trips is the number of passengers reported on Vessel Trip Reports for party and charter vessels.
Note: Differences in totals are the result of rounding.

To understand the relative importance of the Project 1 and 2 WTAs to the regional for-hire recreational fishing industry, Table 3.6.1-28 compares the fishing effort in the WTAs to the entire Northeast Region by year from 2011 to 2020. The years with the highest percentages of fishing effort in the Project 1 WTA relative to the region were 2011 (0.19 percent of vessel trips, 11.78 percent of angler trips, and 1.64 percent of vessel) and 2015 (0.16 percent of vessel trips, 12.85 percent of angler trips, and 1.21 percent of vessels). The relatively high levels of fishing effort in the Project 1 WTA in 2011 and 2015 were the result of a high number of trips to the WTA from Atlantic City, New Jersey, in those years. The percentage of fishing effort in the Project 2 WTA was less than 0.01 percent each year with the exception of 2015 when 0.02 percent of vessel trips, 1.70 percent of angler trips, and 0.81 percent of vessels occurred in that WTA.

Table 3.6.1-28. For-hire recreational fishing effort in Project 1 and Project 2 WTAs as a percentage of total Northeast Region, 2011–2020

	Vessel Trips as % of Total Vessel Trips in the Northeast Region		Angler Trips as % of Total Angler Trips in the Northeast Region		Number of Vessels as % of Total Number of Vessels in the Northeast Region	
Year	Project 1	Project 2	Project 1	Project 2	Project 1	Project 2
2011	0.19	< 0.01	11.78	< 0.01	1.64	< 0.01
2012	0.11	< 0.01	2.74	< 0.01	1.04	< 0.01
2013	0.07	< 0.01	6.46	< 0.01	1.09	< 0.01
2014	0.10	< 0.01	11.69	< 0.01	0.77	< 0.01
2015	0.16	0.02	12.85	1.70	1.21	0.81
2016	0.06	< 0.01	4.33	< 0.01	1.59	< 0.01
2017	0.05	< 0.01	4.07	< 0.01	0.96	< 0.01
2018	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2019	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2020	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Source: NMFS 2022b.

The predominant for-hire recreational fish species that were landed in the Project 1 and Project 2 WTAs are summarized from 2011 through 2020 in Table 3.6.1-29 and Table 3.6.1-30. During this ten-year period, the species with the highest total landings in the Project 1 WTA were black sea bass, which accounted for more than half of the landings in that WTA, followed by tautog, summer flounder, bluefish, and red hake; together, these five species represented 99 percent of the landings that occurred in the WTA. Species with fewer than three permits, which were grouped together, had the highest percentage of landings in the Project 1 WTA relative to the total landings in the Northeast Region (7.11 percent); all other species had less than 1 percent of their landings in the Project 1 WTA. In the Project 2 WTA, species with fewer than three permits accounted for more than 90 percent of landings in the WTA and had the highest percentage of landings in the WTA relative to the total landings in the Northeast Region (8.87 percent). Black sea bass accounted for the second most landings in the Project 2 WTA.

Table 3.6.1-29. For-hire recreational fishing landings in the Project 1 and Project 2 WTAs, 2011–2020

Species[1]	Project 1 Landings in WTA (number of fish)	Project 1 Landings in WTA as % of Total Northeast Region	Species[1]	Project 2 Landings in WTA (number of fish)	Project 2 Landings in WTA as % of Total Northeast Region
Black Sea Bass	3,785	0.08	All Others	1,612	8.87
All Others	878	7.11	Black Sea Bass	109	< 0.01
Tautog	389	0.09			
Summer Flounder	311	0.03			
Bluefish	275	0.01			
Red Hake	219	0.01			
Atlantic Cod	44	< 0.01			
Scup	21	< 0.01			
Sea Robins	8	0.01			
Total	**5,930**				

Source: NMFS 2022b.

Table 3.6.1-30. For-hire recreational fishing landings in the combined Project 1 and Project 2 WTAs, 2011–2020

Species[1]	Landings in WTAs (number of fish)	Landings of Species as % of Total Landings in WTAs	Landings of Species in WTAs as % of Total Northeast Region
Black Sea Bass	3,876	53.13	0.08
All Others	2,153	29.51	13.41
Tautog	389	5.33	0.09
Summer Flounder	311	4.26	0.03
Bluefish	275	3.77	0.01
Red Hake	219	3.00	0.01
Atlantic Cod	44	0.60	< 0.01
Scup	21	0.29	< 0.01
Sea Robins	8	0.11	0.01
Total	**7,296**		

Source: NMFS 2022b.

The economic value associated with recreational saltwater fishing is driven by angler expenditures. Table 3.6.1-31 compares the for-hire recreational fishing revenue generated by fishing ports in New Jersey, the state that accounted for more than 99 percent of angler trips to the WTAs, to the revenue generated from for-hire recreational fishing trips to the combined Project 1 and 2 WTAs. From 2010 through 2018, for-hire recreational fisheries based out of ports in New Jersey generated an average annual revenue of $65.2 million. Over this same period, the average annual revenue generated by for-hire recreational fishing trips to the Project 1 and 2 WTAs was approximately $19 thousand. Collectively, the average annual revenue generated from for-hire recreational fishing trips to the Project 1 and 2 WTAs represented 0.03 percent of the average annual revenue generated by for-hire recreational fisheries trips from the ports of New Jersey.

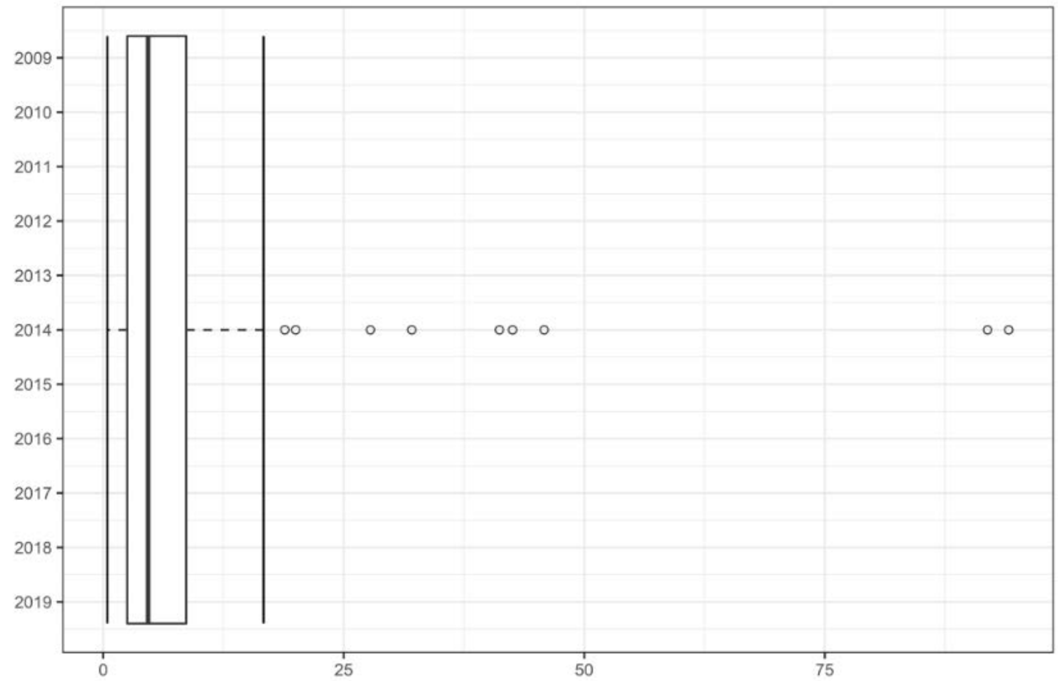
Table 3.6.1-31. For-hire recreational fishing revenue in New Jersey in comparison to the combined Project 1 and Project 2 WTAs, 2010–2018[1]

Year	Revenue in New Jersey (thousands of dollars)[1]	Revenue from WTAs (thousands of dollars)[2]	Percentage of Revenue from WTAs
2010	$55,509	$13	0.02
2011	$62,526	$34	0.05
2012	$61,825	$23	0.04
2013	$102,472	$15	0.01
2014	$97,175	$16	0.02
2015	$88,203	$28	0.03
2016	$33,359	$10	0.03
2017	$36,089	$9	0.02
2018	$49,439	--	--
Average	**$65,177**	**$19**	**0.03**

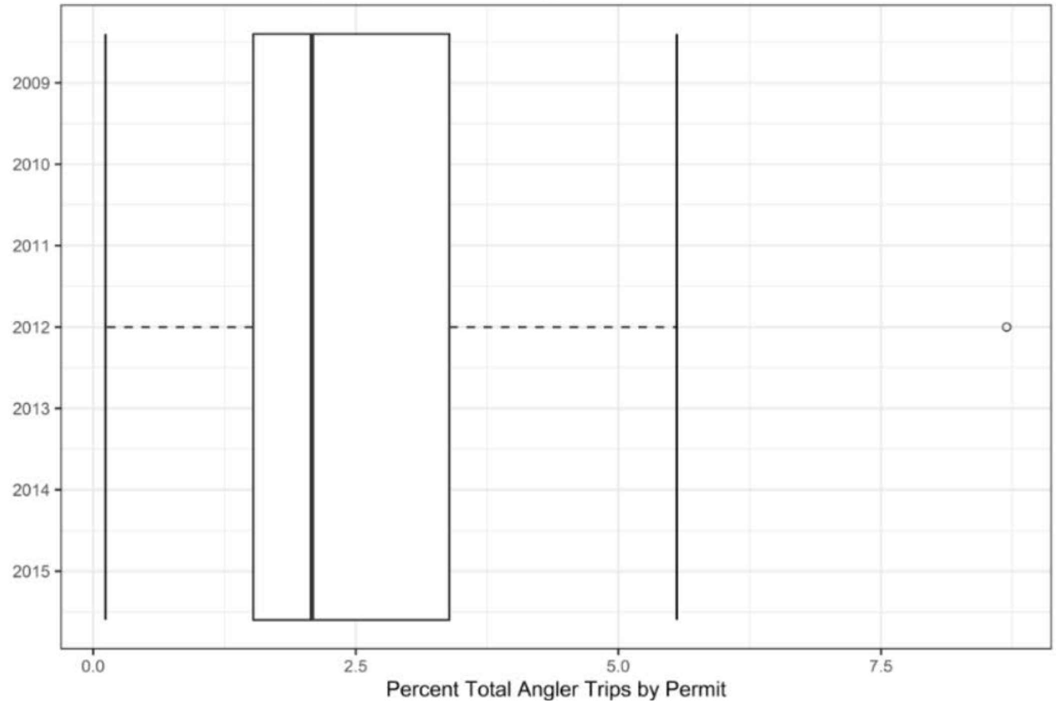
Sources: (1) NMFS 2022d, (2) NMFS 2022b.
Notes:
Available for-hire recreational revenue data for New Jersey were limited to the period of 2010–2018.
Years with no revenue from the WTAs are indicated by "—"

To analyze differences in the importance of fishing grounds in the WTAs for the for-hire recreational fishery, NMFS analyzed the percentage of each permit's total angler trips in the Project 1 and Project 2 WTAs from 2009 through 2019 (NMFS 2022b). Results are summarized in Figure 3.6.1-14, which presents the data in boxplots. The points in these boxplots represent for-hire vessels that derived an exceptionally high proportion of their annual revenue from the WTAs in comparison to other for-hire vessels that fished in the region. Although some vessels derived a high proportion of their annual revenue from the Project 1 and Project 2 WTAs in comparison to other vessels that fished in these areas, the revenue percentage for the majority of vessels was below 10 percent. Therefore, while some vessels depended heavily on the WTAs for their recreational fishing revenue, most derived a small percentage of their total annual revenue from these areas.

Project 1 WTA



Project 2 WTA



Source: NMFS 2022b.

Figure 3.6.1-14. Percentage of revenue harvested from the Project 1 and Project 2 WTAs by for-hire recreational fisheries permit holders

Table 3.6.1-32 summarizes the minimum, first quartile, median, third quartile, and maximum values of percentage revenue harvested from the Project 1 and Project 2 WTAs by for-hire recreational fisheries permit holders from 2009 through 2019. A total of 75 percent (i.e., third quartile) of the permitted vessels that fished in the WTAs derived less than 6 percent and 3 percent of their total annual revenue from the Project 1 and Project 2 WTAs, respectively. The highest percentage of total annual revenue attributed to catch within the WTAs was 93 percent in the Project 1 WTA and 9 percent in the Project 2 WTA.

Table 3.6.1-32. Summary of percentage of revenue harvested from the Project 1 and Project 2 WTAs by for-hire recreational fisheries permit holders, 2009–2018

WTA	Minimum Revenue Percentage Value	First Quartile	Median	Third Quartile	Maximum Revenue Percentage Value[1]
Project 1	0.43	2	4	6	93
Project 2	0.12	1	2	3	9

Source: NMFS 2022b.
[1] Maximum value is inclusive of outliers.

3.6.1.2 Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

This Draft EIS uses a four-level classification scheme to characterize potential impacts of the alternatives, including the Proposed Action, as shown in Table 3.6.1-33. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

Table 3.6.1-33. Impact level definitions for commercial fisheries and for-hire recreational fishing

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	No effect or no measurable effect.
Minor	Adverse	Impacts would not disrupt the normal or routine functions of the affected activity or community. Once the affecting agent is eliminated, the affected activity or community would return to condition with no measurable effects.
	Beneficial	Small or measurable effects that would result in an economic improvement.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the Project. Once the affecting agent is eliminated, the affected activity or community would return to a condition with no measurable effects if mitigation measures are implemented.
	Beneficial	Notable and measurable effects that would result in an economic improvement.
Major	Adverse	The affected activity or community would experience substantial disruptions, and, once the affecting agent is eliminated, the affected activity or community could retain measurable effects indefinitely, even if remedial action is taken.
	Beneficial	Large local, or notable regional effects that would result in an economic improvement.

3.6.1.3 Impacts of Alternative A – No Action on Commercial Fisheries and For-Hire Recreational Fishing

When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for commercial and for-hire recreational fisheries described in Section 3.6.1.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities other than offshore wind within the geographic analysis area that have impacts on commercial and for-hire recreational fisheries include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications), tidal energy projects, marine minerals use and ocean-dredged material disposal, military use, marine transportation, oil and gas activities, onshore development activities, fisheries use and management, and climate change (see Section D.2 in Appendix D for a description of ongoing activities). Some of these activities may also result in bottom disturbance or habitat conversion and may alter the distribution of fishery-targeted species and increase individual mortality. Risks to fisheries associated with these events include the ability to safely conduct fishing operations (e.g., because of storms) and climate-related habitat or distribution shifts in targeted species. If these risks result in a decrease in catch or increase in fishing costs, the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected.

Commercial and for-hire recreational fisheries would continue to be affected by ongoing fisheries use and management. “Regulated fishing effort” refers to fishery management measures necessary to maintain maximum sustainable yield under the MSA, including catch quotas, effort allocations, special management areas, and closed areas. Activities of NMFS and fishery management councils could affect commercial and for-hire recreational fisheries through stock assessments, setting quotas and implementing FMPs to ensure the continued existence of species at levels that will allow commercial and for-hire recreational fisheries to occur. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by the State of New Jersey or NOAA, depending on jurisdiction, will affect commercial fisheries and for-hire recreational fishing by modifying the nature, distribution, and intensity of fishing-related impacts. Fishery management measures affect fishing operations differently for each fishery.

Commercial and for-hire recreational fisheries would continue to be affected by ongoing climate change primarily through ocean acidification, ocean warming, sea level rise, and increases in both the frequency and magnitude of storms, which could lead to altered habitats, altered fish migration patterns, increases in disease frequency, and safety issues for conducting fishing operations. Over the next 35 years, GHG emissions are expected to continue and to gradually warm ocean waters, affecting the distribution and abundance of finfish and invertebrates and their food sources. Ocean acidification driven by climate change is contributing to reduced growth and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can also result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016). Fish and shellfish species are expected to exhibit variation in their responses to climate change, with some species benefiting from climate change and others being adversely affected (Hare et al. 2016). To the extent that impacts on targeted species results in a decrease in catch or an increase in fishing costs (e.g., transit costs to other fishing grounds, need to switch to different fishing gear to target a different species), the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be affected. The location of fishing grounds in commercial and for-hire recreational fisheries could change if the distribution of important fish stocks changes, and coastal communities with fishing-related infrastructure near the shore could be adversely affected by sea level rise (Colburn et al. 2016; Rogers et al. 2019). See Appendix D, Table D.A1-6 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for commercial fisheries and for-hire recreational fisheries.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on commercial and for-hire recreational fisheries include:

- Continued O&M of the BIWF project (5 WTGs) installed in state waters,
- Continued O&M of the CVOW pilot project (2 WTGs) installed in OCS-A 0497, and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the BIWF and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect commercial and for-hire recreational fisheries through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and traffic. Ongoing offshore wind activities would have the same type of impacts from these IPFs that are described in detail in under *Cumulative Impacts of Alternative A – No Action*, but the impacts would be of lower intensity.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

In addition to ongoing activities, BOEM anticipates that the impacts of planned activities other than offshore wind development would result from installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, installation of new structures on the OCS, and fisheries use and management (see Appendix D, Section D.2 for a description of planned activities). Some of these activities may also result in bottom disturbance or habitat conversion and may alter the distribution of fishery-targeted species and increase individual mortality. Fishery management measures that are likely to be implemented in the future include measures to reduce the risk of interactions between fishing gear and NARW by 60 percent (McCreary and Brooks 2019). This measure will likely have an adverse impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area.

Offshore wind activities include planned offshore wind projects on the Atlantic OCS that have been determined by BOEM to be reasonably foreseeable, excluding the Proposed Action (see Appendix D for a description of planned offshore wind activities). BOEM expects planned offshore wind development activities to affect commercial and for-hire recreational fisheries through the following primary IPFs.

Anchoring: Planned offshore wind activities may result in increased anchoring from vessels involved in installation and maintenance. Increased anchoring would pose a temporary (hours to days) navigational hazard to fishing vessels operating within a few hundred meters of anchored vessels. However, the extent of impacts on commercial and for-hire recreational fisheries would depend on the locations and duration of activities. In the maximum-case scenario, which assumes maximum build-out of offshore wind projects within the geographic analysis area, BOEM expects that anchoring from offshore wind projects other than the Proposed Action between 2023 and 2030 would disturb 7,342 acres (2,971 hectares) of the seafloor within the geographic analysis area out of the over 200 million acres (81 million hectares) within the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). However, the extent of anchoring disturbance could be less if planned projects use dynamic positioning vessels. In addition, there could be increased anchoring associated with the installation of meteorological towers or buoys. BOEM expects that anchoring associated with planned offshore wind activities will result in short-term, localized, minor impacts on commercial and for-hire recreational fisheries.

Cable emplacement and maintenance: Planned offshore wind activities will involve the placement and maintenance of export and interarray cables in the geographic analysis area. New cables and cable maintenance could cause localized impacts on commercial fisheries by disrupting fishing activities during periods of active installation and maintenance and during periods when cables are exposed prior to burial. Fishing vessels unable to access affected areas may experience reduced revenue or increased conflict over other fishing areas. BOEM expects that offshore export and interarray cable emplacement in the geographic analysis area from offshore wind projects other than the Proposed Action could cause temporary displacement of fishing vessels and disruption of fishing activities over an estimated area of disturbance of 96,713 acres (39,139 hectares) between 2023 and 2030 within the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2); this area represents less than 0.02 percent of the over 200 million acres (81 million hectares) within the geographic analysis area. Cable laying for some of these projects may occur concurrently, which would disrupt fishing activities over a larger area but for a shorter time than sequential cable laying. However, BOEM does not expect that the decision to lay cables concurrently or sequentially will influence the extent of impacts on fisheries. The season in which cable laying occurs is likely to have a greater influence on the impacts on fisheries resources. Most construction activity is likely to occur in the summer when weather conditions are more favorable, such that fisheries that are most active in the summer (e.g., longfin squid) are more likely to be affected than those that are most active in the winter. BOEM expects that cable emplacement and maintenance for planned offshore wind activities will result in short-term, localized, minor impacts on commercial and for-hire recreational fisheries.

Noise: Planned offshore wind activities that would generate noise include G&G surveys, pile driving, cable laying, vessels, and WTG operations. These noise sources have the potential to temporarily affect fish and shellfish, which may indirectly affect commercial and for-hire recreational fisheries. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities and are expected to occur intermittently over a 2- to 10-year period at locations throughout the geographic analysis area. Site characterization surveys for offshore wind farms typically use sub-bottom profiler technologies that generate sound waves that are similar to common deep-water echosounders. These survey methods produce less-intense sound waves compared to seismic surveys used in oil and gas exploration. Noise from G&G surveys may cause localized and temporary behavioral changes in some fish species, which could affect the catch efficiency of some fishing gears (e.g., hook and line). However, as described in Section 3.5.5.3, because noise from HRF survey equipment would not exceed the threshold for injury to finfish and invertebrates, it is not expected to result in declines in productivity of fish and shellfish stocks that would cause fishery-level impacts. Although schedules for many planned offshore wind activities are still being developed, noise impacts on fish and shellfish might be minimized by sequentially scheduling site assessment and characterization surveys to avoid overlapping noise from different surveys.

Planned offshore wind activities will generate impulsive pile-driving noise during foundation installation. Pile driving is expected to occur for 7 to 9 hours per foundation as 2,974 WTGs and 41 OSSs/ESPs and met towers are anticipated to be constructed between 2023 and 2030 within the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2) for offshore wind projects other than the Proposed Action. One or more projects may install more than one foundation per day, either concurrently or sequentially over the construction period. Noise transmitted through water and the seabed can cause injury to or mortality of fish over a small area around each pile and can cause temporary stress and behavioral changes over a larger area. Because of the relatively small footprint of injurious sound and the ability for most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause stock-level changes that would adversely affect fisheries. High-intensity pile-driving noise may influence fish behavior by causing auditory masking and alteration of foraging patterns, social behavior, and metabolism (Wahlberg and Westerberg 2005; Madsen et al. 2006; Slabbekoorn et al. 2010; Siddagangaiah et al. 2021). It is expected that behavioral responses to noise may cause some displacement of fish, thereby temporarily reducing the quality of fishing in affected areas and causing fishers to seek alternative fishing areas (Skalski et al. 1992). As described in Section 3.6.1.5, *Impacts of Alternative B – Proposed Action on Commercial Fisheries and For-Hire Recreation Fishing,* behavioral responses from pile driving may occur as distances of 6.9 miles (11.2 kilometers) or greater (see Table 3.6.1-35). Most finfish species are expected to avoid the noise-affected areas while invertebrates may exhibit stress and behavioral changes such as discontinuation of feeding activities. For example, noise has been shown to affect bivalves based on reactions where bivalves close their valves and burrow deeper when subjected to noise and vibration stimuli (Roberts and Elliott 2017). Displacement of fishing activity may result in increased conflict among fishers, increased operating costs for vessels, and lower revenue. Furthermore, pile-driving noise may cause changes in spawning behavior. To the extent that changes in spawning behavior result in reduced reproductive success and subsequent recruitment, this could potentially result in long-term effects on populations and associated declines in harvest levels. However, the risk of reduced recruitment from pile-driving noise is low because the behavioral impacts would only occur over the duration of pile driving. Behavioral impacts would be localized to the ensonified area and temporary, as fish behavior is expected to return to preconstruction levels following the completion of pile driving (Jones et al. 2020; Shelledy et al. 2018). Offshore wind developers would implement measures to minimize potential impacts of pile-driving noise, including avoiding sensitive seasons (e.g., fishing, migration, or spawning seasons), using ramp-up or soft start pile-driving procedures to allow mobile fish and invertebrates to vacate the area, and using a noise abatement system to decrease the propagation of potentially harmful noise.

Several activities associated with cable laying would produce noise, including route identification surveys, trenching, jet plowing, backfilling, and installation of cable protection. Modeling based on noise data collected during cable laying for European wind farms has estimated that underwater noise levels from 174 to 180 dB occurred 3 to 4.6 feet (10 to 15 meters) from the source (Bald et al. 2015); these noise levels would exceed the 150-dB threshold for behavioral responses in fish (Mueller-Blenkle et al. 2010; Purser and Radford 2011; Wysocki et al. 2007). As with pile-driving noise, fish that are exposed to cable-laying noise may experience temporary stress and behavioral changes, which could indirectly cause displacement of fishing activity. However, because the cable-laying vessel and equipment would be continually moving and the ensonified area would move with it, a given area would not be ensonified for more than a few hours. Therefore, any behavioral responses to cable-laying noise are expected to be temporary and localized and are not expected to result in fishery-level impacts.

As described in Section 3.5.5.3, vessels generate low-frequency, non-impulsive noise that could cause temporary stress or behavioral responses in fish. Vessel activity from planned offshore wind activities is expected to peak in 2024 when up to 379 vessels could be involved in construction of offshore wind facilities (BOEM 2019). This increase in vessel activity could cause repeated, intermittent behavioral responses in fish, which could indirectly cause displacement of fishing activity. Because behavioral responses to vessel noise would be localized and temporary, dissipating once the vessel leaves the area, vessel noise is not expected to result in fishery-level impacts.

Operating WTGs generate non-impulsive underwater noise that is audible to some fish. The response of fishes to sustained anthropogenic noise is species-specific and may include disruption in social interactions, hearing loss, and a rise in noise-induced stress (Barton 2002; Popper and Hastings 2009; Siddagangaiah et al. 2021). Noise levels generated by operating WTGs are expected to reach ambient levels within a short distance of 10 MW turbines (Stöber and Thomsen 2021). Elliot et al. (2019) compared observed particle motion effects at 164 feet (50 meters) from an operational WTG at the BIWF to current research on particle motion sensitivity in fish. They concluded that particle motion effects could occasionally exceed the lower limit of observed behavioral responses in Atlantic cod and flatfish within these limits. Because behavioral impacts would be localized to the immediate area of WTGs, noise from operating WTGs is not expected to result in fishery-level impacts.

BOEM expects that underwater noise associated with planned offshore wind activities will cause long-term, localized, moderate impacts on commercial and for-hire recreational fisheries, depending on the timing and overlap of construction activities. Impacts are expected to primarily result from pile-driving noise during the installation of foundations for WTGs and OSS. BOEM expects planned offshore wind development activities to affect commercial fisheries and for-hire recreational fishing through the following primary IPFs.

Port utilization: Port expansion will likely be needed to accommodate the increased vessel traffic and increased vessel sizes associated with planned offshore wind activities. At least two proposed offshore wind projects are considering port expansion, and other ports along the Atlantic coast may be expanded as well. Major fishing ports in the geographic analysis area (see Table 3.6.1-3, above) that have been identified as potential ports to support offshore wind energy construction and operations include Atlantic City, Hampton Roads, Montauk, and New Bedford (BOEM 2022). Port expansions would likely occur over the next 6 to 10 years and would result in increased vessel traffic, which would peak during construction. Increased vessel traffic may cause delays or restrictions in access to ports for commercial and for-hire fishing vessels. Furthermore, maintenance dredging of shipping channels may be required to support port expansion, which could cause additional delays or restrictions in access to port for fishing vessels, as well as increased vessel noise and increased suspended sediment concentrations, two factors that may cause temporary and localized displacement of fish. Port expansions could also increase competition for dockside services, which could affect fishing vessels. Port expansion is expected to have impacts on commercial and for-hire fishing vessels that are widespread across ports used for both fishing and offshore wind projects and are long term, with impacts primarily occurring during the construction period of multiple projects. BOEM expects that increased port utilization associated with planned offshore wind activities will cause long-term, widespread, moderate impacts on commercial and for-hire recreational fisheries resulting from increased vessel traffic at ports and increased competition for dockside services.

Presence of structures: As described above, an estimated 2,974 WTGs and 41 OSSs/ESPs and met towers are expected to be built within the geographic analysis area for planned offshore wind activities other than the Proposed Action between 2023 and 2030. Approximately 4,853 acres (1,964 hectares) of hard scour protection would be installed around the foundations, and an additional 2,575 acres (1,042 hectares) of hard protection would be installed around the export and interarray cables (Appendix D, Table D.A2-2). The presence of these structures may have impacts on commercial and for-hire recreational fisheries through entanglement or gear loss or damage, space-use conflicts, navigational hazards, fish aggregation, habitat conversion, and migration disturbances. These impacts may arise from the presence of buoys, meteorological towers, turbine and substation foundations, scour/cable protection, and transmission-cable infrastructure.

The presence of the scour protection for the WTG foundations and transmission cables would result in a widespread, permanent increase in the risk of entanglement or gear loss or damage for commercial and for-hire recreational fishing vessels that operate within the offshore wind lease areas, which would exist over the operational period of the Proposed Action. Although interarray and export cables would be buried below the seabed approximately 5 to 6.6 feet (1.5 to 2 meters), BOEM estimates burial to this depth would not be possible for as much as 10 percent of the cables; these cables would require cable protection in the form of rock placement, concrete mattresses, or half-shell. Mobile gear could become snagged on these structures, resulting in damage to or loss of the gear and increased costs for fishers. The increased risk of damage or loss of fishing gear could affect mobile and fixed-gear fisheries, but the risk would be greatest for commercial mobile gear (e.g., trawl, dredge), which is actively pulled over the seafloor. Periodic damage to or loss of fishing gear would result in a long-term increase in expenses to fishers resulting from the costs of repairing or replacing the gear and lost fishing revenue that occurs while the gear is being repaired or replaced. Fishers may avoid areas where scour and cable protection are present, thereby leading to displacement of fishing activity and increased conflicts with other fishers. Further, lost gear that is carried by currents can disturb habitats and cause injury to aquatic organisms, potentially causing localized, short-term impacts on fish and invertebrates that are targeted in fisheries.

The presence Of WTGs would result in a widespread, permanent navigational risk to commercial and for-hire recreational fishing vessels transiting through and fishing near offshore wind farms. Maneuverability within wind farms depends on several factors including vessel size, fishing gear used, and weather conditions. Trawl and dredge vessel operators have commented that less than 1 nautical mile (1.9 kilometers) spacing between WTGs may not be enough to operate safely due to maneuverability of fishing gear and gear not directly following in line with vessel orientation. Clam industry representatives (Atlantic surfclam and ocean quahog fisheries) have stated that their operations require a minimum distance of 2 nautical miles (3.7 kilometers) between WTGs, in alignment with the bottom contours, for safe operations. For-hire recreational fishing vessels, which are generally smaller than commercial vessels and do not have large, externally deployed fishing gear, are expected to have less difficulty navigating near offshore wind farms. An exception to this would be recreational fishing vessels that troll for migratory species (e.g., bluefin tuna, swordfish), which often deploy many feet of lines and hooks behind the vessel that may create navigational challenges around wind farms. Some fishermen have commented that, because of safety considerations, they would not enter an offshore wind array during inclement weather, especially during low-visibility events (Kirkpatrick et al. 2017). Fishermen have expressed concerns that low visibility, wind, or crew exhaustion could lead to vessels alliding with WTGs (Brink and Dalton 2018). Mechanical problems, such as loss of steerage, could also result in an allision with a WTG as the vessel drifts during repair. The presence of WTGs could cause long-term changes in transit routes of fishing vessels that actively avoid transiting through the offshore wind lease areas, which could result in increased travel time and trip costs. Collectively, the reduced area available for fishing and the navigational hazards to fishing vessels posed by the presence of structures associated with planned offshore wind projects are expected to have long-term, adverse impacts on commercial and for-hire fisheries.

Some fishermen who are displaced from traditional fishing grounds may find suitable alternative fishing grounds and continue to earn revenue, while others may switch the species they target or the gear they use, and others may leave the fishery altogether (Murray et al. 2010; O'Farrell et al. 2019). These behaviors are like those of fishermen experiencing reduced access to fisheries resulting from fishing regulations (Murray et al. 2010) and/or shifting species composition resulting from climate change (Papaioannou et al. 2021). Each of these scenarios requires adaptive behavior and risk tolerance; traits that are not universally shared by all fishermen. For example, O'Farrell et al (2019) observed that some fishermen have low vessel mobility, less explorative behavior, are risk averse, and take shorter trips, whereas other fishermen have high mobility, a greater explorative behavior, are tolerant of risk, and conduct longer trips. Similarly, Papaioannou et al. (2021) observed that smaller trawlers had a higher affinity for their fishing grounds and were less likely to switch fishing grounds than larger trawlers. Fishermen who are willing to seek alternate fishing grounds may experience increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less-productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. Fishermen who switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishermen to land their catch in different ports (Papaioannou et al. 2021), which could increase operational costs depending on where the port is located.

Fishing vessel operators who are displaced from fishing grounds within offshore wind areas and are unable to find alternative fishing locations would experience long-term revenue losses. BOEM has conducted revenue exposure analyses to estimate the amount of commercial fishing revenue that would be foregone if fishing vessel operators choose to no longer fish in offshore wind lease areas and cannot capture that revenue in different locations. Revenue exposure estimates should not be interpreted as measures of actual economic impact, which depend on many factors, including the potential for continued fishing to occur within the footprint of the wind farm, the ecological impact on target species inhabiting the lease areas, and the ability of vessel operators to identify alternative fishing locations.

Table 3.6.1-34 depicts the annual commercial fishing revenue exposed to offshore wind energy development in the geographic analysis area by FMP fishery from 2020 through 2030. The revenue exposure was forecast each year based on the average annual commercial fisheries revenue estimated to occur in Atlantic OSW areas from 2008 through 2019 (NMFS 2022f) and the construction timelines of planned Atlantic OSW projects. The amount of revenue at risk increases as proposed offshore wind energy projects are constructed and come online and would continue beyond 2030 during the continued O&M phases of the offshore wind energy projects. The most revenue at risk is during the construction of these projects, which is the focal period of this table, but revenue exposure would occur during the O&M phase as well, which will extend well beyond 2030. The table was limited to a 10-year period that does not include most of the O&M phases of these projects because of uncertainty stemming from changes in fish distributions and adjustments in fishing practices. Therefore, this table should be regarded as demonstrative rather than predictive. The largest impacts in terms of exposed revenue are expected to be in the Sea Scallop; Surfclam and Ocean Quahog; and Mackerel, Squid, Butterfish FMP fisheries. Vessels from most fisheries remain close to home, such that the exposed revenue is expected to be greatest in fishing ports that are closest to offshore wind projects. A notable exception to this is the scallop fishery, in which vessels often travel several hundred miles to reach fishing grounds. The average annual exposed revenue over the 2020–2030 period represents 0.8 percent of the average annual revenue of all commercial fisheries in the geographic analysis area during the 2011–2020 period (see Table 3.6.12). The maximum exposed revenue—which is projected to occur in year 2029 when construction on the last of the planned activities could begin—represents 1.9 percent of the average annual revenue of all commercial fisheries in the geographic analysis area. In general, fisheries do not have high relative revenue intensity within the offshore wind lease areas compared with nearby waters because offshore wind lease areas were chosen in part to reduce conflicts with fishermen.

The cumulative use of ocean space by planned offshore wind farms will likely result in increased travel time to landing ports, which may cause some fishermen to use different landing ports, thereby resulting in economic loss to ports and communities, especially in small ports. Many fishing vessels use landing ports that differ from their primary port (i.e., the port where the vessel is docked or moored), and these vessels are likely to be particularly vulnerable to reductions in unobstructed ocean space. Silva et al. (2021) conducted an intercept survey from Maine to North Carolina and observed that 20 percent (n=479) of the fishing industry participants reported different primary and landing ports from the intercept port. Among those reporting differences, the primary and landing ports were generally in different states. The ports where differences were most reported included Newport News, Virginia; Cape May and Point Pleasant, New Jersey; New Bedford, Massachusetts; and Point Judith, Rhode Island. Surfclam vessels often travel between Atlantic City, New Jersey, and New Bedford, Massachusetts.

In addition to the economic impacts discussed above, the loss of historical fishing grounds and fishing transit areas may have social and cultural impacts on fishing communities. Discussions of these impacts are provided in Section 3.6.2, *Cultural Resources*, and Section 3.6.4, *Environmental Justice*.

Table 3.6.1-34. Annual commercial fishing revenue exposed to planned offshore wind energy development in the geographic analysis area

	Total Annual Revenue Exposed ($1,000s)									
FMP	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030[1]
Mackerel, Squid, Butterfish	$0	$0	$388	$631	$824	$1,180	$1,324	$1,448	$1,572	$1,572
Summer Flounder, Scup, Black Sea Bass	$0	$0	$306	$476	$661	$921	$1,097	$1,251	$1,406	$1,406
Multispecies (small-mesh)	$0	$0	$144	$185	$275	$361	$383	$394	$405	$405
Skates	$0	$0	$261	$300	$358	$444	$485	$508	$531	$531
American Lobster	$0	$0	$332	$378	$447	$581	$659	$691	$723	$723
Monkfish	$0	$0	$440	$513	$616	$770	$863	$935	$1,007	$1,007
Sea Scallop	$0	$0	$466	$2,710	$2,815	$7,744	$12,598	$17,425	$22,251	$22,251
Jonah Crab	$0	$0	$56	$94	$240	$324	$347	$365	$384	$384
Other FMPs, non-disclosed species, and non-FMP fisheries	$0	$0	$783	$947	$1,111	$1,695	$2,093	$2,459	$2,825	$2,825
Golden and Blueline Tilefish	$0	$0	$4	$10	$56	$76	$81	$86	$91	$91
Multispecies (large-mesh)	$0	$0	$183	$197	$215	$260	$278	$289	$299	$299
Bluefish	$0	$0	$6	$9	$12	$15	$17	$18	$19	$19
Spiny Dogfish	$0	$0	$21	$29	$32	$37	$40	$41	$42	$42
Surfclam, Ocean Quahog	$0	$0	$133	$169	$186	$585	$985	$1,384	$1,783	$1,783
Atlantic Herring	$0	$0	$66	$98	$116	$164	$201	$229	$257	$257
Highly Migratory Species	$0	$0	$0	$0	$1	$1	$1	$1	$1	$1
All FMP and non-FMP Fisheries	**$1**	**$1**	**$3,589**	**$6,745**	**$7,964**	**$15,159**	**$21,451**	**$27,524**	**$33,597**	**$33,597**

Source: Developed using data from NMFS (2022f) and excludes the Proposed Action.

[1] This column represents the total average revenue exposed in 2030 in order to give a value reference for the percentage of revenue exposed in 2030.

[2] Includes revenues from all species not assigned to an FMP including American lobster and Jonah crab fisheries.

Notes: Revenue is in nominal dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing (0223) provided by the U.S. Bureau of Labor Statistics. The data represent the revenue-intensity raster developed using fishery-dependent landings' data. To produce the data set, Vessel Trip Report information was merged with data collected by at-sea fisheries observers, and a cumulative distribution function was estimated to present the distance between Vessel Trip Report points and observed haul locations. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned.

"–" indicates the value is zero; "$0" indicates the value is positive but less than $100.

The presence of the WTG foundations and associated scour protection, as well as cable protection, would convert existing sand or sand with mobile gravel habitat to hard-bottom, which, in turn, would reduce the habitat for target species that prefer soft-bottom habitat (e.g., surfclams, sea scallops, squid, summer flounder). Habitat conversion would also result in the loss of soft-bottom benthic features that occur throughout the Offshore Project area, including sand waves, sand ridges, and shoal formations. These features provide habitat complexity that is used by benthic and finfish communities for refuge, spawning, and foraging, and are often identified as prime fishing areas by commercial and recreational fishermen. The offshore wind structures would also create uncommon relief in a mostly sandy seascape, attracting structure-oriented species and species that prefer hard-bottom habitat to these locations (Claisse et al. 2014; Smith et al. 2016). The presence of structures may increase the catchability of numerous species that are targeted in fisheries, including American lobster, Atlantic cod, black sea bass, and striped bass (Kirkpatrick et al. 2017), thereby resulting in increased opportunities for for-hire recreational fisheries. Conversely, commercial fishing vessels that deploy mobile fishing gear may be unable to fish near these structures because of the risk of snagging, and commercial fishers in general may encounter increased competition with recreational fishers in these areas. Planned offshore wind structures may also provide forage and refuge for some migratory finfish and shellfish that are valued in fisheries, such as black sea bass, lobster, monkfish, and summer flounder. These behavioral effects may affect the migrations of individual fish, but they are not expected to have broad impacts on the migration of fish populations. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migration (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). The impact of structures on fish aggregation and migratory patterns would be localized to the immediate area surrounding the structures and would be long term, existing as long as the structures are in place, but is not expected to cause stock-level changes that would result in fishery-level impacts.

BOEM expects that the presence of structures associated with planned offshore wind activities will cause long-term, widespread, moderate to major impacts on commercial and for-hire recreational fisheries, depending on the mitigation measures that implemented by offshore wind developers. Impacts are expected to primarily result from the risk of fishing gear damage or loss and reduced access to traditional fishing grounds.

Regulated fishing effort: Planned offshore wind development could influence fishery management by affecting fisheries' independent surveys used to inform management measures and by changing patterns of fishing activity. Fisheries managers may need to revise the sampling design of fisheries surveys to include sampling within WTAs to account for uncertainty in stock assessments that may accompany offshore wind development. Increased uncertainty in stock assessments could lead to more conservative quotas and resulting revenue losses in the fishing industry. Changes in fishing behavior from offshore wind development may necessitate new management measures, which would in turn have short-term or long-term impacts on commercial and for-hire recreational fisheries. BOEM expects that changes in regulated fishing effort in response to planned offshore wind activities will cause long-term, widespread, moderate impacts on commercial and for-hire recreational fisheries as management adapts to changing fishing patterns, data availability, and management options.

Traffic: Planned offshore wind activities would result in increased vessel traffic during construction, O&M, and decommissioning of planned offshore wind facilities. This increase in vessel traffic is expected to occur over a 6- to 10-year period and is expected to peak in 2024 when up to 379 vessels could be involved in construction of offshore wind facilities (BOEM 2019). Increased vessel traffic could increase congestion, delays at ports, and the risk for collisions with fishing vessels. The presence of construction vessels could restrict fishing operations in offshore wind lease areas and along cable routes during installation and maintenance activities. Impacts from vessel traffic are expected to occur primarily during the construction period. BOEM expects that increased vessel traffic associated with Planned offshore wind activities will cause long-term, widespread, moderate impacts on commercial and for-hire recreational fisheries.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, ongoing activities would have continuing impacts on commercial and for-hire recreational fishing, primarily through port use, vessel activity, other offshore development, climate change, and fisheries use and management. BOEM anticipates that the commercial and for-hire recreational fisheries impacts from ongoing activities associated with the No Action Alternative would be permanent and **moderate** to **major**. The major impact rating for some fisheries and fishing operations is primarily driven by regulated fishing effort and climate change associated with ongoing activities.

Cumulative Impacts of Alternative A – No Action. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and planned non-offshore wind activities, including port expansions, new cable emplacement and maintenance, and planned marine transportation and fisheries use, would contribute to impacts on commercial and for-hire recreational fisheries. Planned offshore wind activities would impact commercial and for-hire recreational fisheries through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and traffic.

BOEM anticipates that cumulative impacts of the No Action Alternative would have permanent **moderate** to **major** adverse impacts on commercial fisheries and **minor** to **moderate** adverse impacts on for-hire recreational fishing. These impacts would primarily result from future fisheries use and management and the increased presence of offshore structures (i.e., foundations, scour protection, and cable protection), primarily those associated with planned offshore wind projects. The extent of adverse impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. The impacts could also include **minor beneficial** impacts on some for-hire recreational fishing operations resulting from the artificial reef effect.

3.6.1.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case*

Scenario) would influence the magnitude of the impacts on commercial and for-hire recreational fisheries:

- The number, size, and type of WTG and OSS foundations;
- The route of the interarray cables and offshore export cable, including the ability to reach target burial depth and the cable protection measures used when target burial depth is not achieved;
- The time of the year during which construction occurs; and
- The number of simultaneous vessels, number of trips, and size of vessels.
- Variability of the Atlantic Shores South design exists as described in Appendix C. Below is a summary of potential variances in impacts:
- The number of WTG foundations: A larger number of WTG foundations would result in greater impacts on commercial and for-hire recreational fisheries associated with the presence of structures, including the risk of gear loss or damage, navigational hazards, space-use conflicts, and fish aggregation.
- The time of the year during which construction occurs: Commercial fisheries are typically active throughout the year, whereas recreational fisheries are most active during months when the weather is favorable. Some fisheries have distinct peaks in activity. Construction that occurs during periods of peak activity may limit access to fishing areas and may cause displacement of fish from affected areas, thereby reducing catch and revenue.

Although variation is expected in the design parameters, the impact assessments for commercial and for-hire recreational fisheries in Section 3.6.1.5 through Section 3.6.1.8 evaluate impacts associated with the maximum-case scenario identified in Appendix C.

3.6.1.5 Impacts of Alternative B – Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing

As described in Section 2.1.2, *Alternative B – Proposed Action*, the Proposed Action includes the construction of up to 200 WTGs, 10 OSSs, and 1 met tower and the installation of up to 547 miles (880 kilometers) of interarray cables, 37 miles (60 kilometers) of interlink cables, and 441 miles (710 kilometers) of export cables between 2025 and 2027. The Proposed Action also includes 30 years of O&M over a 30-year commercial lifespan and decommissioning activities at the end of commercial life.

The Proposed Action would include both onshore and offshore activities. Anticipated onshore activities include interconnection cable installation and onshore substation or converter station construction, remote monitoring of offshore structures, maintenance of onshore substations or converter stations, and maintenance of interconnection cables. Anticipated offshore activities include submarine export cable installation, OSS installation and commissioning, WTG foundation installation, interarray and interlink cable installation, WTG installation and commissioning, inspection and maintenance of WTGs, structural inspection and maintenance of OSSs, foundation and scour protection inspection and maintenance, and submarine cable surveys and maintenance. The effects of IPFs associated with these activities on commercial and for-hire recreational fisheries are discussed in the following paragraphs.

Anchoring: The Proposed Action would result in increased anchoring from vessels during survey activities and during the construction and installation, O&M, and decommissioning of offshore components. Anchored vessels would disturb approximately 714 acres (289 hectares) of seafloor and would pose a navigational hazard to fishing vessels (Appendix D, Table D.A2-2). All impacts from anchoring would be localized and potential navigational hazards would be temporary (hours to days). Atlantic Shores would implement measures to avoid interactions between anchored Atlantic Shores South vessels and fishing vessels, including development of a website that contains a real-time vessel tracking charts and vessel schedules (COM-16, Appendix G, Table G-1) and employment of a Marine Coordinator to monitor daily vessel movements, implement a communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones (COM-20, Appendix G, Table G-1).

BOEM expects that anchoring associated with the Proposed Action will result in short-term, localized, minor impacts on commercial and for-hire recreational fisheries.

Cable emplacement and maintenance: As provided in Table D.A2-2 of Appendix D, the Proposed Action would involve the placement of 1,025 miles (1,650 kilometers) of export, interlink, and interarray cables and the placement of up to 596 acres (241 hectares) of hard cable protection (294, 20, and 282 acres [119, 8, and 114 hectares] around the export, interlink, and interarray cables, respectively). The incremental contribution of the construction and installation of the Proposed Action is a 2,607-acre (1,055-hectare) area of seabed disturbance for the emplacement of export cables and a 2,335-acre (945-hectare) area of seabed disturbance for the emplacement of interarray and interlink cables.

Cable emplacement could prevent deployment of fixed and mobile fishing gear in limited parts of the Project area from 1 day up to several months (if simultaneous lay and burial techniques are not used). During construction and installation activities, it may not be possible to deploy fixed fishing gear in parts of the Project area, which may result in the loss of revenue to fisheries. As provided in Table 3.6.1-21, from 2011 to 2020, the average annual commercial fishing revenue from fixed gear (i.e., gillnet and pots) in the combined Project 1 and Project 2 WTAs was approximately $15,276, which represented 3.5 percent of the average annual commercial fishing revenue of $436,235 in the WTAs. In addition, temporary limitations to fishing activities for all gear types could occur along the offshore export cable corridor while the site is being prepared and cables laid. Commercial fishing vessels operating in the offshore portion of the export cable corridor are expected to target similar species and use similar gear types compared to vessels operating in the WTAs. However, the target species and gears used are expected to differ along the inshore portion of the cable corridor. Fishing vessels that temporarily do not have access to areas along the export cable corridor could experience reduced revenue if alternative fishing locations are not available or there is increased conflict over other fishing grounds.

The presence of slow-moving (or stationary) cable installation vessels would increase the risk of collisions with fishing vessels. Fishing vessels would need to take additional care when crossing cable routes or would need to avoid installation or maintenance areas entirely during installation and maintenance activities. Navigational impacts from the presence of cable installation vessels are expected to be on the scale of hours and are not expected to occur over large areas.

BOEM expects that cable emplacement and maintenance associated with the Proposed Action would result in short-term, localized, minor impacts on commercial and for-hire recreational fisheries.

Noise: The Proposed Action would generate underwater noise during G&G surveys, pile driving, cable emplacement, vessel operation, and WTG operation. As described in Section 3.5.5.5, these noise sources have the potential to temporarily affect fish and shellfish, which may indirectly affect commercial and for-hire recreational fisheries. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

HRG surveys, a type of G&G survey, would be conducted prior to construction to support final engineering design and after cable emplacement to confirm burial of submarine export and interarray cables. G&G survey noise could temporarily affect commercial and for-hire recreational fisheries indirectly by causing behavioral changes in commercial and recreational fish species within the ensonified area, which may affect the catch efficiency for some types of gear (e.g., hook and line). However, because HRG survey equipment produces less-intense noise, operates in smaller areas, and is deployed by faster-moving vessels compared to other types of G&G survey equipment (e.g., seismic air guns), it is not expected to cause injuries to fish and any behavioral impacts are expected to occur over a small area.

Impact pile driving during the installation of WTGs and OSS foundations would generate intermittent noise during the construction period. A total of 211 foundations are expected to be installed under the Proposed Action, each requiring a maximum of 7 to 9 hours of pile driving (if piled foundations are used), which would occur over a maximum-case scenario of a total of 420 days (2 days per foundation assuming no daylight restrictions) over 3 years. As described in Section 3.6.1.3, *Impacts of Alternative A – No Action on Commercial Fisheries and For-Hire Recreational Fishing,* noise generated by pile driving can cause injury or mortality to fish over a small area around each pile and can cause temporary stress and behavioral changes over a larger area. As summarized in Table 3.6.1-35, pile driving under the Proposed Action was estimated to have a maximum radius of behavioral impacts on all fish of as far as 6.9 miles (11.2 kilometers) at a deep location and 6.4 miles (10.2 kilometers) at a shallow site influenced by bathymetry (COP Volume II, Appendix II-L; Atlantic Shores 2023). Because of the relatively small footprint of injurious sound and the ability for most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause fishery-level impacts on fish stocks. Invertebrates are generally less sensitive to sound than fish, such that injurious sound is expected to occur only close to pile driving and is not expected to cause fishery-level impacts on shellfish stocks.

Table 3.6.1-35. Acoustic radial distances ($R_{95\%}$ in kilometers) to thresholds for fish for 15-meter monopiles using a 4,400 kilojoule hammer energy with 0-dB attenuation

Threshold Type	Fish Type	Threshold Level	Acoustic Radial Distance at Deep Location (km)	Acoustic Radial Distance at Shallow Location (km)
Behavioral, peak	All fish	150 dB re 1 µPa SPL_{RMS}[1]	11.16	10.24
Injury, peak	All fish	206 dB re 1 µPa SPL_{peak}[1]	0.43	0.50
	No swim bladder	213 dB re 1 µPa SPL_{peak}[2]	0.21	0.18
	Swim bladder	207 dB re 1 µPa SPL_{peak}[2]	0.41	0.46
Injury, cumulative	Over 2 grams	187 dB re 1 µPa^2 SEL_{cum}[3]	9.46	8.57
	Under 2 grams	183 dB re 1 µPa^2 SEL_{cum}[3]	11.05	9.98
	No swim bladder	216 dB re 1 µPa SPL_{peak}[2]	1.45	1.34
	Swim bladder	203 dB re 1 µPa SPL_{peak}[2]	4.34	3.90

Sources:
[1] Andersson et al. 2007; Mueller-Blenkle et al. 2010; Purser and Radford 2011; Wysocki et al. 2007.
[2] Popper et al. 2014.
[3] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008).
km = kilometers; µPa = micropascal; Rmax = maximum radius; SELcum = cumulative sound exposure level; SPLpeak = peak sound pressure level.

As described in Section 3.6.1.3, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and installation of cable protection. Cable-laying activities associated with the Proposed Action would generate noise along 1,025 miles (1,650 kilometers) of interarray, interlink, and export cables. Fish that are exposed to cable-laying noise may experience temporary stress and behavioral changes, which could indirectly cause displacement of fishing activity and associated losses in revenue. However, because the cable-laying vessel and equipment would be continually moving and the ensonified area would move with it, a given area would not be ensonified for more than a few hours. The noise impacts of cable-laying activities associated with the Proposed Action are expected to be temporary and localized and are not expected to result in fishery-level impacts.

As described in Section 3.6.1.3, vessel operations during construction of the Proposed Action would generate low-frequency, non-impulsive noise, which could cause repeated, intermittent behavioral responses in fish and resulting displacement of fishing activity. However, because behavioral responses to vessel noise would be localized and temporary, ceasing once the vessel leaves the area, they are not expected to result in fishery-level impacts.

As discussed in Section 3.6.1.3, operating WTGs generate non-impulsive underwater noise that is audible to some fish species. The response of fishes to sustained anthropogenic noise is species-specific and may include disruption in social interactions, hearing loss, and a rise in noise-induced stress (Barton 2002; Popper and Hastings 2009; Siddagangaiah et al. 2021). Noise levels generated by operating WTGs are expected to reach ambient levels within a short distance of 10 MW turbines (Stöber and Thomsen 2021), such that impacts would be localized to the immediate area of WTGs. Therefore, noise from operating WTGs is not expected to result in fishery-level impacts.

BOEM expects that underwater noise associated with the Proposed Action would cause short-term to long-term, localized, minor to moderate impacts on commercial and for-hire recreational fisheries.

Moderate impacts are expected to result from pile-driving noise during installation of foundations for WTGs and OSSs, whereas minor impacts are expected to result from other noise sources.

Port utilization: No port expansion would be required to specifically accommodate the Proposed Action, but an increase in port utilization is expected during its construction and installation and O&M. Atlantic Shores has identified five port facilities in the Mid-Atlantic and New England that may be used for major construction staging activities for the Proposed Action: New Jersey Wind Port, Paulsboro Marine Terminal, and Repauno Port and Rail Terminal in New Jersey; Portsmouth Marine Terminal in Virginia; and Port of Corpus Christi in Texas. All port facilities being considered to support construction activities are located within industrial waterfront areas with existing marine industrial infrastructure or where such infrastructure is proposed for development within the required timeframe of Atlantic Shores South. While there is no port expansion included as part of the Project, for the O&M phase, Atlantic Shores would operate out of a new onshore O&M facility in Atlantic City, New Jersey, sited on a retired marine terminal. Several of the ports under consideration to support construction and installation and O&M are located within or near areas that have a medium or high level of fisheries engagement (e.g., Atlantic City, New Jersey; New Bedford, Massachusetts; North Kingstown, Rhode Island; Wilmington, Delaware) (NMFS 2022c). Use of these ports by vessels associated with the Proposed Action would result in increased vessel traffic, which may cause delays or restrictions for commercial and for-hire fishing vessels. Impacts from port utilization associated with the Proposed Action are expected to be localized and long term, occurring primarily during the construction period, and are not expected to result in fishery-level impacts.

BOEM expects that increased port utilization associated with the Proposed Action would cause long-term, localized, minor impacts on commercial and for-hire recreational fisheries resulting from an increase in vessel traffic.

Presence of structures: The Proposed Action would include the installation of up to 200 WTGs, 10 OSSs, 1 permanent meteorological tower, up to 252 acres (102 hectares) of hard scour protection around the WTG foundations, up to 25 acres (10 hectares) of hard scour protection around the OSS foundations, and up to 596 acres (241 hectares) of hard cable protection around the export, interlink, and interarray cables (Appendix D, Table D.A2-2). As described in Section 3.6.1.3, the presence of these structures during the operational phase of the Proposed Action could have several impacts on commercial and for-hire recreational fisheries, including through gear loss or damage, navigational hazards, habitat conversion and fish aggregation, migration disturbances, and space-use conflicts. The potential impacts associated with the presence of these structures are discussed separately in the following paragraphs.

The presence of structures, particularly the export and interarray cables and associated scour protection, would pose an increased risk of damage or loss of fishing gear. Although interarray and export cables would be buried at a target depth of 5 to 6.6 feet (1.5 to 2 meters) below the seabed, BOEM estimates that burial to this depth would not be possible for as much as 10 percent of the area along the cable corridor; these cables would require an estimated 596 acres (241 hectares) of cable protection in the form of rock placement, concrete mattresses, or half-shell. Mobile gear could become snagged on these cable protection structures, resulting in damage to or loss of the gear, increased costs to fishers associated with repairing or replacing the gear, and revenue loss while the gear is being repaired or replaced. The increased risk of damage or loss of fishing gear would affect mobile and fixed-gear commercial fisheries and for-hire recreational fisheries, but the risk would be greatest for bottom-oriented commercial fisheries that use mobile gear (e.g., trawl, dredge), which is actively pulled over the seafloor. Although the Project area is generally classified as mostly sandy, areas where the seabed requires cable protection often contain natural snags that would provide suboptimal conditions for trawling or dredging and would therefore be avoided by those fisheries. Bottom-oriented mobile gear is the predominant type of gear used in the Lease Area. From 2011 to 2020, bottom-oriented mobile gear harvested an average annual revenue of $396,188 from the combined Project 1 and Project 2 WTAs (Table 3.6.1-21) which represented approximately 91 percent of the total revenue generated there. Atlantic Shores would implement measures to avoid, minimize, and mitigate impacts from the risk of interactions between fishing gear and submarine cables, including limiting the amount of cable protection and designing cable protection that minimize effects on fishing gear (COM-07, Appendix G, Table G-1); burying cables at a sufficient depth of 5 to 6.6 feet (1.5 to 2 meters) (GEO-07, Appendix G, Table G-1); and developing a Gear Loss Avoidance Program to identify gear located within the Project area and to work with fishermen to avoid, remove, or relocate fishing gear in the Project area (COM-15, Appendix G, Table G-1). Collectively, the risk of damage or loss of fishing gear posed by the Proposed Action is expected to have long-term, adverse impacts, primarily on commercial fisheries.

Structures installed under the Proposed Action would pose a long-term navigational hazard and risk of allisions to commercial and for-hire recreational fishing vessels transiting through and fishing near the Lease Area. Depending on the location and width of transit corridors, commercial and for-hire recreational fishing vessels may have difficulty safely navigating within the Lease Area, as there may be less space for maneuverability and greater risk of allision or collision if there is a loss of steerage. Vessels that choose not to navigate through the WTAs and use alternative transit routes may experience increases in travel times and fuel costs. As described in Section 3.6.1.3, commercial fishing vessels, which are generally larger than for-hire recreational fishing vessels and often have large, externally deployed fishing gear, are expected to have more difficulty navigating within the Lease Area. Fishing industry representatives have stated that their operations require a minimum distance greater than 1 nautical mile (1.9 kilometers) between WTGs, in alignment with the prevailing tidal currents for safe operations (NYSERDA 2022). Fishing vessels navigating through the Lease Area could also have difficulty using navigational radar when WTGs present many radar targets that may obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions, such as heavy fog. To provide additional navigational flexibility during inclement weather, Atlantic Shores has recommended that the WTGs be aligned in a uniform grid with rows in an east-northeast to west-southwest direction spaced 1.0 nautical mile (1.9 kilometers) apart and rows in an approximately north to south direction spaced 0.6 nautical mile (1.1 kilometers) apart (Atlantic Shores 2023). As described in Section 3.6.1.1 and summarized on Figure 3.6.1-4, VMS-enabled vessels in the Lease Area generally move along an east-west or slightly northeast-southwest bearing when fishing and a north-south or northwest-southeast bearing when transiting. However, as Figure 3.6.1-5 through Figure 3.6.1-11 demonstrate, the orientation of vessels varies by fishery. For instance, scallop vessels, which account for a high percentage of fishing activity in the Lease Area, generally follow either a north or northwest bearing when fishing that is not in alignment with the dominant row direction and may therefore experience greater difficulties with navigation. Atlantic Shores would implement measures to avoid, minimize, and mitigate impacts of navigational hazards on commercial and for-hire recreational fisheries, including marking all offshore structures with marine navigation lighting in accordance with USCG and BOEM guidance (COM-08, Appendix G, Table G-1); equipping each WTG and OSS with access ladders to allow distressed mariners access to an open refuge area above the splash zone (COM-11, Appendix G, Table G-1); equipping each WTG, OSS, and met tower position with AIS to indicate positions to mariners (COM-12, Appendix G, Table G-1); and communicating with offshore fishermen while they are at sea (COM-17, Appendix G, Table G-1). Collectively, the navigational hazards and risk of allisions to fishing vessels posed by the Proposed Action are expected to have long-term, adverse impacts on commercial and for-hire recreational fisheries.

As described in Section 3.6.1.3, the presence of gear entanglement hazards and navigational hazards associated with structures in the WTAs may cause some fishermen to seek alternative fishing grounds, switch the species they target or the gear they use, or leave the fishery altogether. Each of these scenarios requires adaptive behavior and risk tolerance, traits that are not universally shared by all fishermen (O'Farrell et al 2019). Fishermen who are willing to seek alternate fishing grounds may experience increased operating costs and/or lower revenue. Fishermen who switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishermen to land their catch in different ports (Papaioannou et al. 2021), which could increase operational costs depending on where the port is located.

Fishing vessel operators who are displaced from fishing grounds within offshore wind areas and are unable to find alternative fishing locations would experience long-term revenue losses. BOEM estimated the amount of commercial fishing revenue that would be exposed in the Lease Area. As described in Section 3.6.1.3, these estimates of revenue exposure should not be interpreted as measures of actual economic impact, which would depend on many factors. Table 3.6.1-36 depicts the average annual revenue exposure in the Lease Area by FMP fishery from 2020 through 2030 based on data from 2007 through 2018. The most revenue at risk is during the construction and installation of the Proposed Action, which is the focal period of this table, but revenue exposure would occur during the O&M phase as well, which would extend well beyond 2030. The table was limited to a 10-year period that does not include most of the O&M phases of the Proposed Action because of uncertainty stemming from changes in fish distributions and adjustments in fishing practices. Therefore, this table should be regarded as demonstrative rather than predictive. The average annual commercial fishing revenue exposure is estimated to be $968,010 across all FMP and non-FMP fisheries and represents about 0.08 percent of the total average annual revenue of these fisheries in the geographic analysis area. The largest impacts in terms of exposed revenue as a percentage of total revenue in the geographic analysis area would be in the Surfclam and Ocean Quahog FMP fishery (1.96 percent), followed by the Bluefish (0.06 percent), Spiny Dogfish (0.05 percent), and Summer Flounder, Scup, Black Sea Bass (0.04 percent) FMP fisheries.

Table 3.6.1-36. Annual average commercial fishing revenue exposed to the Lease Area, 2020–2030

FMP Fishery	Peak Annual Revenue	Average Annual Revenue	Average Annual Exposed Revenue as a Percentage of Total Revenue from the Geographic Analysis Area
Atlantic Herring	$1,337	$608	< 0.01
Bluefish	$2,539	$1,154	0.06
Golden Tilefish	$30	$14	< 0.01
Highly Migratory Species	$233	$106	< 0.01
Mackerel, Squid, Butterfish	$16,198	$7,363	0.01
Monkfish	$7,555	$3,434	0.02
Multispecies Large-Mesh	$333	$151	< 0.01
Multispecies Small-Mesh	$462	$210	< 0.01
Red Crab[1]	$593	$269	< 0.01
River Herring	$10	$4	0.01
Sea Scallop	$316,091	$143,678	0.03
Skate	$4,193	$1,906	0.03
Spiny Dogfish	$3,556	$1,616	0.05
Summer Flounder, Scup, Black Sea Bass	$38,788	$17,631	0.04
Surfclam and Ocean Quahog	$1,684,937	$765,881	1.96
None: Unmanaged[2]	$52,769	$23,986	0.01
All FMP and non-FMP Fisheries	**$2,129,623**	**$968,010**	**0.08**

Sources: Developed using data from NMFS 2022f.
[1] Red Crab: data only encompass 2016, 2017, and 2018.
[2] Includes revenues from all species not assigned to an FMP.
Notes: Revenue is in nominal dollars and is estimated based on the annual average revenue by FMP from 2007 through 2018.

Fishing vessel operators who have historically derived a large percentage of their total revenue from the Lease Area and choose to avoid fishing there would experience lost revenue if they were unable to find alternative fishing grounds. Further, revenue losses may be compounded if displacement of fishing effort causes fishing vessels to become concentrated into smaller areas, potentially leading to reduced catches at the individual level. Several commercial fishing vessels fish heavily in the Lease Area; the highest percentage of total annual revenue attributed to catch within the Lease Area for an individual commercial permit holder was 62 percent in 2013. Three quarters of the vessels fishing in the area derived less than 0.34 percent of their total revenue from the area in 2008 through 2019. Considering the revenue risk across ports, together with the number of vessels and fishing activity that would be affected by Atlantic Shores South, the impacts on other fishing industry sectors, including seafood processors and distributors and shoreside support services, would be long term and moderate to major, depending on the fishery in question.

Changes in fishing activity resulting from the presence of offshore wind structures would likely result in impacts on shoreside support services (e.g., seafood processing, fuel, ice). Fishing communities that derive a high percentage of revenue from the Lease Area and have a high reliance on the commercial fishing industry are expected to experience the greatest impacts from reduced demand for shoreside support services. As summarized in Table 3.6.1-24, fishing communities that generate a relatively large percentage of their revenue from the Lease Area and have a high reliance on the commercial fishing industry include Barnegat and Cape May in New Jersey.

The presence of structures in the Lease Area could cause fishing vessel route detours, leading to direct and indirect impacts on fishermen, fishing ports, seafood processing facilities, and other shoreside support industries. Fishing vessels transiting between ports in different states may be particularly impacted if they decided to make vessel route detours that avoid the Lease Area. For instance, NYSERDA, New York State Department of Environmental Conservation, and RODA collected information on transit patterns of commercial fishermen from January 2019 through January 2020 and determined that vessels frequently transit between ports in New Jersey, Cape May in particular, and ports in New York State (NYSERDA 2020). A key driver of these transit patterns stems from New York ports having insufficient docking and unloading facilities, seafood processing capacity, or land-based transportation networks to efficiently get the seafood to market. This has resulted in some New York fishing vessels landing their catch in other states, like surfclam fishermen landing in New Jersey because New York does not have an appropriate processing facility. Where a fisherman chooses to land their catch also depends on market price, proximity to fishing grounds, permit requirements, and other factors. Because of these existing challenges, infringement on vessel transit lanes by offshore wind structures could make it more challenging or costly for fishermen to land their catch in New Jersey, which may have adverse effects on shoreside support industries.

Revenue exposure of for-hire recreational fishing in the WTAs was summarized for the period of 2011 through 2020 in Section 3.6.1.1. During this period, more than 99 percent of the for-hire angler and vessel trips made to the combined Project 1 and Project 2 WTAs originated from ports in New Jersey (see Table 3.6.1-27). From 2010 through 2018, an annual average of approximately $19,000 was generated from for-hire recreational fishing trips to the combined Project 1 and Project 2 WTAs, which represented approximately 0.03 percent of the revenue generated by the for-hire recreational fishery in the state of New Jersey (see Table 3.6.1-31).

The scour protection and cable protection would convert soft-bottom habitat to hard-bottom habitat. It is estimated that installation of these structures under the Proposed Action would provide 885 acres (358 hectares) of hard-bottom habitat. The introduction of hard-bottom habitat may result in adverse, beneficial, or mixed impacts, depending on the species and location. Habitat conversion from the Proposed Action would result in the displacement of soft-bottom species, such as squid and winter flounder, in the area immediately surrounding the structures. Further, habitat conversion would result in the loss of soft-bottom benthic features that occur throughout the Offshore Project area, including sand waves, sand ridges, and shoal formations. These features provide habitat complexity that is used by benthic and finfish communities for refuge, spawning, and foraging, and are often identified as prime fishing areas by commercial and recreational fishermen. The introduction of hard-bottom, structured habitat may also attract structure-oriented species that are targeted in recreational fisheries, such as American lobster, Atlantic cod, black sea bass, scup, and striped bass (Guida et al. 2017). Highly migratory pelagic predators that are targeted in recreational fisheries (e.g., tuna, billfish, sharks) may also be attracted to the prey that aggregate around the WTG foundations. These impacts could provide enhanced opportunities to for-hire recreational fisheries but could also cause space-use conflicts with commercial fisheries. Although local distributions of squid and finfish may respond to the presence of foundations, no stock-level effects are expected. Collectively, habitat conversion caused by the Proposed Action is expected to have localized, long-term impacts that would be adverse for commercial fisheries and beneficial to for-hire recreational fisheries.

The hard-bottom habitat created by the Proposed Action may provide forage and refuge for some migratory finfish and shellfish that are valued in fisheries, such as black sea bass, lobster, monkfish, and summer flounder. Highly migratory pelagic predators are also likely to encounter the WTG foundations and may be attracted by the prey that aggregate around the vertical structures for shelter, foraging, or other reasons. Highly migratory species may use offshore structures as navigational landmarks (Taormina et al. 2018). These behavioral effects may affect the migrations of individual fish, but they are not expected to have broad impacts on migration. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migrations (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Collectively, the impact on migratory patterns from structures introduced by the Proposed Action is expected to be negligible on commercial and for-hire recreational fisheries.

The previously described impacts from the presence of structures under the Proposed Action, including navigational hazards and increased risk of damage or loss of fishing gear, are likely to cause some displacement of fishing activity from traditional fishing grounds. Commercial fishing vessels have well-established and mutually recognized traditional fishing locations, and the displacement of fishing activity outside of the Project area may result in space-use conflicts among fishermen as other areas are encroached upon. BOEM expects that space-use conflicts would be higher in fisheries that target less-mobile species, such as crab, lobster, scallop, and surfclam, and in fisheries where regulations constrain where vessels can fish. Fisheries that target less-mobile species are among the most valuable in the Lease Area: from 2010 to 2019, the average annual revenue generated by the Surfclam, Ocean Quahog FMP and Sea Scallop FMP fisheries in the Lease Area was $1.1 million, or approximately 90 percent of the total revenue generated in the Lease Area. Because of constraints on these fisheries, economic losses caused by displacement from traditional fishing grounds would not necessarily be compensated for by revenue earned on alternative fishing grounds. Finally, as described above, fish aggregation around the vertical habitat provided by the WTGs and resulting increases in recreational fishing effort around the WTGs could contribute to space-use conflicts with the commercial fisheries within the Lease Area. Collectively, space-use conflicts that would result from the Proposed Action are expected to have long-term, adverse impacts on commercial and for-hire recreational fisheries. BOEM expects that the presence of structures associated with the Proposed Action would cause long-term, localized, moderate to major impacts on commercial fisheries and minor to moderate impacts on for-hire recreational fisheries. Impacts are expected to primarily result from reduced access to traditional fishing grounds and increased risk of fishing gear damage or loss. As described above, variation in the capacity of fishermen to adapt to change associated with offshore wind development would cause variation in the magnitude of impacts across the fishing industry.

Traffic: The Proposed Action would result in increased vessel traffic due to vessels transiting to and from the Project area during construction, O&M, and decommissioning. Construction support vessels, including vessels carrying assembled WTGs or WTG components, would be present in the waterways between the Lease Area and the ports used during construction. Atlantic Shores expects up to 51 vessels to be used during construction, though a maximum of 16 vessels are expected to operate at one time for a given construction activity. Construction vessels would make an estimated 1,745 trips to the Project area, including trips from the future New Jersey Wind Port, Paulsboro Marine Terminal, and Repauno Port and Rail Terminal in New Jersey; Portsmouth Marine Terminal in Virginia; and the Port of Corpus Christi in Texas (see Section 3.6.6, *Navigation and Vessel Traffic)*. Impacts associated with vessel traffic during the O&M phase would be lower because of lower vessel activity; Atlantic Shores generally expects 5 to 11 maintenance vessels to operate at a given time, though up to 22 vessels may be required in some repair scenarios. Maintenance vessels would make an estimated 1,861 trips to the Project area, the majority of which would originate from the O&M facility in Atlantic City, with a smaller number originating from the New Jersey Wind Port. As described in Section 3.6.1.3, increased vessel traffic could increase congestion, delays at ports, and the risk for collisions with fishing vessels. Furthermore, the presence of construction vessels would temporarily restrict fishing operations in the Lease Area and the offshore export cable corridors. Fishing vessels transiting between ports and the Project area would be able to avoid Atlantic Shores South vessels and restricted safety zones though adjustments to navigation. Atlantic Shores would implement measures to avoid interactions between Atlantic Shores South vessels and fishing vessels, including development of a website that contains real-time vessel tracking chart and vessel schedules (COM-16, Appendix G, Table G-1) and employment of a Marine Coordinator to monitor daily vessel movements, implement of communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones (COM-20, Appendix G, Table G-1). Any impacts on commercial and for-hire recreational fisheries from vessel traffic would be localized and temporary, occurring primarily in the Project area during the construction phase.

BOEM expects that increased vessel traffic associated with the Proposed Action would cause long-term, localized, moderate impacts on commercial and for-hire recreational fisheries.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* improvements to the existing marine infrastructure within an approximate 20.6-acre (8.3-hectare) site at the Atlantic City, New Jersey, Inlet Marina area are planned in connection with construction of the O&M facility of the Proposed Action. The connected action includes construction of a new 356-foot (109-meter) bulkhead composed of steel or composite vinyl sheet piles to replace the existing and deteriorating 250-foot (76-meter) bulkhead. Additionally, the connected action will include maintenance dredging at the site to be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. Atlantic Shores is proposing to implement the construction of the new bulkhead and the City of Atlantic City would complete the maintenance dredging at the site.

BOEM expects the connected action to affect commercial fisheries and for-hire recreational fishing through the following primary IPFs.

Noise: Installation of sheet piles for construction of the new bulkhead may include impact or vibratory pile driving and vessel operation, which would generate intermittent noise during the construction period. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

The connected action would include installation of 16-inch (0.4-meter) steel or composite vinyl sheet piles. Sheet piles would be installed using a vibratory hammer. As described in Section 3.6.1.3, noise generated by pile driving can cause injury or mortality to fish over a small area around each pile and can cause temporary stress and behavioral changes over a larger area. The radius for injurious impacts from driving of 16-inch (0.4-meter) steel pipe piles would be much smaller than that of 49-foot (15-meter) monopiles. Because of the relatively small footprint of injurious sound and the ability for most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause fishery-level impacts on fish stocks. Invertebrates are generally less sensitive to sound than fish, such that injurious sound is expected to occur only close to pile driving and is not expected to cause fishery-level impacts on shellfish stocks. Because there is minimal fishing activity near the marina where the connected action would be sited, displacement of fish and invertebrates associated with behavioral impacts of noise is not expected to result in measurable revenue loss for commercial or recreational fisheries.

Construction vessel activity would also generate noise during connected action activities. Vessels associated with the connected action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in finfish and invertebrates. However, because behavioral responses to vessel noise would be localized and temporary, ceasing once the vessel leaves the area, they are not expected to result in fishery-level impacts.

Port utilization: The connected action would aid in the conversion of a retired marine terminal to an active O&M facility that would support the offshore wind industry, thereby resulting in an increase in port utilization. The connected action would be sited in Atlantic City, which generates approximately $19 million in annual revenue from commercial fisheries (see Table 3.6.1-3) and is classified as having a high level of commercial fisheries engagement (see Table 3.6.1-24). Commercial and for-hire recreational fishing vessels traveling to and from Atlantic City may experience delays from increased vessel traffic associated with the connected action. Impacts from port utilization associated with the Proposed Action are expected to be localized and long term, occurring during the construction and installation and O&M periods.

As described in Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, dredging and dredge material management from the connected action may affected finfish and invertebrates that are targeted in commercial and for-hire recreational fisheries through organism mortality, direct disturbance and modification of bottom habitat, and sediment suspension and deposition. Demersal and pelagic fish and invertebrates would likely avoid the dredge, but benthic invertebrates and fish with benthic life stages (e.g., eggs, larvae) may be captured by the dredge, possibly resulting in mortality. The potential loss of individual fish and invertebrates from mortality associated with dredging is not expected to cause fishery-level effects for any species. Because there is minimal fishing activity near the marina where the connected action would be sited, displacement of fish and invertebrates associated with dredging is not expected to result in measurable revenue loss for commercial or recreational fisheries.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned activities include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredge material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; regulated fishing effort; global climate change; and planned offshore wind development. Ongoing and planned offshore wind activities in the geographic analysis area include the construction and installation, O&M, and decommissioning of 33 planned offshore wind projects. Impacts on commercial and for-hire recreational fishing from the Proposed Action and other ongoing and planned activities include anchoring, cable emplacement, noise, port utilization, presence of structures, and vessel traffic.

Anchoring: The incremental contributions of the Proposed Action to the cumulative anchoring effects of ongoing and planned activities would be appreciable, given the relatively large area that would be affected by the Proposed Action. The 714 acres (289 hectares) of seafloor disturbed by anchoring under the Proposed Action would represent 9 percent of the estimated 8,056 acres (3,260 hectares) of seafloor that would be disturbed on the OCS by existing and planned offshore wind development activities, including the Proposed Action.

Cable emplacement and maintenance: The incremental contributions of the Proposed Action to the cumulative cable emplacement impacts of ongoing and planned activities would be noticeable. The 4,942 acres (2,000 hectares) of seabed disturbance associated with the Proposed Action represents approximately 5 percent of the 101,472 acres (41,064 hectares) of seabed expected to be disturbed on the OCS from existing and planned offshore wind development activities, including the Proposed Action (Appendix D, Table D.A2-2).

Noise: The incremental contributions of construction and installation of the Proposed Action to the cumulative noise impacts associated with ongoing and planned activities would be noticeable. The loudest sources of noise are expected to be pile driving, assuming piled foundations are selected, followed by vessels. The 211 structures for the Proposed Action represent 7 percent of the 3,226 offshore wind structures that would be installed on the OCS for existing and planned offshore wind development activities, including the Proposed Action (Appendix D, Table D.A2-2).

Port utilization: The incremental contributions of the Proposed Action to the cumulative port utilization impacts associated with ongoing and planned activities would be noticeable. There are several major fishing ports in the geographic analysis area (see Table 3.6.1-3) that have been identified as potential ports to support offshore wind energy construction or operations, including Atlantic City, Hampton Roads, Montauk, and New Bedford (BOEM 2022). None of the major fishing ports in the geographic analysis area are being slated for expansion for the Proposed Action.

Presence of structures: The incremental contributions of the Proposed Action to the cumulative impacts from the presence of structures associated with ongoing and planned activities would be noticeable. The 211 structures for the Proposed Action represent 7 percent of the 3,226 offshore wind structures anticipated on the OCS for existing and planned offshore WTAs, including the Proposed Action (Appendix D, Table D.A2-2). The 869 acres (352 hectares) of scour and cable protection installed under the Proposed Action would represent approximately 10 percent of the 8,297 acres (3,358 hectares) of scour and cable protection anticipated on the OCS for planned offshore wind farms, including the Proposed Action (Appendix D, Table D.A2-2).

Traffic: The incremental contributions of the Proposed Action to the cumulative impacts of vessel traffic associated with ongoing and planned activities would be noticeable given the large volume of existing vessel traffic in the geographic analysis area.

Conclusions

Impacts of Alternative B – Proposed Action. Project construction and installation, O&M, and decommissioning could affect port and fishing access, as well as transit and harvesting activities, fishing gear interactions, and target species catch. BOEM anticipates that the adverse impacts of the Proposed Action on commercial fisheries and for-hire recreational fishing would vary by fishery and fishing operation because of differences in target species abundance in the Project Area, gear type, and predominant location of fishing activity. Some of the fishing vessels that generate a large percentage of their total revenue in the WTAs may choose to avoid this area once the Project becomes operational. If these fishing vessels are unable to find suitable alternative fishing locations, they could experience long-term, major disruptions. However, it is expected that most fishing vessels would only have to adjust somewhat in response to impacts of the Proposed Action. Therefore, BOEM expects that the impacts resulting from the Proposed Action would range from **moderate** to **major** on commercial fisheries and **minor** to **moderate** on for-hire recreational fisheries, depending on the fishery and fishing vessel. This impact rating is driven mostly by long-term impacts from the presence of structures (e.g., cable protection measures and foundations), including navigational hazards, gear loss and damage, and space use conflicts, which are expected to result in revenue loss for some commercial and recreational fishermen. Additionally, the impacts of the Proposed Action could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations because of the artificial reef effect.

BOEM expects that the connected action alone would have **negligible** impacts on commercial fisheries and for-hire recreational fishing.

Cumulative Impacts of Alternative B – Proposed Action. The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities and other planned offshore wind activities. BOEM anticipates that the cumulative impacts of these activities would result in **major** impacts on commercial and for-hire recreational fisheries in the geographic analysis area. This impact rating is driven mostly by reduced stock levels from ongoing fishing mortality because of regulated fishing effort, changes in the abundance and distribution of fish and invertebrates associated with ongoing climate change, and permanent impacts from the presence of structures associated with planned offshore wind projects. Additionally, the cumulative impacts of the could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations because of the artificial reef effect. The Proposed Action would contribute to the overall impact rating primarily through permanent impacts associated with the presence of structures, including navigational hazards, gear loss and damage, and space-use conflicts. The overall impacts on commercial and for-hire recreational fisheries would be **major** because the fishing industry would experience unavoidable disruptions beyond what is normally acceptable, but mitigation, including financial compensation and uniform spacing and layout across adjacent projects, could reduce impacts if adopted for planned offshore wind projects.

3.6.1.6 Impacts of Alternatives C, D, and E on Commercial Fisheries and For-Hire Recreational Fishing

Impacts of Alternatives C, D, and E. Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), and E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would include micrositing or a reduction of the number of WTGs compared to the Proposed Action. As detailed in Section 2.1.3, under Alternative C, up to 29 WTGs, 1 OSS, and the associated interarray cables would be removed to avoid and minimize impacts on sensitive habitats. As detailed in Section 2.1.4, under Alternative D, up to 31 WTGs sited closest to shore would be removed in order to reduce visual impacts. As detailed in Section 2.1.5, under Alternative E, modifications would be made to the wind turbine array layout to create a setback between WTGs in the lease areas of Atlantic Shores South (OCS-A 0499) and Ocean Wind 1 (OCS-A 0498) to reduce impacts on existing ocean uses, including commercial and recreational fishing. Alternative E would allow for a setback of 0.81 nautical mile (1,500 meters) to 1.08 nautical mile (2,000 meters) by removing or micrositing up to 4 to 5 WTG positions from the southern boundary of Project 1.

Offshore construction and installation activities associated with Alternatives C, D, and E would not differ from the Proposed Action, but the number of WTGs that are installed would potentially be reduced by as few as 4 WTGs under Alternative E to as many as 31 WTGs under Alternative D. Any reduction in the number of WTGs may also reduce the length of the interarray cables. A reduction in the number of WTGs and the length of the interarray cables would result in a reduction in impacts associated with construction and installation, including anchoring, cable emplacement, noise, and vessel traffic.

Impacts of offshore O&M activities of Alternatives C, D, and E on commercial and for-hire recreational fisheries would be slightly reduced relative to the Proposed Action. The removal of 4 to 5 WTGs from the southern boundary of Project 1 under Alternative E would allow for a setback area that would enable fishing vessels to transit between the Ocean Wind 1 and Atlantic Shores South lease areas more safely and efficiently, thereby minimizing navigational hazards and reducing transit costs incurred by fishers relative to the Proposed Action. The 2- to 15-percent reduction in the number of WTGs that would be installed under Alternatives C, D, and E would reduce the number of structures in the Lease Area, which would primarily affect commercial fisheries by reducing the navigation hazards and risk of gear loss or damage associated with transiting through or fishing in the Lease Area. However, the contiguous structure-free area that would be added to the Lease Area by the removal of WTGs under these alternatives would be small, and any additional revenue realized by the commercial fishery would likely be minimal and would be dependent on the targeted species that may be in that area and whether commercial fishermen are willing to fish that part of the Lease Area. The reduction in the number of WTGs in the Lease Area would also reduce the artificial reef effect, slightly decreasing benefits from this effect for for-hire recreational fishing but also decreasing potential vessel conflicts with commercial fishing vessels that transit or fish within the Lease Area. Alternative C1 would avoid and minimize the potential impacts on Lobster Hole, a designated recreational fishing area, by removing up to 16 WTGs, 1 OSS, and associated interarray cables (see Figure 2.1-7), thereby producing a benefit to for-hire recreational fisheries relative to the Proposed Action.

Cumulative Impacts of Alternatives C, D, and E. The contribution of Alternatives C, D, or E to the impacts of individual IPFs from ongoing and planned activities would be slightly reduced relative to the Proposed Action. The cumulative impacts on commercial and for-hire recreational fisheries of ongoing and planned activities in combination with Alternatives C, D, or E would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternatives C, D, and E. The anticipated minor to major impacts of individual IPFs associated with Alternatives C, D, and E would be slightly reduced relative to those of the Proposed Action. However, any additional revenue realized by commercial fisheries would likely be minimal, and benefits of the artificial reef effect for for-hire recreational fishing would be reduced. When considering all of the IPFs, the adverse impact on commercial fisheries would still be **moderate** to **major and minor** to **moderate** for for-hire recreational fisheries and could include **minor beneficial** impacts on for-hire recreational fisheries.

Cumulative Impacts of Alternatives C, D, and E. BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternatives C, D, or E, would result in **major** impacts on commercial and for-hire recreational fisheries and could include **minor beneficial** impacts on for-hire recreational fisheries, as described in Section 3.6.1.5.

3.6.1.7 Impacts of Alternative F on Commercial Fisheries and For-Hire Recreational Fishing

Impacts of Alternative F. As detailed in Section 2.1.6, Alternative F (Foundation Structures) allows for an evaluation of impacts associated with specific foundation types, whereas the Proposed Action evaluated a variety of foundation types. Under Alternative F1, monopile or piled jacked foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (monopile or piled jacket), up to 5 medium OSSs (piled jacket), or up to 4 large OSSs (piled jacket) for Project 1 and Project 2. Under Alternative F2, mono-bucket, suction bucket jacket, or suction bucket tetrahedron base foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (mono-bucket or suction bucket jacket), up to 5 medium OSSs (suction bucket jacket), or up to 4 large OSSs (suction bucket jacket), for Project 1 and Project 2. Under Alternative F3, gravity-pad tetrahedron or GBS foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs, up to 5 medium OSSs, or up to 4 large OSSs, with GBS for Project 1 and Project 2.

Though all potential offshore activities under Alternative F were evaluated under the Proposed Action, some sub-alternatives of Alternative F may exclude some activities evaluated under the Proposed Action. Offshore construction and installation activities would not differ between the Proposed Action and Alternative F1. However, in contrast to the Proposed Action, impact pile driving would not be conducted during offshore construction and installation of Alternative F2 (suction bucket foundations) and Alternative F3 (gravity-based foundations). The avoidance of pile-driving noise impacts would slightly reduce the overall construction and installation impacts on commercial and for-hire recreational fisheries under Alternatives F2 and F3 compared to the Proposed Action.

Though offshore O&M activities would not differ between Alternative F and the Proposed Action, some sub-alternatives may result in reduced habitat conversion compared to the Proposed Action. Alternative F2 (suction bucket foundations) would result in the greatest area of habitat conversion from scour protection and was evaluated under the Proposed Action. Alternative F1 (piled foundations) and Alternative F3 (gravity-based foundations) would result in a reduction in scour protection, compared to the Proposed Action and Alternative F2. Such reductions would reduce O&M impacts from the presence of structures on commercial and for-hire recreational fisheries. Less scour protection would result in a lower risk of gear entanglement within the Lease Area for commercial fisheries that deploy mobile, bottom-oriented gear (i.e., dredges and trawls) compared to the Proposed Action and Alternative F2. However, less scour protection would also result in a reduced artificial reef area, thereby reducing benefits to for-hire recreational fisheries compared to the Proposed Action and Alternative F2. Given that the presence of structures is expected to have adverse impacts on commercial fisheries that outweigh the beneficial impacts on for-hire recreational fisheries, the reduction in scour protection under Alternatives F1 and F3 is expected to result in slightly reduced overall impacts on commercial and for-hire recreational fisheries compared to the Proposed Action and Alternative F2.

Cumulative Impacts of Alternative F. The contribution of Alternatives F1 or F3 to the impacts of individual IPFs from ongoing and planned would be slightly reduced relative to the Proposed Action. Alternative F2 would result in the greatest area of habitat conversion from scour protection and was evaluated under the Proposed Action. The cumulative impacts on commercial and for-hire recreational fisheries of ongoing and planned activities in combination with Alternatives F1, F2, or F3 would be the same level as described under the Proposed Action.

Conclusions

Impacts of Alternative F. Impacts of Alternative F2 would not be measurably different from the Proposed Action, whereas impacts of Alternatives F1 and F3 would be slightly reduced compared to the Proposed Action because of a reduction in the amount of scour protection in the Lease Area. As is the case with the Proposed Action, the individual IPFs associated with Alternatives F1, F2, and F3 would result in **minor** to **major** impacts and an overall **moderate** to **major** impact on commercial and for-hire recreational fisheries with the potential for **minor beneficial** impacts on for-hire recreational fisheries.

Cumulative Impacts of Alternative F. BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternatives F1, F2, and F3, would result in **major** impacts on commercial and for-hire recreational fisheries and could include **minor beneficial** impacts on for-hire recreational fisheries, as described in Section 3.6.1.5.

3.6.1.8 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed in Table 3.6.1-37 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.6.1-37. Proposed mitigation measures – commercial fisheries and for-hire recreational fishing

Mitigation Measure	Description	Effect
Artificial reef buffer for turbines	Atlantic Shores must remove a single turbine approximately 150–200 feet (46–61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site).	This measure would reduce long-term impacts on for-hire recreational fishing operations that have historically relied on the Atlantic City Artificial Reef Site.
Cable maintenance	In conjunction with cable monitoring, Atlantic Shores will develop and implement a Cable Maintenance Plan that requires prompt remedial burial of exposed and shallow-buried cable segments, review to address repeat exposures, and a process for identifying when cable burial depths reach unacceptable risk levels.	This measure would reduce the risk of interactions between fishing gear and shallow-buried cable segments.
Incident reporting	Provide written notification of incidents (e.g., gear interactions, anchor strikes, vessel allisions, property damage less than $25,000) that fall below or are simply not captured by the regulatory thresholds outlined in 30 CFR 585.832 and 585.833. Summaries could be provided to BOEM/BSEE and USACE during construction, operations, and decommissioning. The purpose is to increase awareness of the frequency and circumstances surrounding these incidents and assess whether any actions are needed to address them.	This measure would enable BOEM to determine whether changes to compensation thresholds are warranted.
Fisheries compensation/ mitigation fund	No later than 1 year after the approval of the COP, Atlantic Shores will establish a compensation/mitigation fund (Fund) consistent with BOEM's draft[3] *Guidance for Mitigating*	This measure would mitigate for economic impacts of the Proposed Action on commercial and recreational fisheries and

[3] Draft Guidance shall be superseded by Final Guidance, if Final Guidance is published by the signing of the ROD for the Project.

	Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 (Guidance) to compensate commercial and for-hire recreational fishermen for loss of income due to unrecovered economic activity resulting from displacement from fishing grounds due to project construction and operations and to shoreside businesses for losses indirectly related to the Project. For losses to commercial and for-hire recreational fishermen, the Fund will be based on the revenue exposure for fisheries based out of ports listed in Table 3.6.1-15. For losses to shoreside businesses, the Atlantic Shores will analyze the impacts on shoreside seafood businesses adjacent to ports listed in Table 3.6.1-15. Shoreside business impacts may include (but are not limited to): • Fishing gear suppliers and repair services; • Vessel fuel and maintenance services; • Ice and bait suppliers; • Seafood processors and dealers; and • Wholesale distributors. Atlantic Shores will be required to provide BOEM with their analysis (including any model outputs, such as an IMPLAN model or other economic report) verifying the exposed impacts on shoreside businesses and services. Atlantic Shores must submit to BOEM a report that includes (1) a description of the structure of the Fund and its consistency with BOEM's draft Guidance and (2) an analysis of the impacts of the Project on shoreside businesses, for a 45-day review and comment period at least 90 days prior to establishment of the Fund. Atlantic Shores must resolve all comments on the report to BOEM's satisfaction before implementation of the Fund. Atlantic Shores must then submit to BOEM evidence of the implementation of the Fund, including: • A description of any implementation details not covered in the report to BOEM regarding the mechanism established to compensate for losses to commercial and for-hire recreational fishermen and related shoreside businesses resulting from all phases of the project development on the Lease Area (pre-construction, construction, operation, and decommissioning); • The Fund charter, including the governance structure, audit and public reporting procedures, and standards for paying compensatory mitigation for impacts to	associated shoreside support services.

Mitigation Measure	Description	Effect
	fishers and related shoreside businesses from lease area development; and • Documentation regarding the funding account, including the dollar amount, establishment date, financial institution, and owner of the account.	
Boulder Relocation Plan	Atlantic Shores will develop and implement a boulder relocation plan to ensure potential impacts to essential fish habitat and commercial and recreational fisheries are adequately minimized.	This measure would reduce impacts to habitat of species targeted in fisheries and reduce the risk of gear damage and/or loss associated with relocated boulders.

3.6.1.9 Comparison of Alternatives

Alternatives C, D, E, and F would have similar or slightly reduced adverse and beneficial impacts on commercial and for-hire recreational fisheries relative to the Proposed Action; however, the overall impact designations would not change under any of the alternatives. This section provides a comparison of the alternatives relative to the Proposed Action and in terms of which alternatives would provide the greatest reduction in adverse impacts on commercial and for-hire recreational fisheries.

Relative to the Proposed Action, Alternatives C, D, and E would result in the removal of WTGs from the Lease Area and are expected to provide a reduction in potential adverse impacts on commercial fisheries compared to other alternatives, including the Proposed Action. However, the removal of WTGs under these alternatives would also reduce benefits associated with enhanced recreational fishing around the WTGs. Alternative D would provide the greatest reduction in adverse impacts on commercial fisheries compared to other alternatives because it would potentially remove up to 31 WTGs, the most of any alternative, within a contiguous area, which would potentially provide a meaningful expansion of commercial fishing activity. However, Alternative D would also result in the greatest reduction in potential beneficial impacts on recreational fishing because it would remove WTGs that are closest to shore and therefore most accessible to recreational fishers. Alternative E would provide the next greatest reduction in adverse impacts on commercial fisheries compared to other alternatives because it would allow for a setback between the Atlantic Shores South and Ocean Wind 1 Lease Areas and would remove WTGs from a contiguous area within Atlantic Shores South. The setback is expected to produce a small reduction in adverse impacts because it may provide fishing vessels with an alternate route through the Lease Area, and the removal of WTGs from a contiguous area would potentially provide an expansion of area for commercial fishing. Under Alternative E, there would be a reduction in adverse impacts on commercial fisheries because it would allow the removal of up to 5 WTGs. Alternative C would also remove WTGs from a contiguous area within the Lease Area, which would potentially provide a meaningful expansion of commercial fishing activity, but over smaller areas. Therefore, Alternative C is expected to result in a smaller reduction in adverse impacts on commercial fisheries than Alternative D or E.

Sub-alternatives F1 and F3 would result in reductions in the area of scour protection compared to the Proposed Action. The reduction in scour protection would reduce the risk of gear entanglement to commercial fishing vessels that operate mobile, bottom-oriented gear within the Lease Area but would also reduce the area of artificial reef habitat that would be available to recreational fishers. These sub-alternatives are expected to result in a reduction in adverse impacts on commercial fisheries and an increase in adverse impacts on for-hire recreational fisheries compared to the Proposed Action. Sub-alternative F2 would result in the greatest area of scour protection, thereby resulting in the greatest reduction in fishable area for actively towed gears. This sub-alternative is expected to result in an increase in adverse impacts on commercial fisheries compared to the Proposed Action.

3.6.2 Cultural Resources

This section discusses potential impacts on cultural resources from the proposed Project, alternatives, and ongoing and planned activities in the cultural resources geographic analysis area. The cultural resources geographic analysis area, as shown on Figure 3.6.2-1, is equivalent to the Project's APE, as defined in the implementing regulations for National Historic Preservation Act (NHPA) Section 106 at 36 CFR Part 800 (Protection of Historic Properties). *See Appendix I, Finding of Adverse Effect for the Atlantic Shores Offshore Wind South Project Construction and Operations Plan*, Section I.1.3, for a complete description of the delineated Project APE. In 36 CFR 800.16(d), the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist." BOEM (2020) defines the Project APE as the following:

- The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities, constituting the marine portion of the APE;
- The depth and breadth of terrestrial areas potentially impacted by any ground-disturbing activities, constituting the terrestrial portion of the APE;
- The viewshed from which renewable energy structures, whether located offshore or onshore, would be visible, constituting the visual portion of the APE; and
- Any temporary or permanent construction or staging areas, both onshore and offshore, which may fall into any of the above portions of the APE.

The phrase *cultural resource* refers to a physical resource valued by a group of people. A resource can date to the pre-Contact period (i.e., the time prior to the arrival of Europeans in North America), post-Contact period, or both. The range of common resource types includes archaeological sites, buildings, structures, objects, districts, and traditional cultural properties (TCPs) and may be listed on national, state, or local historic registers or be identified as being important to a particular group during consultation. Federal, state, and local regulations recognize the public's interest in cultural resources. Many of these regulations, including NEPA and NHPA, require a project to consider how it might have impacts on significant cultural resources. For a more detailed discussion of cultural resource types, see Section 3.6.2.1, *Description of the Affected Environment and Future Baseline Conditions*.

The phrase *historic property*, as defined in the NHPA (54 U.S.C. 300308), refers to any "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places [NRHP], including artifacts, records, and material remains related to such a property or resource." The term *historic property* also includes National Historic Landmarks (NHLs), as well as properties of traditional religious and cultural importance to tribal nations that meet NRHP criteria.

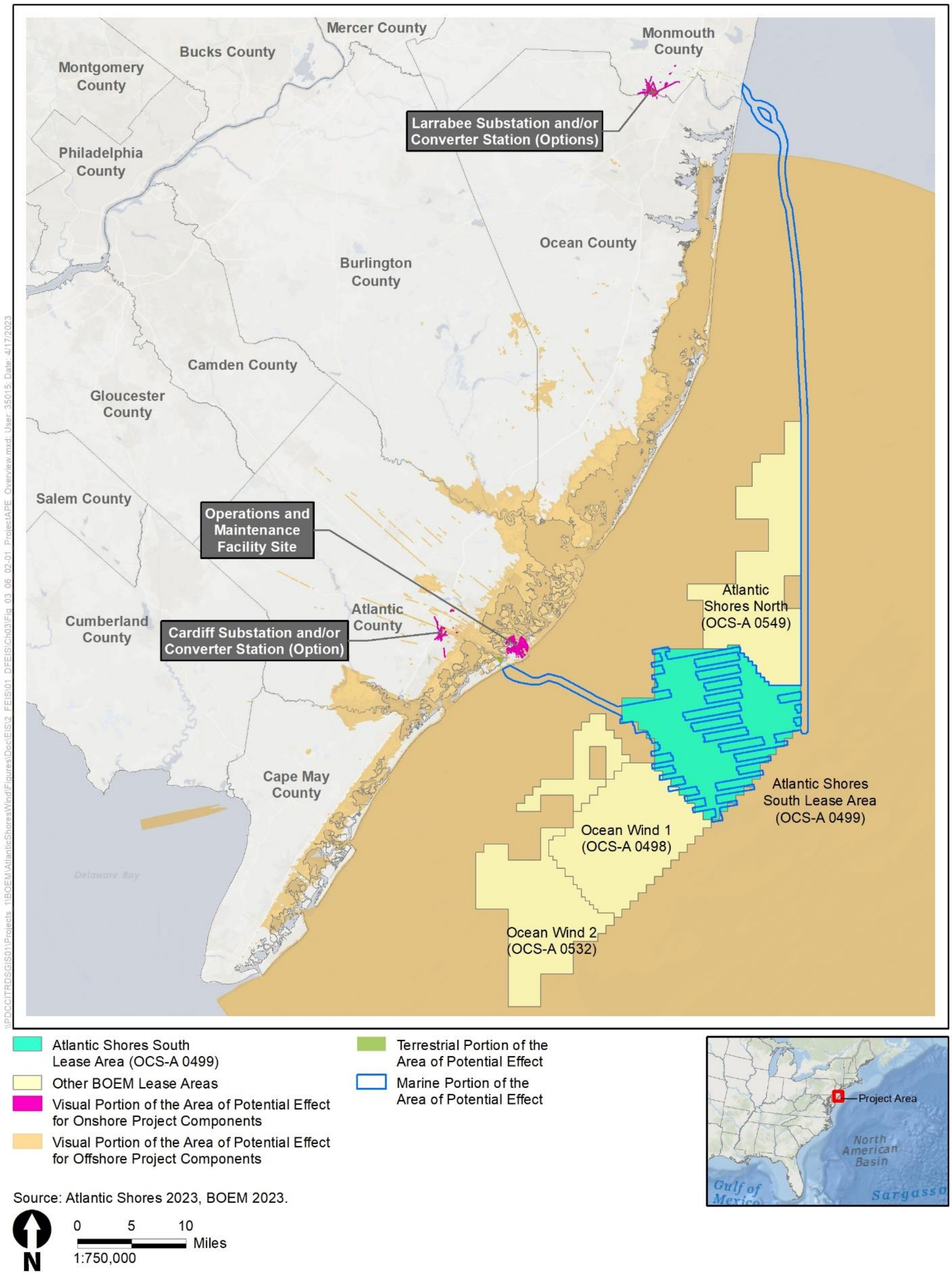


Figure 3.6.2-1. Cultural resources geographic analysis area

3.6.2.1 Description of the Affected Environment and Future Baseline Conditions

This section discusses baseline conditions in the geographic analysis area for cultural resources as described in the COP (Volume II, Section 6.0; Atlantic Shores 2023), supplemental COP cultural resources studies (COP Volume II, Appendices II-N, II-O, II-P, and II-Q; Atlantic Shores 2023), and Appendix I. Specifically, this includes marine and terrestrial areas potentially affected by the proposed Project's seabed- or ground-disturbing activities, areas where structures from the Proposed Action would be visible, and the area of intervisibility where structures from the Proposed Action and other offshore wind projects would be visible simultaneously.

Atlantic Shores has conducted onshore and offshore cultural resource investigations to identify known and previously undiscovered cultural resources in the marine, terrestrial, and visual portions of the APE. Table 3.6.2-1 presents a summary of the pre-Contact and post-Contact cultural context of the Project area in New Jersey based on the Project's Marine Archaeological Resources Assessment (MARA; COP Volume II, Appendix II-Q1; Atlantic Shores 2023) and Terrestrial Archaeological Resources Assessment (TARA; COP Volume II, Appendix II-P; Atlantic Shores 2023).

Table 3.6.2-1. Summary of cultural context of coastal New Jersey and the Project area

Period	Date	Description
Paleoindian	13,000–10,000 BP	Environment composed of spruce, boreal forest and low sea level causing coastline to be miles out to sea from its current location. Pleistocene megafauna present along coast. Mobile hunting and gathering. Use of fluted points. Coastline sites from this period now inundated in Atlantic Ocean.
Archaic	10,000–3,500 BP	Period subdivided into Early (10,000–8,000 BP), Middle (8,000–6,000 BP), and Late (6,000–3,500 BP) phases. Gradual establishment of modern environmental conditions. Warmer and wetter conditions relative to previous period. Sea level begins to rise. Introduction of a broad range of food. Decreasing hunting and gathering mobility. Diversifying stone toolkit over period. Increasing amounts of seasonal exploitation of resources, marine resources. Increasing population densities, and small seasonal settlements.
Archaic-Woodland Transitional	4,000–3,000 BP	Cooling trend. Mixed deciduous forests persist. Somewhat high residential mobility, likely on seasonal basis. Small-scale exploitation of marine resources. Orient Culture influences. Small shell middens. Use of cemeteries. Use of steatite vessels.
Woodland	3,000– 400 BP	Period subdivided into Early (3,000–2,300 BP), Middle (2,300–1,000 BP), and Late (1,000–400 BP) phases. Cooler temperatures in Early Woodland, then warming and drying trend begins in Middle Woodland. Mixed deciduous forests persist. Terrestrial foraging and intensive exploitation of marine resources. Use of ceramics. Increasing sedentism with use of agriculture. Increasing projectile point varieties.
Post-Contact	17th Century AD	Cooler, wetter conditions. Native Americans settle in sedentary villages supported by agriculture and seasonal camps targeting large and small game, plants, riverine, and marine resources. Native Americans have similar technologies to Late Woodland but increasingly use European trade goods. Interactions occur among Native Americans and European colonists. Dutch, Finnish, Swedish colonies established. Colonial New Jersey organized into two provinces: East Jersey and West Jersey. The English formed Monmouth County in 1683 in the East Jersey province.

Period	Date	Description
Post-Contact	18th Century AD	New Jersey provinces combined into single province in 1702. During the American War for Independence, several engagements between British and Continental forces took place in New Jersey. City of Princeton served as seat of the U.S. government for brief period in 1783. New Jersey statehood granted in 1787.
Post-Contact	19th Century AD	Iron production an important aspect of economy in present-day Howell and Wall Townships. Growth of public roadways connecting farms and communities. The Raritan and Delaware Bay Railroad Company (later the New Jersey Southern Railroad) completed its north-south line from Port Monmouth on Raritan Bay to Lakewood by 1860, passing through Howell Township.
Post-Contact	20th Century AD	Wall and Howell Townships remained largely agricultural. Rail connections with larger urban areas and later improved roadways for automobiles led to growth of seaside communities in Monmouth County. Manasquan formed as distinct borough from Wall Township in 1887. Sea Girt formed as distinct borough in 1917.

Source: COP Volume II, Appendices II-Q1 and II-P; Atlantic Shores 2023.
AD = Anno Domini; BP = before present.

For the purposes of this analysis, cultural resources are divided into several types and subtypes: marine cultural resources (i.e., marine archaeological resources and ancient submerged landform features), terrestrial archaeological resources, and historic aboveground resources. These broad categories may include archaeological or historic aboveground resources with cultural or religious significance to Native American tribes.

Archaeological resources are the physical remnants of past human activity that occurred at least 50 years ago. These remnants can include items left behind by past peoples (i.e., artifacts) and physical modifications to the landscape (i.e., features). This analysis divides archaeological resources into those that are submerged underwater (i.e., marine) and those that are not (i.e., terrestrial). *Ancient submerged landform features* (ASLFs) are landforms that have the potential to contain Native American archaeological resources inundated and buried as sea levels rose at the end of the last Ice Age; additionally, Native American tribes in the region may consider ASLFs to be TCPs or tribal resources representing places where their ancestors lived. *Historic aboveground resources* include standing buildings, bridges, dams, and other structures of historic or aesthetic significance. *TCPs* are places, landscape features, or locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community; they may have either or both archaeological and aboveground elements. *Historic districts* may be composed of a collection of any of the resources described above. The discussion of cultural resources in this section is divided by the marine, terrestrial, and visual portions of the APE and may be further discussed in relation to Onshore and Offshore Project components.

As a subcategory of marine cultural resources, marine archaeological resources in the region include pre-Contact and post-Contact archaeological resources that are submerged underwater. Based on known historic and recent maritime activity in the region, the marine portion of the APE (hereafter referred to as the *marine APE*) has a high probability for containing shipwrecks, downed aircraft, and related debris fields (BOEM 2012; COP Volume II, Appendix II-Q; Atlantic Shores 2023). Marine geophysical archaeological surveys performed for the Proposed Action identified 21 potential marine archaeological resources in the marine APE: eight within the WTA (i.e., six in the Project 1 area, two in the Project 2 area, and none in the Overlap Area); four within the Atlantic offshore ECC; and nine within the offshore Monmouth ECC (COP Volume II, Appendix II-Q; Atlantic Shores 2023). These resources include both known and potential shipwrecks and related debris fields from the post-Contact and recent (i.e., less than 50 years ago) eras. Because ages of these resources cannot be confirmed through the marine cultural investigations, these resources are all assumed to be archaeological and therefore historic properties potentially eligible for listing in the NRHP.

Marine cultural resources also include ASLFs on the OCS (BOEM 2012). Marine geophysical archaeological surveys performed for the Proposed Action identified 37 ASLFs in the marine APE (COP Volume II, Appendix II-Q; Atlantic Shores 2023). The extent of marine cultural investigations performed for the Proposed Action does not enable conclusive determinations of eligibility for listing identified ASLFs in the NRHP; as such, all ASLFs are assumed eligible for listing in the NRHP and are therefore historic properties.

Cultural resources investigations performed for the Proposed Action in the terrestrial portion of the APE (hereafter referred to as the *terrestrial APE*) have identified one previously recorded terrestrial archaeological resource that may be eligible for listing in the NRHP and one historic aboveground resource eligible for listing in the NRHP (the West Jersey and Atlantic Railroad Historic District) (COP Volume II, Appendix II-P1; Atlantic Shores 2023). The terrestrial APE intersects the mapped West Jersey and Atlantic Railroad Historic District boundary; these areas may contain archaeological elements potentially contributing to the historic property's eligibility for listing in the NRHP and may be subject to impacts from the Proposed Action.

As of March 2023, terrestrial archaeological investigations have been limited to Phase IA background research and reconnaissance surveys; no Phase IB archaeological surveys have been completed for the Proposed Action. As such, currently undiscovered but potential terrestrial archaeological resources may exist in the terrestrial APE. In consultation with BOEM and the New Jersey Historic Preservation Office (NJHPO; the New Jersey State Historic Preservation Office [SHPO]), Atlantic Shores will be using a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for the unsurveyed areas of the terrestrial APE (COP Volume II, Appendix II-P1; Atlantic Shores 2023). Completion of Phase IB archaeological surveys during the phased process may lead to the identification of archaeological resources in the terrestrial APE. BOEM will use the Memorandum of Agreement (MOA) to establish commitments for reviewing the sufficiency of any supplemental terrestrial archaeological investigations as phased identification; assessing effects on historic properties; and implementing measures to avoid, minimize, or mitigate effects in these areas prior to construction. See Appendix I, Section I.5, *Phased Identification and Evaluation*, for additional details on the phased process and Appendix I, Attachment A, for the MOA.

The visual portion of the APE (hereafter referred to as the *visual APE*) includes a visual APE for Offshore Project components, visual APE for Onshore Project components, and visual APE for the O&M facility.

Cultural resources review of the visual APE for Offshore Project components identified a total of 123 aboveground historic properties: 2 NHLs, 18 NRHP-listed historic districts and individual historic properties, 63 individual historic properties and historic districts determined eligible for the NRHP, and 40 individual properties and historic districts recommended as eligible for the NRHP as a result of field surveys (COP Volume II, Appendix O; Atlantic Shores 2023). A review of the visual APE for Onshore Project components identified 3 NRHP-listed or eligible aboveground historic properties, and 3 NRHP-eligible historic districts within the visual APE for the proposed onshore substations and/or converter stations in Cardiff and Larrabee (COP Volume II, Appendices II-N1; Atlantic Shores 2023). Lastly, 7 NRHP-eligible aboveground historic properties were identified within the portion of the visual APE for the proposed O&M facility in Atlantic City (COP Volume II, Appendices II-N2; Atlantic Shores 2023).

3.6.2.2 Impact Level Definitions for Cultural Resources

This Draft EIS uses a four-level classification scheme to characterize potential impacts on cultural resources (including historic properties under Section 106) resulting from Project alternatives, including the Proposed Action, as shown in Table 3.6.2-2.

Table 3.6.2-2. Definitions of potential adverse impact levels for cultural resources by type

Impact Level	Historic Properties under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
Negligible	No historic properties affected, as defined at 36 CFR 800.4(d)(1).	A. No cultural resources subject to potential impacts from ground- or seabed-disturbing activities; or B. All disturbances to cultural resources are fully avoided, resulting in no damage to or loss of scientific or cultural value from the resources.	A. No measurable impacts; or B. No physical impacts and no change to the integrity of resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or C. All physical impacts and disruptions are fully avoided.
Minor	No adverse effects on historic properties could occur, as defined at 36 CFR 800.5(b). This can include avoidance measures.	A. Some damage to cultural resources from ground- or seabed-disturbing activities, but there is no loss of scientific or cultural value from the resources; or B. Disturbances to cultural resources are avoided or limited to areas lacking scientific or cultural value.	A. No physical impacts (i.e., alteration or demolition of resources) and some limited visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to historic or aesthetic settings are short term and expected to return to an original or comparable condition (e.g., temporary vegetation clearing and construction vessel lighting).

Impact Level	Historic Properties under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
Moderate	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be altered in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, but the adversely affected property would remain eligible for the NRHP.	As compared Minor Impacts: A. Greater extent of damage to cultural resources from ground- or seabed-disturbing activities, including some loss of scientific or cultural data; or B. Disturbances to cultural resources are minimized or mitigated to a lesser extent, resulting in some damage to and loss of scientific or cultural value from the resources.	As compared to Minor Impacts: A. No or limited physical impacts and greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to settings are minimized or mitigated; or C. Historic or aesthetic settings may experience some long-term or permanent impacts.
Major	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be affected in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association to the extent that the property is no longer eligible for listing in the NRHP.	As compared to Moderate Impacts: A. Destruction of or greater extent of damage to cultural resources from ground- or seabed-disturbing activities; or B. Disturbances are minimized or mitigated but do not reduce or avoid the destruction or loss of scientific or cultural value from the cultural resources; or C. Disturbances are not minimized or mitigated resulting in the destruction or loss of scientific or cultural value from the resources.	As compared to Moderate Impacts: A. Physical impacts on cultural resources (for example, demolition of a cultural resource onshore); or B. Greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance, including long-term and/or permanent impacts; or C. Disruptions to settings are not minimized or mitigated.

3.6.2.3 Impacts of Alternative A – No Action on Cultural Resources

When analyzing the impacts of the No Action Alternative on cultural resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for cultural resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario.*

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for cultural resources described in Section 3.6.2.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities within the geographic analysis area that contribute to impacts on cultural resources in onshore areas include ground-disturbing activities and the introduction of intrusive visual elements, while the primary sources of impacts on cultural resources in offshore areas include seabed-disturbing activities. Onshore and offshore construction activities and associated impacts are expected to continue at current trends, range in severity from minor to major, and have the potential to result in impacts on cultural resources. See Appendix D, Table D.A1-7 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for cultural resources.

There are no ongoing offshore wind activities within the geographic analysis area for cultural resources.

Ongoing sea level rise, ocean acidification, increased storm severity/frequency, and increased sedimentation and erosion associated with climate change have the potential to result in long-term, permanent impacts on cultural resources. Sea level rise could lead to the inundation of terrestrial archaeological and historic aboveground resources. Increased storm severity and frequency would likely increase the severity and frequency of damage to coastal historic aboveground resources. Increased erosion along coastlines could lead to the complete destruction of coastal archaeological resources and the collapse of historic structures as erosion undermines their foundations. Ocean acidification could accelerate the rate of decomposition and corrosion of marine archaeological resources, such as shipwrecks and downed aircraft, on the seafloor.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned non-offshore wind activities that may have impacts on cultural resources include new submarine cables and pipelines, oil and gas activities, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Section D.2 in Appendix D for a description of planned activities). These activities may result in short-term, long-term, and permanent onshore and offshore impacts on cultural resources.

The following sections summarize the potential impacts of planned offshore wind activities on cultural resources during construction and installation, O&M, and decommissioning of the projects, excluding the Proposed Action. Planned offshore wind projects in the geographic analysis area that would contribute to impacts on cultural resources include Lease Areas OCS-A 0549 (Atlantic Shores North), OCS-A 0482 (Garden State Offshore Energy [GSOE] I), OCS-A 0498 (Ocean Wind 1), OCS-A 0532 (Ocean Wind 2), OCS-A 0519 (Skipjack Offshore Energy), OCS-A 0539 (Bight Wind Holdings), OCS-A 0541 (Atlantic Shores Offshore Wind Bight), and OCS-A 0542 (Invenergy Wind Offshore). BOEM expects planned offshore wind activities to have impacts on cultural resources through the following primary IPFs.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, may pose long-term, infrequent risks to cultural resources. The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils. In the planned activities scenario, there would be a low risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs or substations offshore New Jersey. The potential for accidental releases, volume of released material, and associated need for cleanup activities from offshore wind projects aside from the Proposed Action in the geographic analysis area would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard BMPs to prevent releases, and localized nature of such events. As such, the majority of individual accidental releases from offshore wind development would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts.

Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete removal of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; temporary or permanent impacts on the setting of coastal historic aboveground resources such as historic buildings, structures, objects, districts, significant landscapes, and TCPs; and damage to or removal of nearshore marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale major impacts on cultural resources.

Anchoring: Anchoring associated with ongoing commercial and recreational activities and the development of offshore wind projects has the potential to cause permanent, adverse impacts on marine cultural resources. These activities would increase during the construction and installation, O&M, and eventual decommissioning of planned offshore wind energy facilities. Construction of offshore wind projects could result in impacts on cultural resources on the seafloor caused by anchoring in the geographic analysis area. The placement and relocation of anchors and other seafloor gear such as wire ropes, cables, and anchor chains that affect or sweep the seafloor could potentially disturb marine archaeological resources and ASLFs on or just below the seafloor surface. The damage or destruction of marine cultural resources from these activities would result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts.

The scale of impacts on cultural resources would depend on the number of marine archaeological resources and ASLFs in offshore wind lease areas and offshore export cable corridors. Impacts on marine archaeological resources can typically be avoided through project design. The number, extent, and dispersed character of the ASLFs make avoidance difficult, while the depth of these resources makes mitigative measures difficult and expensive. It is unlikely that offshore wind projects would be able to avoid all of these resources. The potential for impacts would be mitigated, however, by existing federal and state requirements to identify and avoid marine cultural resources. Specifically, as part of its compliance with the NHPA, BOEM requires offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas to identify cultural resources and implement plans to avoid, minimize, or mitigate impacts on these resources. As a result, impacts on marine cultural resources from anchoring would be localized and permanent, and range from negligible to major on a case-by-case basis, depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Cable emplacement and maintenance: Construction and installation of offshore wind infrastructure would have permanent, geographically extensive, adverse impacts on cultural resources. Planned offshore wind projects would result in seabed disturbance from construction and installation of structure foundations and interarray and offshore export cables. With the exception of Ocean Wind 1 (OCS-A 0498), other planned offshore wind activities in the geographic analysis area do not yet have publicly available COPs. This includes Atlantic Shores North (OCS-A 0549), GSOE I (OCS-A 0482), Ocean Wind 2 (OCS-A 0532), and Skipjack Offshore Energy (OCS-A 0519). As such, the extent of cable route emplacement and maintenance in the geographic analysis area is largely unknown. There is the potential that these planned projects may propose cable routes that intersect the geographic analysis area. The 2012 BOEM study and the Proposed Action studies (BOEM 2012; COP Volume II, Appendix II-Q1; Atlantic Shores 2023) suggest that the offshore wind lease areas and offshore export cable corridors of the offshore wind projects would likely contain a number of marine archaeological resources and ASLFs, which could be subject to impacts from offshore construction activities.

As part of compliance with the NHPA, BOEM and SHPOs will require planned offshore wind project developers to conduct extensive geophysical surveys of offshore wind lease areas and export cable corridors to identify marine cultural resources and avoid, minimize, or mitigate these resources when identified. Due to these federal and state requirements, the adverse impacts of offshore construction on marine cultural resources would be infrequent and isolated and in cases where conditions are imposed to avoid marine cultural resources, impacts would be negligible. However, if marine cultural resources cannot be avoided, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts. As such, across potential circumstances, the magnitude of impacts would range from negligible to major.

If present in a project area, the number, extent, and dispersed character of ASLFs make avoidance impossible in many situations and make extensive archaeological investigations of formerly terrestrial archaeological resources within these features logistically challenging and prohibitively expensive. As a result, offshore construction would result in geographically widespread and permanent adverse impacts on portions of these resources. For ASLFs that cannot be avoided, mitigation would likely be considered under the NHPA Section 106 review process, including studies to document the nature of the paleontological environment during the time these now-submerged landscapes were occupied and provide Native American tribes with the opportunity to include their history in these studies. However, the magnitude of these impacts would remain moderate to major, due to their permanent, irreversible nature.

Gear utilization: Construction and installation, O&M, and decommissioning of offshore wind activities may necessitate additional monitoring or geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in adverse impacts. Other offshore wind activities in the geographic analysis area (i.e., Atlantic Shores North, GSOE I, Ocean Wind 1, Ocean Wind 2, and Skipjack) have the potential to conduct these additional surveys. The 2012 BOEM study and the Proposed Action studies (BOEM 2012; COP Volume II, Appendix II-Q1; Atlantic Shores 2023) suggest that the offshore wind lease areas and offshore export cable corridors of the offshore wind projects would likely contain a number of marine archaeological resources that could be subject to impacts from gear utilization.

As part of compliance with the NHPA, BOEM and SHPOs will require planned offshore wind project developers to conduct extensive geophysical surveys of offshore wind lease areas and export cable corridors to identify marine cultural resources and avoid, minimize, or mitigate these resources when identified. Due to these federal and state requirements, the adverse impacts of offshore construction on marine cultural resources would be infrequent and isolated. However, the magnitude of these impacts would remain moderate to major in the case of an entanglement, due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided.

Land disturbance: The construction and installation of onshore components associated with offshore wind projects, such as electrical export cables and onshore substations and/or converter stations, could result in physical adverse impacts on known and undiscovered cultural resources. Ground-disturbing construction activities, including vegetation removal, excavation, grading, and placement of fill material, could disturb or destroy undiscovered archaeological resources and TCPs, if present. The number of cultural resources subject to impacts, scale and extent of impacts, and severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources and the proportion of the resource subject to impacts. State and federal requirements to identify cultural resources, assess project impacts, and develop historic property treatment plans (HPTPs) to avoid, minimize, or mitigate adverse impacts would limit the extent, scale, and magnitude of impacts on individual cultural resources; as a result, if adverse impacts from this IPF occur, they would likely be permanent but localized, and range from negligible to major.

Lighting: Development of planned offshore wind projects would increase the amount of offshore anthropogenic light from vessels, area lighting during construction and decommissioning of projects (to the degree that construction occurs at night), and use of aircraft and vessel hazard/warning lighting on WTGs and OSSs during operation. Up to 811 WTGs, excluding those from the Proposed Action, with a maximum blade tip height of 1,049 feet (320 meters) AMSL would be added within the geographic analysis area for cumulative visual effects on historic properties (Appendix D, Tables DA.2-1 and DA.2-2).

Offshore wind projects could require nighttime construction lighting, and would require nighttime hazard lighting during operations. Construction and decommissioning lighting would be most noticeable if construction activities occur at night. Up to five planned offshore wind projects (Ocean Wind 1 and 2, Atlantic Shores North, GSOE I, and Skipjack) could contribute to cumulative visual effects on historic properties. These could be constructed from 2023 through 2030 (with some of the projects potentially under construction simultaneously; see Appendix D, Table DA.2-1). Construction lighting from any project would be temporary, lasting only during nighttime construction, and could be visible from shorelines and elevated locations, although such light sources would be limited to individual WTG or OSSs rather than the entirety of the lease areas in the geographic analysis area. Aircraft and vessel hazard lighting systems would be in use for the entire operational phase of each offshore wind project, resulting in long-duration impacts. The intensity of these impacts would be relatively low, as the lighting would consist of small, intermittently flashing lights at a significant distance from the resources.

The impacts of construction and operational lighting would be limited to historic aboveground resources on the coast of New Jersey for which a dark nighttime sky is a character-defining feature that contributes to historic significance and integrity. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources, as the majority of the proposed WTGs would be over 15 miles (24.1 kilometers) from the nearest shoreline (see Section 3.6.8, *Recreation and Tourism)*. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As a result, nighttime construction and decommissioning lighting would have short-term, intermittent, and localized adverse impacts on a limited number of cultural resources. Operational lighting would have longer-term, continuous, and localized adverse impacts on a limited number of cultural resources.

Lighting impacts would be reduced if ADLS is used to meet FAA aircraft hazard lighting requirements. ADLS would activate the aviation lighting on WTGs and OSSs only when an aircraft is within a predefined distance of the structures (for a detailed explanation, see Section 3.6.9, *Scenic and Visual Resources*). For the Proposed Action, the reduced time of FAA hazard lighting resulting from an ADLS, if implemented, would reduce the duration of the potential impacts of nighttime aviation lighting by 99 percent from the normal operating time that would occur without using ADLS (COP, Appendix II-M4; Atlantic Shores 2023). The use of ADLS on offshore wind projects other than the Proposed Action would likely result in similar limits on the frequency of WTG and OSS aviation warning lighting use. This technology, if used, would reduce the already low-level impacts of lighting on cultural resources. As such, lighting impacts on cultural resources would range from minor to major.

Onshore structure lighting would be required for offshore wind projects and could impact cultural resources. The magnitude of impact would depend on the height of the buildings or towers and the intensity of the lighting fixtures. The impacts on cultural resources from these lights would be minimized by the distance between the facilities and cultural resources, and the presence of vegetation, buildings, or other visual buffers that may diffuse or obscure the light. Therefore, the lighting associated with onshore components from offshore wind activities could have long-term, continuous, negligible to minor impacts on cultural resources.

Noise: The development of offshore wind projects would introduce noise from onshore and offshore construction and installation, O&M, and decommissioning. Airborne noise could result in a change to the integrity of the historic setting of historic aboveground resources by introducing modern sounds into historic contexts both onshore and offshore. Historic properties set in urban contexts may not be affected by an increase in airborne noise, while in other contexts such noise may lead to the disruption of the historic setting by which a historic aboveground resource derives its significance. Onshore noise may be generated from substation and converter station construction, underground installation of onshore interconnection cables, HDD, and electrical and mechanical components of the substations or converter stations or POI sites, such as electric generators and transformers. These noise impacts may be reduced by designing onshore substations and converter sites to comply with applicable state residential or commercial sound level limits, mitigation elements (e.g., certified enclosures, natural barriers, and landscaping around the onshore component sites), and adherence to municipal noise ordinances and seasonal construction restrictions. Offshore noise associated with these activities, such as vessel noise or the construction and O&M of WTGs and OSSs, is either expected to be temporary or not audible from the nearest shorelines. Overall, noise from offshore wind activities would have localized, short-term, negligible to minor impacts on cultural resources.

Port utilization: Expected increases in port activity associated with the development of offshore wind projects would likely require modifications and expansions at ports along the East Coast. These port modification and expansion projects could have impacts on cultural resources within or near port facilities. Channel deepening by dredging that may be required to accommodate larger vessels necessary to carry WTG and OSS components and increased vessel traffic and economic activity associated with offshore wind projects could have impacts on marine cultural resources in or near ports. Due to state and federal requirements to identify and assess impacts on cultural resources as part of NEPA and the NHPA and the requirements to avoid, minimize, or mitigate adverse impacts on cultural resources, these impacts would be long term, adverse, and isolated to a limited number of cultural resources that cannot be avoided or that were previously undocumented. As such, impacts from port utilization would range from negligible to major.

Presence of structures: The development of other offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coast of New Jersey. Excluding the Proposed Action, up to 811 WTGs and additional OSSs and met towers would be added within the geographic analysis area for cumulative visual effects on historic properties, assuming WTGs with a maximum blade tip height of 1,049 feet (320 meters) AMSL (Appendix D, Tables D-3, DA.2-1 and DA.2-2).

Impacts on cultural resources from the presence of structures would be limited to those cultural resources from which offshore wind projects would be visible, which would typically be limited to historic aboveground resources (e.g., buildings, structures, objects, districts, significant landscapes, and TCPs) relatively close to shorelines and on elevated landforms near the coast. The magnitude of impacts from the presence of structures would be greatest for historic aboveground resources for which a maritime view, free of modern visual elements, is an integral part of their historic integrity and contributes to their significance and eligibility for listing in the NRHP. Due to the distance between the reasonably foreseeable wind development projects and the nearest historic aboveground resources, in most instances exceeding 15 miles (24.1 kilometers), WTGs of individual projects would appear relatively small on the horizon, and the visibility of individual structures would be further affected by environmental and atmospheric conditions such as vegetation, clouds, fog, sea spray, haze, and wave action (for a detailed explanation, see Section 3.6.9). While these factors would limit the intensity of impacts, the presence of visible WTGs from offshore wind activities would have long-term, continuous, negligible to major impacts on cultural resources.

Additionally, the presence of onshore components associated with offshore wind projects, including substations, converter or switching stations, transmission lines, O&M facilities, and other components, would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources located within sight of these components in New Jersey. The magnitude of impacts from the presence of structures would be greatest for historic aboveground resources for which a setting free of modern visual elements is an integral part of their historic integrity and contributes to their eligibility for listing in the NRHP. Factors such as distance and visual buffers, including vegetation and buildings, would also affect the intensity of these impacts. While these factors would limit the intensity of impacts, the presence of onshore components associated with offshore wind activities would have long-term, continuous, negligible to major impacts on cultural resources.

Traffic: The development of offshore wind projects could introduce new onshore and offshore traffic along the coast of New Jersey during construction and installation, O&M, and decommissioning. An increase in traffic associated with these projects could result in a change to the integrity of the historic setting of historic aboveground resources by creating an increase in the flow of aircraft, marine vessels, or land-based vehicles that could disrupt onshore or offshore historic contexts of these cultural resources. However, given the existing degree of vehicle traffic in the geographic analysis area and relative existing frequency of seagoing vessels on the horizon along the New Jersey coast, it is unlikely that traffic related to the offshore wind activities would result in any measurable impacts on cultural resources. As a result, impacts from traffic from offshore wind activities would have localized, short-term, negligible to minor impacts on cultural resources.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, cultural resources would continue to be subject to impacts from existing environmental trends and ongoing activities in the geographic analysis area. Ongoing activities are expected to have continued short-term, long-term, and permanent impacts (e.g., via disturbance, damage, disruption, destruction) on cultural resources. These impacts would be primarily driven by offshore construction impacts and the presence of structures and, to a lesser extent, onshore construction impacts. The primary sources of onshore impacts from ongoing activities include ground-disturbing activities and the introduction of intrusive visual elements, while the primary source of offshore impacts includes activities that disturb the seafloor. Given the extent of known cultural resources in the region and extent of planned development on the OCS, ongoing offshore wind activities would noticeably contribute to impacts on cultural resources. While long-term and permanent impacts may occur as a result of offshore wind development, impacts would be reduced through the NHPA Section 106 consultation process to resolve adverse effects on historic properties. The No Action Alternative would result in **moderate** adverse impacts on cultural resources.

Cumulative Impacts of Alternative A – No Action. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and cultural resources would continue to be subject to impacts from natural and human-caused IPFs. Planned activities would contribute to impacts on cultural resources due to disturbance, damage, disruption, and destruction of individual cultural resources located onshore and offshore. BOEM anticipates that the cumulative impacts of the No Action Alternative would likely be **major** due to the extent of known cultural resources in the region subject to impacts.

3.6.2.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on cultural resources:

- Physical impacts on marine cultural resources (i.e., archaeological resources and ASLFs), depending on the location of offshore bottom-disturbing activities, including the locations where Atlantic Shores would embed the WTGs and OSSs into the seafloor in the Lease Area, and the location of the cables in the offshore ECCs;
- Physical impacts on terrestrial cultural resources (i.e., archaeological resources and historic aboveground resources), depending on the location of onshore ground-disturbing activities; and
- Visual impacts on cultural resources (e.g., historic aboveground resources), depending on the design, height, number, and distance of WTGs, OSSs, and Onshore Project components (e.g., onshore cables, substations, converter stations) visible from these resources.

Variability of the proposed Project design exists as outlined in Appendix C. The following summarizes the potential variances in impacts:

- WTG and OSS number, size, and location: If marine cultural resources cannot be avoided, impacts can be minimized with fewer WTGs and OSS footprints, smaller footprints, and the selection of footprint locations in areas of lower archaeological or ASLF sensitivity. Fewer WTGs could also decrease visual impacts on cultural resources for which unobstructed ocean views or a setting free of modern visual elements is a contributing element to historical integrity.
- WTG and OSS lighting: Arrangement and type of lighting systems could affect the degree of nighttime visibility of WTGs onshore and decrease visual impacts on cultural resources for which a dark nighttime sky is a contributing element to historical integrity.
- Size of scour protection around foundations: If marine cultural resources cannot be avoided, a smaller size of scour protection around foundations can minimize disturbance or destruction of marine cultural resources.

- Offshore cable (interarray, substation interconnector) burial location, length, depth of burial, and burial method: If marine cultural resources cannot be avoided entirely, specific location, length, and depth of burial could minimize disturbance or destruction of marine cultural resources.

- Landfall for offshore export cable installation method: Selection of trenchless installation over open-cut installation could have decreased potential for unanticipated disturbance of terrestrial archaeological resources.

- Onshore export cable corridor width and burial depth: Reduced width and burial depth to reduce overall volume of excavation in the export cable construction corridors could decrease potential for unanticipated disturbance of terrestrial archaeological resources. Additionally, the installation of aboveground onshore export cables and associated towers would have lesser adverse impacts on terrestrial archaeology than the installation of underground onshore export cables.

Atlantic Shores has committed to several EPMs to avoid, minimize, or mitigate impacts on cultural resources (CUL-01-CUL-21, Appendix G, Table G-1).

3.6.2.5 Impacts of Alternative B – Proposed Action on Cultural Resources

Under the Proposed Action, Atlantic Shores would install up to 200 WTGs, 10 OSSs and 1 met tower, and related onshore and offshore facilities, which would have negligible to minor impacts on most cultural resources but would potentially have moderate to major impacts on presently undiscovered but potential marine archaeological resources, ASLFs, known and presently undiscovered but potential terrestrial archaeological resources, and historic aboveground resources.

Specifically, the Proposed Action may have negligible impacts on 21 marine archaeological resources (Targets 01–21), negligible to major physical impacts on 37 ASLFs (Targets 22–58), negligible to major physical impacts on 1 terrestrial archaeological resource, and negligible to major physical impacts on 1 historic aboveground resource (i.e., West Jersey and Atlantic Railroad Historic District) (COP Volume II, Appendices II-P1, and II-Q; Atlantic Shores 2023). The proposed Project may also have minor to moderate visual impacts on up to 27 aboveground historic properties—including 2 NHLs (i.e., Atlantic City Convention Hall and Lucy, The Margate Elephant)—of the 123 total historic aboveground resources identified in the visual APE for Offshore Project components (COP Volume II, Appendix II-O; Atlantic Shores 2023). Negligible impacts are anticipated on the 3 aboveground historic properties in the visual APE for Onshore Project components or 7 aboveground historic properties in the visual APE for the O&M facility (COP Volume II, Appendices II-N1 and II-N2; Atlantic Shores 2023). See Appendix I for a complete list of historic properties in the marine, terrestrial, and visual APEs for the Project.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, could have impacts on cultural resources. The WTGs and OSSs associated with the Proposed Action alone would include storage for a variety of potential chemicals such as diesel fuel, hydraulic fluid, and lubricating oil (COP Volume I, Chapter 7.0; Atlantic Shores 2023). Construction and installation, O&M, and decommissioning of the onshore and offshore portions of the Project would require use of several types of vehicles, ocean-going vessels, and aircraft from which there may be unanticipated release or spills of substances onto land or into receiving waters (COP Volume I, Section 4.10; Atlantic Shores 2023). Overall, the potential for accidental releases, volume of released material, and associated need for cleanup activities from the Proposed Action would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard BMPs to prevent releases, and localized nature of such events.

The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils, trash, or debris. As such, the majority of potential individual accidental releases from the Proposed Action would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete destruction of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; temporary or permanent impacts on the setting of coastal historic aboveground resources such as buildings, structures, objects, districts, significant landscapes, and TCPs; and damage to or destruction of nearshore marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale major impacts on cultural resources. Overall, the impacts on cultural resources from accidental releases from the Proposed Action would be localized, short term, and negligible to major depending on the number and scales of accidental releases.

Anchoring: Anchoring associated with offshore activities of the Proposed Action could have impacts on marine cultural resources. Atlantic Shores' marine geophysical archaeological surveys identified 21 marine archaeological resources in the marine APE: 8 within the WTA (i.e., 6 in the Project 1 area, 2 in the Project 2 area, and none in the Overlap Area); 4 within the Atlantic offshore ECC; and 9 within the Monmouth offshore ECC (COP Volume II, Appendix II-Q; Atlantic Shores 2023). Atlantic Shores has committed to avoidance of these marine archaeological resources (CUL-18, Appendix G, Table G-1). Additionally, 37 ASLFs were identified in the marine APE. The severity of effects of this IPF would depend on the horizontal and vertical extent of disturbance relative to the size of the ASLF subject to impacts. If the Proposed Action is unable to avoid ASLFs due to design (e.g., the cultural resource crosses the entire offshore ECC), engineering, or environmental constraints, Atlantic Shores would work with the NHPA Section 106 consulting parties, Native American Tribes, BOEM, and NJHPO to develop and implement minimization and mitigation plans for disturbance of known resources.

Based on this information, impacts of the Proposed Action on marine archaeological resources are expected to be negligible due to Atlantic Shores' commitment to avoidance of these resources and their protective buffers. However, impacts on ASLFs would be localized, permanent, and range from negligible to major depending on the ability of Atlantic Shores to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Cable emplacement and maintenance: The installation of interlink cables and offshore export cables would include site preparation activities (e.g., dredging, trenching), cable installation via jet trenching, plowing/jet plowing, or mechanical trenching, which could have impacts on marine cultural resources. The specific cultural resources subject to potential impacts, AMM measures, and potential range of severity and extent of impacts on cultural resources under this IPF are the same as those described under the *Anchoring* IPF for the Proposed Action. Overall, impacts of the Proposed Action on marine archaeological resources are expected to be negligible due to Atlantic Shores' commitment to avoidance of these resources and their protective buffers. However, impacts on ASLFs would be localized, permanent, and range from negligible to major depending on the ability of Atlantic Shores to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Gear utilization: Construction and installation, O&M, and decommissioning of the Proposed Action may necessitate additional monitoring or geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in adverse impacts. The specific marine archaeological resources subject to potential impacts, EPMs, and potential range of severity and extent of impacts on marine archaeological resources under this IPF are the same as those described under the *Anchoring* IPF for the Proposed Action. Overall, impacts of the Proposed Action on marine archaeological resources are expected to be negligible due to Atlantic Shores' commitment to avoidance of these resources. More substantial impacts could occur if previously undiscovered resources are discovered during construction.

Land disturbance: Land disturbance associated with the construction and installation of Onshore Project components could have impacts on cultural resources. Construction activities may include site clearing, grading, excavation, and filling during the construction and installation phase of the landfall sites, interconnection cable routes, and substations and/or converter stations (COP Volume II, Section 6.2; Atlantic Shores 2023). The onshore interconnection cables would be buried beneath or adjacent to existing ROWs (COP Volume II, Appendix II-N1; Atlantic Shores 2023). Overall, visual impacts of land disturbance related to the construction of Onshore Project components would have negligible impacts on historic aboveground resources identified in the visual APE.

Ground-disturbing activities associated with construction (e.g., site clearing, grading, excavation, and filling) could have impacts on terrestrial archaeological resources. The number of resources subject to impacts would depend on the location of specific Project components relative to known and undiscovered cultural resources, and the severity of impacts would depend on the horizontal and vertical extent of disturbance relative to the size of the resources subject to impacts. Onshore cultural resource investigations conducted for the Proposed Action determined the Project could potentially impact one terrestrial archaeological resource and one historic aboveground resource (the West Jersey and Atlantic Railroad Historic District) (COP Volume II, Section 6.2, and Appendix II P; Atlantic Shores

2023). The terrestrial APE intersects the mapped West Jersey and Atlantic Railroad Historic District boundary; these areas may contain archaeological elements potentially contributing to the historic property's eligibility for listing in the NRHP and may be subject to impacts from the Proposed Action.

As of January 2023, terrestrial archaeological investigations have been limited to Phase IA background research and reconnaissance surveys; no Phase IB archaeological surveys have been completed for the Proposed Action. As such, currently undiscovered but potential terrestrial archaeological resources may exist in the terrestrial APE. In consultation with BOEM and NJHPO, Atlantic Shores will be using a process of phased identification and evaluation of historic properties as defined in 36 CFR 800.4(b)(2) for the unsurveyed areas of the terrestrial APE (COP Volume II, Appendix II-P1; Atlantic Shores 2023). Completion of Phase IB archaeological surveys during the phased process may lead to the identification of archaeological resources in the terrestrial APE. BOEM will use the MOA to establish commitments for reviewing the sufficiency of any supplemental terrestrial archaeological investigations as phased identification; assessing effects on historic properties; and implementing measures to avoid, minimize, or mitigate effects in these areas prior to construction. See Appendix I, Section I.5, *Phased Identification and Evaluation*, for additional details on the phased process and Appendix I, Attachment A, for the MOA. Furthermore, Atlantic Shores has proposed to implement several EPMs to reduce the risk of impacts on terrestrial archaeological resources (Appendix G, *Mitigation and Monitoring*), including siting Onshore Project components within previously disturbed and developed areas (e.g., roadways, ROWs, previously developed industrial/commercial areas) to the maximum extent practicable (CUL-12, Appendix G, Table G-1) in areas where no terrestrial archaeological resources are known to exist, thereby avoiding, and minimizing impacts on, known terrestrial archaeological resources (CUL-12 and CUL-14, Appendix G, Table G-1).

Based on this information, the impacts of land disturbance from the Proposed Action on cultural resources are expected to be localized, range from short term to permanent, and range from negligible to major. The degrees of impact on terrestrial archaeological resources depend on the findings from the completed Phase IB archaeological surveys and ability of Atlantic Shores to avoid, minimize, or mitigate impacts. BOEM anticipates that Atlantic Shores would implement plans to avoid, minimize, or mitigate impacts on cultural resources as aligned with NJHPO and NHPA requirements. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are found during construction.

Lighting: Anthropogenic light from activities associated with the Proposed Action could result in a change to the integrity of the historic setting of historic aboveground resources by introducing new sources of light into settings or contexts, both onshore and offshore (COP Volume II, Section 6.1.2.2; Atlantic Shores 2023). Depending on the existing conditions in which a historic aboveground resource is located, the introduction of an additional light source may be disruptive, or not noticeable at all.

Construction and installation, O&M, and conceptual decommissioning of the Proposed Action may require nighttime vessel and construction area lighting. The lighting impacts would be short term, and the intensity of this nighttime lighting from the Proposed Action would be limited to active construction areas at any given time. Impacts would be further reduced by the distance between the nearest construction area (i.e., the closest line of WTGs) and the nearest cultural resources on the New Jersey coast. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light.

The susceptibility and sensitivity of cultural resources to lighting impacts from the Proposed Action would vary based on the unique characteristics of individual cultural resources. Nighttime lighting impacts would be restricted to cultural resources for which a dark nighttime sky is a character-defining feature that contributes to their historic significance and integrity. Onshore construction lighting may result in temporary intrusions to the visual setting of historic aboveground resources but are not anticipated to affect or diminish the integrity of historic properties. Due to the developed nature of the visual APE for Onshore Project components, lighting associated with the construction and conceptual decommissioning of the Proposed Action would be temporary and is not expected to contribute significantly to the sky glow resulting from existing light sources present in each of the respective areas (COP Volume II, Section 6.1.2.2; Atlantic Shores 2023). As a result, the visual APE for Onshore Project components would result in negligible impacts on cultural resources.

The Proposed Action would also include offshore construction lighting and nighttime and daytime use of aviation and vessel hazard avoidance lighting on WTGs and OSSs. Impacts from lighting would be reduced by the distance between the nearest construction area and the closest line of WTGs and the nearest cultural resources on the New Jersey coast. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As previously stated, these impacts would be limited to cultural resources for which a dark nighttime sky is a character-defining feature that contributes to their historic significance and integrity. If implemented, an ADLS would reduce operational phase nighttime lighting impacts (COP Volume I; Atlantic Shores 2023). ADLS would only activate the required FAA aviation obstruction lights on WTGs and OSSs when aircraft enter a predefined airspace and turn off when the aircraft were no longer in proximity to the WTA. Based on recent studies (COP Volume II, Appendix II-M4; Atlantic Shores 2023), activation of the Atlantic Shores ADLS would be anticipated to occur for less than 9 hours per year, compared to standard continuous FAA hazard lighting. Overall, the impacts on cultural resources from operational lighting on WTGs and OSSs associated with the Proposed Action would result in negligible to minor impacts on cultural resources.

Use of lighting on Onshore Project facilities for O&M of the Proposed Action could result in a change to the integrity of the historic setting of historic aboveground resources by introducing new sources of light into historic contexts, both onshore and offshore. Operational lighting would be required for the O&M of the onshore substations, converter stations, and POIs. However, the lights associated with these facilities would have minimal visibility from historic aboveground resources, and due to the developed nature of the visual APE for Onshore Project components, the lights are not expected to contribute significantly to the sky glow resulting from existing light sources present in their respective areas. Plantings to create screening would be installed at the onshore substation and converter station sites to the maximum extent practicable to reduce potential visibility and thereby avoid impacts from lighting from onshore facilities during O&M (COP Volume II, Section 6.1.2.2; Atlantic Shores 2023). Additional lighting mitigation may include keeping lighting to a minimum, turning lights on only as needed, directing lights downward, and utilizing full cut-off fixtures to minimize offsite light trespass (COP Volume II, Appendices II-M2 and II-M3; Atlantic Shores 2023). As a result, lighting would likely result in negligible impacts on the three aboveground historic properties in the visual APE for Onshore Project components and seven aboveground historic properties in the visual APE for the O&M facility.

During decommissioning, WTGs and OSSs would be disassembled, resulting in the removal of lighting components (COP Volume I, Sections 6.2.1 and 6.2.2; Atlantic Shores 2023). Onshore facilities (such as onshore substations, converter stations, POIs, and buried duct banks) would either be retired in place or reused for other purposes (COP Volume I, Section 6.2.6; Atlantic Shores 2023). Overall, lighting associated with the Proposed Action is anticipated to have negligible impacts on cultural resources during the construction and installation, O&M, and conceptual decommissioning phases.

Noise: Airborne noise produced by the Project could result in a change to the integrity of the historic setting of historic aboveground resources by introducing modern sounds into historic contexts both on- and offshore. Historic aboveground resources set in urban contexts may not be subject to impacts by an increase in airborne noise, while in other contexts airborne noise may lead to the disruption of the historic setting by which a cultural resource derives its significance. Based on an assessment of operational noise of the Project (COP Volume II, Appendix II-U; Atlantic Shores 2023), noise generated by Offshore Project components, including the WTGs, is not expected to be audible at the nearest shorelines. Therefore, operational noise associated with the Offshore Project components is anticipated to have negligible impacts on cultural resources.

The onshore interconnection facilities and substations/converter stations may generate noise at levels that would vary based on the type of facility constructed. The design of onshore facilities would depend on whether HVAC, HVDC, or a combination of both HVAC and HVDC onshore interconnection cables are constructed. It is anticipated that the HVDC design would have generally lesser sound impacts on the surrounding community than HVAC technology. Therefore, only the HVAC onshore substation design was evaluated to provide the most conservative assessment of potential noise impacts. Modeled sound levels around the onshore substation and converter station sites showed all nearby land uses would comply with their respective residential or commercial A-weighted sound limits with some sound level mitigation (COP Volume II, Section 6.1.2.3; Atlantic Shores 2023). Noise from the O&M of onshore substations and cables is anticipated to be consistent with background noise already in the area, including automobile and marine traffic, and would be mitigated by the incorporation of noise-reducing design features, such as strategically placed noise barriers on equipment and other features required to comply with local noise ordinances (COP Volume II, Appendix II-U; Atlantic Shores 2023).

The onshore interconnection cables would not generate noise during operations because the cable would be buried beneath existing roads or within other public and utility ROWs. Noise levels generated by the proposed onshore facilities would vary based on the type of facilities (HVAC, HVDC, or both HVAC and HVDC) that are constructed, but it is anticipated that the HVDC design would have generally lesser sound impacts on the surrounding community than HVAC technology. If necessary, screening would be implemented at the onshore substation sites to the extent feasible to reduce potential noise effects on aboveground historic properties (CUL-08; Appendix G, Table G-1). The proposed O&M facility is not anticipated to produce noise that would be out of character with the surrounding environment, including noise associated with marine and automobile traffic (COP Volume II, Appendix II-N2; Atlantic Shores 2023). To minimize potential impacts, the onshore substations/converter stations would be designed to comply with NJDEP sound level limits. Screening would be implemented at the onshore substation and converter station sites to the maximum extent practicable, to reduce potential noise impacts from onshore facilities. The anticipated levels of noise generated by onshore facilities are described in greater detail in the Onshore Noise Report (COP Volume II, Appendix II-U; Atlantic Shores 2023). It is anticipated that any noise from the facilities during O&M would be eliminated once the facilities are decommissioned. Therefore, noise associated with the Onshore Project components is anticipated to have negligible impacts on historic aboveground resources.

Overall, impacts of noise from onshore and offshore components of the Proposed Action are anticipated to have negligible impacts on cultural resources.

Port utilization: Construction and O&M vessels would travel between the Offshore Project area and a third-party port facility where equipment and materials would be staged. Atlantic Shores anticipates using ports in Salem County and Gloucester County, New Jersey; Portsmouth City, Virginia; and Nueces County and San Patricio Counties, Texas, to support construction. The proposed O&M facility would be located at Atlantic City Harbor, Atlantic County, New Jersey. The areas of the Project APE and potential impacts from the Proposed Action associated with the O&M facility are discussed under the *Land disturbance* and *Presence of structures* IPFs. Potential impacts from activities under the connected action at the O&M facility are discussed in the next section. Overall, the Proposed Action would not directly require any upgrades to port infrastructure at these locations and therefore would have no measurable impacts on cultural resources that may be present at or near those port locations.

Presence of structures: The visibility of Project components could have impacts on cultural resources. Atlantic Shores' investigations identified three aboveground historic properties in the visual APE for Onshore Project components with potential visibility of these components as determined through viewshed analysis (COP Volume II, Appendix II-N1; Atlantic Shores 2023). The onshore interconnection cables would be buried beneath or adjacent to existing ROWs. The onshore substation and/or converter stations may include equipment and facilities such as transformers, static synchronous compensators, shunt reactors, harmonic filter banks, a valve hall, an AC yard and a DC area, a reactor yard, valve cooling towers, AC filters, and substation control, service, and storage buildings, depending on the type of transmission cables used. The nature and degree of visual impacts would be minimal due to the density of existing modern development and infrastructure (COP Volume II, Appendix II-N1; Atlantic Shores 2023). Impacts would be further minimized on historic aboveground resources due to the distance from the site, the overall setting that already features overhead utilities and buildings, and by the likelihood that drivers along these parkways would be primarily focused on navigating traffic along a busy section of roadway and, thus, less likely to notice the visual changes (COP Volume II, Appendices II-M2 and II-M3; Atlantic Shores 2023). Therefore, the new transmission lines and substations/converter stations that would be operated as a part of the Proposed Action are expected to have negligible impacts on the three aboveground historic properties within the visual APE for Onshore Project components (COP Volume II, Appendix II-N1; Atlantic Shores 2023).

Atlantic Shores' investigations identified seven aboveground historic properties in the visual APE for the O&M facility with potential visibility of this component as determined through viewshed analysis (COP Volume II, Appendix II-N2; Atlantic Shores 2023). The O&M facility includes a three-story operations building, a parking structure, an access road around the building perimeter, and three floating pontoons used to moor work vessels. The facility would be up to 50 feet (15 meters) tall, and the tallest component would be a communications tower, which would be up to 120 feet (36.6 meters) tall. The O&M facility would likely not appear out of place in the context of modern buildings and infrastructure surrounding it. Therefore, the proposed O&M facility would have negligible impacts on the seven aboveground historic properties identified in this portion of the visual APE for Onshore Project components (COP Volume II, Appendix II-N2; Atlantic Shores 2023).

The presence of structures in the WTA, including foundations and scour protection for WTGs and OSSs, could have impacts on cultural resources. Atlantic Shores' Historic Resources Visual Effects Assessment (HRVEA) for Offshore Project components also determined that the Proposed Action could adversely affect up to 27 aboveground historic properties, including historic districts, individual historic aboveground resources, and two NHLs, in the visual APE for Offshore Project components (see Appendix I for a complete list of historic properties) (COP, Appendix II-O; Atlantic Shores 2023). The study determined that views and vistas of the Atlantic Ocean, free of modern visual elements, are a contributing element to the NRHP eligibility of the historic homes and structures, recreational properties, lighthouses and navigational aids, and maritime defense facilities. A location near the water or a historic functional relationship with the sea is also an element of the latter three aboveground property types. Although the operational life of the Project is 30 years, and the WTGs and OSSs would be decommissioned after that period, the presence of visible WTGs from the Proposed Action alone would have long-term, continuous, widespread, minor to moderate impacts on these resources. The study determined that the scale, extent, and intensity of these impacts would be partially mitigated by environmental and atmospheric factors such as clouds, haze, fog, sea spray, vegetation, and wave height that would partially or fully screen the WTGs from view during various times throughout the year. In addition, offshore components of the Proposed Action alone would only affect seaward views from these resources. To further minimize and mitigate the Proposed Action's effects, Atlantic Shores has voluntarily committed to several EPMs (Appendix G, Table G-1*;* COP Volume II, Section 6.1.2.5; Atlantic Shores 2023). These measures include painting the WTGs no lighter than Pure White (RAL 9010) and no darker than Light Grey (RAL 7035) and implementation of an ADLS to limit nighttime lighting impacts (VIS-03 and VIS-05, Appendix G, Table G-1).

The final resolution of adverse effects on historic properties will be determined through BOEM's NHPA Section 106 consultation process and included as conditions of COP approval as established in the MOA.

Traffic: An increase in traffic associated with the Project could result in a change to the integrity of the historic setting of historic aboveground resources by creating an increase in the flow of aircraft, vessels, or land-based vehicles that could disrupt the historic contexts of cultural resources. Marine vessels used to complete construction and decommissioning activities would likely include jack-up vessels, heavy-lift vessels, and support vessels such as tugboats and crew transfer vessels for Offshore Project components (COP Volume I, Section 6.2; Atlantic Shores 2023). Given the relative frequency of seagoing vessels on the horizon in the APE, it is unlikely that marine traffic related to the construction and installation, O&M, and decommissioning of the Project would be a noticeable change (COP Volume II, Section 6.1.2.4; Atlantic Shores 2023).

The proposed Onshore Project areas are within or adjacent to busy roadways, where vehicle traffic is already a part of the setting. While O&M of the onshore substations and converter stations and POIs would occur regularly based on manufacturer recommended schedules, these facilities would be unmanned during routine operations and would likely cause no noticeable increase in existing traffic patterns. If any unforeseen maintenance is required, impacts on traffic from potential detours might occur (COP Volume II, Section 6.1.2.4; Atlantic Shores 2023). Additionally, Onshore Project components may require truck-mounted winches, cable reels, and cable reel transport trucks during decommissioning (COP Volume I, Section 6.2; Atlantic Shores 2023). Traffic is not anticipated to have an impact on the integrity of the historic setting of identified historic aboveground resources for the duration of the Project's activity. The O&M facility operation may result in a slight increase in traffic as automobiles and marine vessels arrive and depart during working hours. However, it is not anticipated that this slight increase would result in adverse impacts on identified historic aboveground resources due to the existing conditions near the O&M facility site, as it would be located immediately adjacent to a state marina and a major highway onramp (COP Volume II, Appendix II-N2; Atlantic Shores 2023). Overall, onshore and offshore traffic caused by the Proposed Action is anticipated to have negligible impacts on cultural resources.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). These activities are proposed to include the repair and/or replacement of an existing bulkhead to be conducted by Atlantic Shores via a USACE Nationwide Permit 3 or USACE Nationwide Permit 13 and implementation of a maintenance dredging program to be conducted by Atlantic Shores in coordination with the City of Atlantic City via USACE DA Permit (CENAP-OPR-2021-00573-95) and a NJDEP Dredge Permit (No. 0102.20.0001.1 LUP 210001). See Chapter 2, Section 2.1.2.4, *Connected Action*, for additional details. The area subject to impacts from the connected action largely coincides with a portion of the Project APE associated with the O&M facility under the Proposed Action (see Appendix I, Figure I-2). However, activities associated with the connected action are distinct from and will occur independently of other activities Atlantic Shores has proposed at the O&M facility under the Proposed Action.

Subsequently, activities under the connected action have undergone or will undergo Section 106 review, with USACE serving as the lead federal agency. In its issuance of City of Atlantic City's DA Permit (CENAP-OPR-2021-00573-95), USACE fulfilled its Section 106 obligations and determined the proposed activities would have no effect on historic properties. Atlantic Shores is in the process of preparing their USACE

Nationwide Permit 3 or Nationwide Permit 13 for the proposed bulkhead repair and/or replacement activities, and as such, USACE's Section 106 review has not yet commenced for this portion of activities under the connected action. BOEM will participate in Section 106 consultation for this portion of activities under the connected action. If findings from the Section 106 review change BOEM's final determinations and finding of effects for the Proposed Action, BOEM will ensure consulting parties may review and consult on final determinations and findings associated with this portion of activities under the connected action.

City of Atlantic City's approved USACE DA Permit (CENAP-OPR-2021-00573-95) indicates USACE found that the dredging activities proposed under the connected action would have no effect on historic properties. BOEM has determined Atlantic Shores' proposed bulkhead repair or replacement under the connected action has the potential to subject cultural resources to adverse impacts. Based on relevant cultural resource background information provided in Atlantic Shores' COP (COP Volume II, Appendices II-N2 and II-P2; Atlantic Shores 2023), no previously recorded marine cultural resources, terrestrial archaeological resources, or historic aboveground resources are located in the area subject to physical effects from seabed- or ground-disturbing activities of the connected action. However, seven aboveground historic properties are located in the Proposed Action's visual APE for the O&M facility and may be subject to effects from the connected action. Presently unknown but potential cultural resources may exist in this area and would be subject to adverse impacts.

Impacts on cultural resources from the connected action are expected through the following primary IPFs.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during activities associated with the connected action. However, the volume of materials released in an accidental spill or leak is unlikely to require cleanup operations that would permanently have impacts on cultural resources. As a result, the impacts of accidental releases from the connected action alone on cultural resources would be negligible to minor. More substantial impacts could occur in the unlikely event of a large-scale release and if previously undiscovered cultural resources are discovered during the performance of these activities.

Land disturbance: Bulkhead repair activities of the connected action may involve ground disturbance, which could have impacts on cultural resources. No previously recorded terrestrial archaeological resources or historic aboveground resources are located in the area subject to ground-disturbing activities of the connected action (COP Volume II, Appendices II-N2 and II-P2; Atlantic Shores 2023). Cultural resource and historic property investigations are being conducted under Section 106 review for the portion of the connected action related to bulkhead repair and/or replacement, with USACE serving as Lead Federal Agency, and may lead to the identification of cultural resources subject to impacts from land disturbance. However, activities under the connected action are proposed for an area likely significantly disturbed by land reclamation and construction throughout the twentieth century, and therefore there is low potential for intact or potentially significant terrestrial archaeological resources in this area (COP Volume II, Appendix II-P2; Atlantic Shores 2023). Cultural resource investigations completed for the Proposed Action have found that the bulkhead subject to repair or replacement under the connected action is not itself a historic property eligible for listing in the NRHP and subject to adverse effects. As such, BOEM expects that land disturbance associated with the connected action would have negligible to major impacts on cultural resources, with more substantial moderate to major impacts occurring if previously undiscovered archaeological resources are discovered during the performance of these activities.

Lighting: Should any of these activities occur at night, nighttime lighting may be utilized, which could have impacts on cultural resources. Impacts on cultural resources could occur on any of those historic properties with visibility of the lighting and for which a dark nighttime sky is a character-defining feature that contributes to historic significance and integrity. However, these impacts would be short term. As a result, BOEM anticipates lighting associated with the connected action would have negligible impacts on cultural resources.

Port utilization: Under the connected action, Atlantic Shores would conduct bulkhead repair activities and, in coordination with the City of Atlantic City, would conduct maintenance dredging at Atlantic City's Inlet Marina. These activities have been or are being separately reviewed and authorized by USACE and state and local agencies. City of Atlantic City's approved USACE DA Permit (CENAP-OPR-2021-00573-95) indicates USACE found the dredging activities proposed under the connected action would have no effect on historic properties; as such, BOEM does not anticipate activities that affect or sweep the seafloor would have impacts on any marine cultural resources. Any activities associated with the bulkhead repair and/or replacement that involve ground disturbance could potentially have physical impacts on presently undiscovered but potential terrestrial archaeological resources or historic aboveground resources. Based on relevant cultural resource background information provided in Atlantic Shores' COP (COP Volume II, Appendices II-N2 and II-P2; Atlantic Shores 2023), no previously recorded cultural resources are located in the area subject to physical impacts from the connected action. Activities under the connected action are proposed for an area subject to prior dredging, land reclamation, and construction disturbances, and therefore the area bears low potential for intact or potentially significant marine cultural resources or terrestrial archaeological resources (COP Volume II, Appendix II-P2; Atlantic Shores 2023). However, cultural resource and historic property investigations are being conducted under Section 106 review for the portion of the connected action related to bulkhead repair and/or replacement, with USACE serving as Lead Federal Agency and may lead to the identification of cultural resources subject to impacts. Cultural resource investigations completed for the Proposed Action have found that the bulkhead subject to repair or replacement under the connected action is not itself a historic property eligible for listing in the NRHP and subject to physical adverse effects. Additionally, investigations completed for the connected action may identify historic aboveground resources that are historic properties subject to visual adverse effects. As such, port utilization associated with the connected action would have negligible to major impacts on cultural resources depending on the identification of cultural resources in the area subject to impacts. More substantial moderate to major impacts could occur if previously undiscovered archaeological resources are discovered during the performance of these activities or if historic properties subject to visual effects are identified in the area subject to impacts.

Presence of structures: Repair of the existing bulkhead may not introduce elements that diminish the location, feeling, and association of potential historic aboveground resources with visibility of the bulkhead, because the visual alterations could be consistent with and sustain the current setting of the marina. The replacement of the bulkhead could introduce visual alterations that diminish such characteristics of these potential historic aboveground resources, depending on the appearance of the replacement. Cultural resource and historic property investigations are being conducted under Section 106 review for the portion of the connected action related to repair and/or replacement of the bulkhead, with USACE serving as the Lead Federal Agency, and may lead to the identification of cultural resources subject to impacts. As a result, presence of structures associated with the connected action would have negligible to major impacts on cultural resources depending on the identification of cultural resources in the area subject to impacts. More substantial moderate to major impacts could occur if historic properties subject to visual effects are identified in the area subject to impacts.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action.

Accidental releases: Impacts from accidental releases on cultural resources from offshore wind projects would be similar to those of the Proposed Action and be negligible in most cases, except that rare cases of large-scale accidental release may represent major impacts on cultural resources. The cumulative impacts on marine cultural resources from accidental releases would range from localized, short-term, and negligible to geographically extensive, permanent, and major depending on the number and scales of accidental releases, if any.

Anchoring: The Proposed Action, combined with impacts from ongoing and planned activities, could have impacts on marine cultural resources through anchoring. BOEM anticipates that lead federal agencies and relevant SHPOs would require the applicants for offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. BOEM would also continue to require developers to avoid, minimize, or mitigate impacts on any identified marine cultural resources that are historic properties during construction and installation, O&M, and decommissioning. BOEM has committed to working with Tribes, NJHPO, applicants, and consulting parties to develop specific HPTPs to address effects on marine cultural resources that cannot be avoided by proposed offshore wind development projects. Development and implementation of Project-specific HPTPs, agreed to by Tribes and consulting parties, would likely reduce the magnitude of unmitigated impacts on marine cultural resources; however, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided. As a result, the cumulative impacts on marine cultural resources from anchoring from the Proposed Action, combined with impacts from ongoing and planned activities, would be localized and permanent, and range from negligible to major depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Cable emplacement and maintenance: The Proposed Action, combined with impacts from ongoing and planned activities, could have impacts on marine cultural resources through cable emplacement and maintenance. The potential range of severity and extent of impacts on marine cultural resources under this IPF are the same as those described under the *Anchoring* IPF for the cumulative impacts of the Proposed Action. The cumulative impacts on marine cultural resources from cable emplacement and maintenance from the Proposed Action, combined with impacts from ongoing and planned activities, would be localized and permanent, and range from negligible to major depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Gear utilization: The Proposed Action, combined with impacts from ongoing and planned activities, could have impacts on marine cultural resources through gear utilization. The potential range of severity and extent of impacts on marine cultural resources under this IPF are the same as those described under the *Anchoring* IPF for the cumulative impacts of the Proposed Action. The cumulative impacts on marine cultural resources from gear utilization from the Proposed Action, combined with impacts from ongoing and planned activities, would be localized and permanent, and range from negligible to major depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Land disturbance: Land disturbance (e.g., ground-disturbing construction activities) from offshore wind developments could result in impacts on known and undiscovered cultural resources (if present). BOEM anticipates that federal (i.e., NEPA and NHPA Section 106) and state-level requirements to identify cultural resources, assess impacts, and implement measures to avoid, minimize, or mitigate impacts would minimize impacts on cultural resources from the reasonably foreseeable wind developments. The cumulative impacts from land disturbance from the Proposed Action, combined with ongoing and planned activities, would result in localized, short-term to permanent, and negligible to major impacts on cultural resources depending on the developers' abilities to avoid, minimize, or mitigate impacts of ground-disturbing activities. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Lighting: Lighting from the offshore wind developments could result in impacts on cultural resources. Nighttime lighting impacts would be restricted to cultural resources for which a dark nighttime sky is a character-defining feature contributing to the historic significance and integrity of the resource. Permanent aviation and vessel warning lighting would be required on all WTGs and OSSs built by offshore wind projects. The Proposed Action would account for approximately 29.7 percent of the WTGs and OSSs in the geographic analysis area that could potentially have cumulative visual impacts on historic properties. If ADLS were used by offshore wind developments, nighttime hazard lighting impacts on cultural resources from ongoing and planned activities, including offshore wind and the Proposed

Action, would be negligible. If offshore wind projects do not commit to using ADLS, operational lighting from the Proposed Action combined with ongoing and planned activities including offshore wind would have negligible to moderate impacts on cultural resources. Therefore, cumulative impacts from lighting from the Proposed Action combined with ongoing and planned activities would result in negligible to moderate impacts on cultural resources.

Noise: Impacts of noise from offshore wind projects would be similar to those of the Proposed Action: noise generated by offshore wind project components would be unlikely to be audible from the nearest shorelines. Noise could also occur in localized locations associated with onshore project components throughout the larger geographic analysis area. Noise from the O&M of onshore substations and cables could be consistent with background noise already in the area of these components, including automobile and marine traffic. Therefore, the cumulative impacts on cultural resources from noise from the Proposed Action combined with impacts from ongoing and planned activities would be localized and short term, and would range from negligible to minor.

Port utilization: Expected increases in port activity associated with the development of offshore wind projects would likely require modifications and expansions at ports along the East Coast. These port modification and expansion projects could have impacts on cultural resources within or near port facilities. Due to state and federal requirements to identify and assess impacts on cultural resources as part of NEPA and the NHPA and the requirements to avoid, minimize, or mitigate adverse impacts on cultural resources, these impacts would be long term, adverse, and isolated to a limited number of cultural resources that cannot be avoided or that were previously undocumented. As such, impacts from port utilization from the Proposed Action, combined with ongoing and planned activities, would range from negligible to major.

Presence of Structures: BOEM conducted a Cumulative Historic Resources Visual Effects Assessment (CHRVEA) to evaluate visual impacts on the 27 aboveground historic properties in the visual APE determined to be adversely affected (BOEM 2023). The planned activities scenario assessment determined the maximum number of WTGs from the Proposed Action and planned offshore wind projects that could be theoretically visible (based on distance, topography, vegetation, and intervening structures) from each of the 27 historic properties affected by the Proposed Action. The study assessed these values using known project specifications of each project within the geographic analysis area to simulate the maximum number of WTGs that could theoretically be visible from the Proposed Action and offshore wind projects. Other offshore wind projects included in the cumulative WTG count from historic properties are Atlantic Shores North, GSOE I, Ocean Wind 1, Ocean Wind 2, Skipjack Offshore Energy, Bight Wind Holdings, Atlantic Shores Offshore Wind Bight, and Invenergy Wind Offshore that have intervisibility with the 27 historic properties (BOEM 2023). See Appendix I, Table I-6 for a list of these historic properties.

The CHRVEA demonstrated that portions of WTGs would be theoretically visible from each of the 27 historic properties. Fewer WTGs would be visible from lower elevations, locations without clear east-facing seaward views, and from historic properties located farther from the lease areas. Historic properties with unobstructed views toward the ocean would be subject to the largest scale impacts due to theoretical visibility of portions of the up to 1,021 WTGs within the geographic analysis area (BOEM 2023).[1] WTGs associated with the Project would represent 22.8 to 35.9 percent of the total WTGs theoretically visible from each property, with the closest Project WTG approximately 9.91 miles (15.95 kilometers) away from the closest historic property. WTGs associated with other offshore wind energy development activities would represent 64.1 to 77.2 percent of the total WTGs theoretically visible from each property, with the closest WTGs approximately 8.62 miles (13.87 kilometers) away from the closest historic property. As such, the proposed Project is a large-scaled development when compared to other developments planned nearby (BOEM 2023).

In addition to the limited geographic extent of impacts, the intensity of visual impacts on these historic properties would be limited by distance and environmental and atmospheric factors. As discussed in Section 3.6.8, *Recreation and Tourism,* the visibility of WTGs would be further reduced by environmental and atmospheric factors such as cloud cover, haze, sea spray, vegetation, and wave height. While these factors would limit the intensity of impacts, the presence of visible WTGs from ongoing and planned activities, including the Proposed Action, would have long-term, continuous, minor to moderate impacts on these 27 aboveground historic properties. The Proposed Action would contribute a noticeable increment to these impacts.

Traffic: Impacts of traffic from offshore wind projects would be similar to those of the Proposed Action due to the anticipated increase in the flow of aircraft, vessels, or land-based vehicles. Increased traffic would occur in localized locations throughout the larger geographic analysis area. The cumulative impacts on cultural resources from traffic from the Proposed Action combined with impacts from ongoing and planned activities would be localized and short term, and would range from negligible to minor.

Conclusions

Impacts of Alternative B – Proposed Action. The Proposed Action alone would have negligible to major impacts on individual cultural resources. Impacts would be reduced through the NHPA Section 106 consultation process as a result of the commitments made by Atlantic Shores and implementation of EPMs to resolve adverse effects on historic properties. Similarly, the analysis of impacts is based on a maximum-case scenario; impacts would be reduced by implementation of a less-impactful construction or infrastructure development scenario in the PDE. Greater impacts, ranging from moderate to major, would occur without the pre-construction NHPA requirements to identify historic properties, assess potential effects, and develop HPTPs to resolve effects through avoidance, minimization, or mitigation. These NHPA-required, “good-faith” efforts to identify historic properties

[1] The CHRVEA analyzes the intervisibility of other regional projects based on known WTG location and height information as of July 2022 and as provided to Atlantic Shores by BOEM to produce the cumulative photosimulations. The information regarding WTG totals for each project was based on the best available information about commercially available WTGs at that time and differs from the totals presented in Appendix D of this Draft EIS.

and address impacts resulted in or contributed to Atlantic Shores making a number of commitments to reduce the magnitude of impacts on cultural resources (Appendix G).

BOEM expects the connected action alone would have negligible to major impacts on cultural resources depending on the identification of cultural resources in the area subject to impacts from activities proposed under the connected action. More substantial moderate to major impacts could occur if previously undiscovered archaeological resources are discovered during the performance of these activities or if historic properties subject to visual effects are identified in the area subject to impacts.

BOEM anticipates that NHPA requirements to identify historic properties and resolve adverse effects would similarly reduce the significance of potential impacts on historic properties from offshore wind projects as they complete the NHPA Section 106 review process. However, mitigation of both physical and visual adverse effects on historic properties would still be needed under the Proposed Action. Therefore, the overall impacts on historic properties from the Proposed Action would likely qualify as **major** because a notable and measurable impact requiring mitigation is anticipated.

Cumulative Impacts of Alternative B – Proposed Action. Impacts of individual IPFs resulting from the Proposed Action in combination with other ongoing and planned activities and the connected action would be appreciable. Considering all the IPFs together, BOEM anticipates that the impacts on cultural resources associated with the Proposed Action and other ongoing and planned activities would be **major** due to the long-term or permanent and irreversible impacts on archaeological (terrestrial and marine) resources and ASLFs if they cannot be avoided, and long-term impacts on historic aboveground resources, including the 27 historic properties identified in Appendix I, Table I-6.

3.6.2.6 Impacts of Alternative C on Cultural Resources

Impacts of Alternative C. Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) includes four sub-alternatives (C1, C2, C3, and C4) that involve the adjustment of layout or maximum number of WTGs and OSSs to avoid and minimize potential impacts on important fisheries habitats and AOCs identified by NMFS. NMFS identified two AOCs within the Lease Area that have pronounced bottom features and produce habitat value: AOC 1 is part of a designated recreational fishing area called "Lobster Hole," and AOC 2 is part of a sand ridge (ridge and trough) complex. Due to Atlantic Shores' commitment to avoidance of marine archaeological resources (CUL-18, Appendix G, Table G-1), impacts on marine archaeological resources under this alternative are anticipated to be the same as the Proposed Action. Proposed activities under Alternative C would not involve changes to any Onshore Project components; therefore, impacts on historic aboveground resources in the visual APE for Onshore Project components and terrestrial archaeological resources under Alternative C would be the same as those under the Proposed Action. Given the size, locations, and number of WTGs unaffected by removal under this alternative, impacts on historic aboveground resources in the visual APE for Offshore Project components would not substantially reduce the overall visual impact of the Project on this type of cultural resource. As such, impacts on historic aboveground resources under this alternative are anticipated to be the same or similar to those under the Proposed Action.

Removal of the number of WTGs, OSSs, and associated interlink cables may change the degrees of impact on ASLFs depending on the locations of the removed components in relation to the locations of ASLFs. ASLFs located within the area from which Offshore Project components would be removed would experience no or fewer impacts from the Project. Details on each of the Alternative C sub-alternatives and their specific impacts on ASLFs are provided below.

Alternative C1 would involve the removal of up to 16 WTGs, 1 OSS, and associated interlink cables within the Lobster Hole designated area as identified by NMFS. Implementation of Alternative C1 would result in a reduction of impact severity on 3 ASLFs (i.e., Targets 47, 48, and 49) that have been identified within the area from which Offshore Project components would be removed under this alternative. However, this alternative would not result in full avoidance of impacts on these resources. Alternative C2 would involve the removal of up to 13 WTGs and associated interlink cables within the NMFS-identified sand ridge complex. Implementation of Alternative C2 would result in a reduction of impact severity on two ASLFs (i.e., Targets 52 and 53) that have been identified within the area from which Offshore Project components would be removed under this alternative. Additionally, Alternative C2 could result in full avoidance of impacts on these resources depending on Atlantic Shores' implementation of avoidance buffers around the defined resource boundaries. Alternative C3 would involve the removal of up to six WTGs and associated interlink cables within the sand ridge complex area identified by NMFS but further demarcated through the use of NOAA's Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores. Implementation of Alternative C3 would result in a reduction of impact severity on two ASLFs (i.e., Targets 52 and 53) that have been identified within the area from which Offshore Project components would be removed under this alternative. Additionally, Alternative C3 could result in full avoidance of impacts on Target 53 depending on Atlantic Shores' implementation of avoidance buffers around the defined resource boundaries. Alternative C4 would involve micrositing 29 WTGs, one OSS, and associated interlink cables outside of 1,000-foot (305-meter) buffers of ridges and swales within AOCs 1 and 2. This alternative is not anticipated to reduce or increase impacts on ASLFs compared to those anticipated for the Proposed Action. As such, impacts on ASLFs under Alternative C4 are anticipated to be similar to those under the Proposed Action.

Removal of Offshore Project components from the Proposed Action, as proposed under any or all of these sub-alternatives, would reduce potential impacts on presently undiscovered marine archaeological resources in these areas. As a result, impacts on individual ASLFs under Alternative C may be reduced or similar compared to those under the Proposed Action depending on the specific locations of removed Offshore Project components and ASLFs. Overall, the majority of ASLFs are located in other areas of the marine APE that are unchanged under Alternative C. As a result, this alternative and its sub-alternatives would not substantially change the impacts on ASLFs overall; therefore, impacts on ASLFs under Alternative C would be similar to those of the Proposed Action.

Cumulative Impacts of Alternative C. The incremental impacts contributed by Alternative C to the cumulative impacts on cultural resources would be the same or similar to those described for the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative C and other ongoing and planned activities would be major.

Conclusions

Impacts of Alternative C. The impacts resulting from individual IPFs associated with Alternative C alone on cultural resources may be reduced or similar compared to the Proposed Action depending on the specific locations of removed Offshore Project components. The degree of impacts on specific cultural resources may be reduced from the removal of Offshore Project components under this alternative. As a result, Alternative C would have similar **major** impacts on cultural resources compared to the Proposed Action that may be avoided, minimized, or mitigated depending on Atlantic Shores' implementation of mitigation measures developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative C. The incremental impacts contributed by Alternative C to the cumulative impacts on cultural resources would be appreciable—the same or similar as for the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative C when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.6.2.7 Impacts of Alternative D on Cultural Resources

Impacts of Alternative D. Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) includes three sub-alternatives (D1, D2, and D3) that involve adjustments to the layout and maximum number of WTGs to reduce visual impacts. Due to Atlantic Shores commitment to avoidance of marine archaeological resources (CUL-18, Appendix G, Table G-1), impacts on marine archaeological resources under this alternative are anticipated to be the same as the Proposed Action. However, removal of Offshore Project components under this alternative would reduce potential impacts on presently undiscovered marine archaeological resources areas of removal. Proposed activities under Alternative D would not involve changes to any Onshore Project components; therefore, impacts on historic aboveground resources in the visual APE for Onshore Project components and terrestrial archaeological resources under Alternative D would be the same as those under the Proposed Action.

Impacts on ASLFs as well as historic aboveground resources in the visual APE for Offshore Project components would be different under Alternative D compared to the Proposed Action due to the removal of and modification of the height of Offshore Project components. Removal of WTGs and associated interlink cables may change the degrees of impact on marine cultural resources depending on the locations of the removed components in relation to the locations of marine cultural resources. ASLFs located within the area from which Offshore Project components would be removed would experience no or fewer impacts than for the Project. Removal of Offshore Project components from the Proposed Action would also reduce potential impacts on currently undiscovered marine archaeological resources that may be present in these areas. Reductions in height of the remaining WTGs in the Lease Area would reduce impacts on the number of individual historic aboveground resources subject to visual impacts and the severity of impacts on those resources. Details on each of the Alternative D sub-alternatives and their specific impacts on the aforementioned cultural resource types are provided below.

Alternative D1 would exclude placement of WTGs up to 12 miles (19.3 kilometers) from shore, resulting in the removal of up to 21 WTGs from Project 1 and associated interarray cables. Under this alternative, the height of the remaining WTGs in Project 1 would also be restricted to a maximum hub height of 522 feet (159 meters) ASML and a maximum blade tip height of 932 feet (284 meters) ASML. Implementation of this alternative would reduce impact severity on two ASLFs (i.e., Targets 45 and 58) but would not fully avoid impacts on these resources. Additionally, Alternative D1 is anticipated to reduce the impacts and impact severity on historic aboveground resources in the visual APE for Offshore Project components compared to those under the Proposed Action due to the decreased visibility of the Project. Alternative D2 would exclude placement of WTGs up to 12.75 miles (20.5 kilometers) from shore, resulting in the removal of up to 31 WTGs from Project 1 and associated interarray cables. The height of the remaining WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) ASML and a maximum blade tip height of 932 feet (284 meters) ASML. Implementation of this alternative would reduce the impact severity on two ASLFs (i.e., Targets 45 and 58). Full avoidance of impacts on Target 58 may be possible depending on Atlantic Shores' implementation of avoidance buffers around the defined resource boundaries. Additionally, Alternative D2 is anticipated to reduce the impacts and severity of impacts on historic aboveground resources in the visual APE for Offshore Project components compared to those under the Proposed Action due to the decreased visibility of the Project. Alternative D3 would exclude placement of WTGs up to 10.8 miles (17.4 kilometers) from shore, resulting in the removal of up to six WTGs from Project 1 and associated interarray cables. The height of the remaining WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL. No ASLFs are located within the area from which the six WTGs would be removed for this alternative; as such, impacts from Alternative D3 on ASLFs are expected to be the same as the Proposed Action. Additionally, while Alternative D3 would slightly reduce the visibility of the Project on historic aboveground resources in the visual APE for Offshore Project components, the visual impacts from the size, location, and number of retained WTGs under this alternative would not be substantially different from those of the Proposed Action. As such, the impacts and severity of impacts on these historic aboveground resources are anticipated to be similar to those under the Proposed Action despite the slight decreased visibility of the Project.

Overall, the majority of ASLFs are located in other areas of the marine APE that would be unchanged under Alternative D. As a result, this alternative and its sub-alternatives would not substantially change the impacts on ASLFs overall, and impacts on marine cultural resources under Alternative D would be similar to those of the Proposed Action. Finally, while sub-alternatives D1 and D2 may substantially reduce the visual impacts on historic aboveground resources in the visual APE for Offshore Project components, Alternative D3 is not anticipated to result in a substantial reduction.

Cumulative Impacts of Alternative D. The incremental impacts contributed by Alternative D to the cumulative impacts on cultural resources would be the same or similar to those described for the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative D and other ongoing and planned activities would be major.

Conclusions

Impacts of Alternative D. The impacts resulting from individual IPFs associated with Alternative D alone on cultural resources may be reduced or similar compared to the Proposed Action depending on the size, location, and number of removed Offshore Project components. The degree of impacts on cultural resources under Alternative D1 and D2 would be reduced compared to that of the Proposed Action, but the degree of impacts on cultural resources under Alternative D3 would be similar. Whereas impacts from Alternatives D1 and D2 would likely qualify as moderate, the Proposed Action and Alternative D3 are anticipated to have major impacts on cultural resources. As a result, Alternative D would have **moderate** to **major** impacts on cultural resources that may be avoided, minimized, or mitigated depending on Atlantic Shores' implementation of mitigation measures developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative D. The incremental impacts contributed by Alternative D to the overall impacts on cultural resources would be noticeable to appreciable. BOEM anticipates that the overall impacts on cultural resources associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.6.2.8 Impacts of Alternative E on Cultural Resources

Impacts of Alternative E. Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would involve modifications to the wind turbine array layout to create a setback between the WTGs in the lease areas of Atlantic Shores South (OCS-A 0499) and Ocean Wind 1 (OCS-A 0498) to reduce impacts on existing ocean uses. A setback of 0.81 to 1.08 nautical miles (1,500 to 2,000 meters) would occur along the southern boundary of the Lease Area through the exclusion or micrositing of up to 4 to 5 WTG positions proposed under the Proposed Action.

Due to Atlantic Shores commitment to avoidance of marine archaeological resources (CUL-18, Appendix G, Table G-1), impacts on marine archaeological resources under this alternative are anticipated to be the same as the Proposed Action. However, removal of Offshore Project components under this alternative would reduce potential impacts on presently undiscovered marine archaeological resources areas of removal. Proposed activities under Alternative E would not involve changes to any Onshore Project components; therefore, impacts on historic aboveground resources in the visual APE for Onshore Project components and terrestrial archaeological resources under Alternative E would be the same as those under the Proposed Action. Given the size, locations, and number of WTGs unaffected by removal under this alternative, impacts on historic aboveground resources in the visual APE for Offshore Project components would not substantially change the overall visual impact of the Project on this type of cultural resource. As such, impacts on historic aboveground resources under this alternative are anticipated to be the same or similar to those under the Proposed Action.

Removal or micrositing of Offshore Project components under this alternative may change the degrees of impact on marine cultural resources depending on the locations of the removed or microsited components in relation to the locations of marine cultural resources. No known marine archaeological resources are located within the proposed setback area; however, the removal of Offshore Project components from the Proposed Action would reduce potential impacts on presently undiscovered but potential marine archaeological resources in this area. Impacts on ASLFs would be different under Alternative E than those anticipated under the Proposed Action due to the removal of Project components to form the setback area. Three ASLFs (Targets 51, 52, and 53) have been identified within the proposed setback areas under Alternative E. Any setback measuring 0.81 to 1.08 nautical miles (1,500 to 2,000 meters) would result in a reduction of impact severity on Targets 51, 52, and 53 compared to impacts under the Proposed Action but would not fully avoid impacts on these resources. Overall, the majority of ASLFs are located in other areas of the marine APE that would be unchanged under Alternative E. As a result, this alternative would not substantially change the impacts on marine cultural resources overall; therefore, impacts on marine cultural resources under Alternative E would be similar to those of the Proposed Action.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the cumulative impacts on cultural resources would be the same or similar to those described for the cumulative impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative E and other ongoing and planned activities would be major.

Conclusions

Impacts of Alternative E. The impacts resulting from individual IPFs associated with Alternative E alone on cultural resources would be similar to those under the Proposed Action. This is because the nature and physical extent of proposed activities under this alternative would be largely comparable to those of the Proposed Action. As a result, Alternative E would have similar **major** impacts on cultural resources that may be avoided, minimized, or mitigated depending on Atlantic Shores' implementation of mitigation measures developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the overall impacts on cultural resources would be appreciable—the same as for the Proposed Action. BOEM anticipates that the overall impacts on cultural resources associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.6.2.9 Impacts of Alternative F on Cultural Resources

Impacts of Alternative F. Alternative F (Foundation Structures) includes three sub-alternatives (F1, F2, and F3) to analyze the maximum design scenario for each of the three different foundation categories that could be used for WTGs, OSSs, and the met tower proposed for Project 1 and Project 2. Due to Atlantic Shores commitment to avoidance of marine archaeological resources (CUL-18, Appendix G, Table G-1), impacts on marine archaeological resources under this alternative are anticipated to be the same as the Proposed Action. However, removal of Offshore Project components under this alternative would reduce potential impacts on presently undiscovered marine archaeological resources areas of removal. Proposed activities under Alternative F would not involve changes to any Onshore Project components; therefore, impacts on historic aboveground resources in the visual APE for Onshore Project components and terrestrial archaeological resources under Alternative F would be the same as those under the Proposed Action. Additionally, differences in foundation type are not anticipated to result in measurable differences in the impacts on historic aboveground resources in the visual APE for Offshore Project components. As such, impacts on historic aboveground resources overall (i.e., those in the visual APE for both Onshore and Offshore Project components) under Alternative F are anticipated to be the same as those under the Proposed Action.

Impacts on ASLFs would be different under Alternative F than those anticipated under the Proposed Action. These impacts are caused by temporary and permanent seabed disturbances that occur during the construction of WTGs and OSSs. The maximum area of seabed disturbance for each of the three foundation types is subject to differ (COP Volume I, Sections 4.4.1 and 4.6.1 and Tables 4.2-1 and 4.4-2; Atlantic Shores 2023).

Under Alternative F1, piled foundations would be used. Use of the monopile subtype would cause greater seabed disturbance than the piled jacket subtype and therefore greater potential impacts on marine cultural resources. Analyzing the maximum design scenario of this sub-alternative (i.e., use of the monopile subtype), Alternative F1 would result in less severe impacts on ASLFs than Alternative F2 but more severe impacts than Alternative F3. Under Alternative F2, suction bucket foundations would be used. The jacket subtype would cause the greatest seabed disturbance and therefore the most severe impacts on ASLFs among the suction bucket foundations, followed by the mono-bucket subtype, and then the tetrahedron base subtype. Analyzing the maximum design scenario of this sub-alternative (i.e., use of the jacket subtype), Alternative F2 would result in more severe impacts on ASLFs than Alternatives F1 or F3. Under Alternative F3, gravity foundations would be used. Use of the GBS subtype would cause greater seabed disturbance than the gravity-pad tetrahedron base and therefore greater potential impacts on ASLFs. Analyzing the maximum design scenario of this sub-alternative (i.e., use of the GBS subtype), Alternative F3 would result in less severe potential impacts on ASLFs than either Alternative F1 or F2.

In summary, foundations proposed under Alternative F3 would have the least potential for and severity of impacts on ASLFs as a result of having the least area of maximum seabed disturbance. Alternative F2 would have the most potential for and severity of impacts on ASLFs as a result of having the greatest area of maximum seabed disturbance.

Cumulative Impacts of Alternative F. The incremental impacts contributed by Alternative F to the cumulative impacts on cultural resources would be the same or similar to those described for cumulative impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative F and other ongoing and planned activities would be major.

Conclusions

Impacts of Alternative F. The impacts resulting from individual IPFs associated with Alternative F alone on cultural resources may be reduced, the same, similar, or increased compared to those under the Proposed Action depending on the final foundation type(s) selected under the Proposed Action and specific locations of ASLFs in relation to proposed WTGs and OSSs. The severity of impacts on ASLFs increases with the size of the foundation type and anticipated seabed disturbance. However, overall, the nature and physical extent of proposed activities under this alternative would be largely comparable to those of the Proposed Action. As a result, Alternative F would have similar **major** impacts on cultural resources as the Proposed Action that may be avoided, minimized, or mitigated depending on Atlantic Shores' implementation of mitigation measures developed through the NHPA Section 106 consultation process.

Cumulative Impacts of Alternative F. The incremental impacts contributed by Alternative E to the overall impacts on cultural resources would be appreciable—the same as for the Proposed Action. BOEM anticipates that the overall impacts on cultural resources associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.6.2.10 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed in Table 3.6.2-3 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.6.2-3. Proposed mitigation measures – cultural resources

Mitigation Measure	Description	Effect
Marine cultural resources avoidance or additional investigation	Atlantic Shores must establish and comply with requirements for all protective buffers recommended by the Qualified Marine Archaeologist for each marine cultural resource (i.e., archaeological resource and ASLFs) based on the size and dimension of the resource. Protective buffers extend outward from the maximum discernable limit of each resource and are intended to minimize the risk of disturbance during construction. If avoidance of a resource is not feasible, additional investigations must be conducted for the purpose of determining eligibility for listing in the NRHP. If any such resource is determined eligible for listing, or if BOEM assumes the resource to be eligible for listing, Atlantic Shores must conduct Phase III data recovery investigations or implement another appropriate mitigation measure as determined through consultation for the purposes of resolving adverse effects in accordance with 36 CFR 800.6.	Avoidance would result in negligible impacts on these cultural resources, whereas additional investigations could result in minor to major impacts on individual resources on a case-by-case basis.

Mitigation Measure	Description	Effect
ASLF monitoring program and post-review discovery plan	Atlantic Shores must establish and implement a monitoring program and post-review discovery plan to review impacts of construction or any seabed-disturbing activities on ASLFs if such landforms will not be avoided and will be impacted.	Implementation of monitoring and a post-review discovery plan, which would include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and post-review discoveries procedures and contacts, would reduce potential impacts on any previously undiscovered but potential marine archaeological resources encountered during construction. Depending on the location of the ASLF, enforcement of this measure would be under the jurisdiction of BOEM or NJHPO. Implementation of a post-review discoveries plan would reduce potential impacts on previously undiscovered archaeological resources to a minor level by preventing further physical impacts on the resource during construction.
Terrestrial archaeological resource avoidance or additional investigation	Atlantic Shores must avoid any identified terrestrial archaeological resource. If avoidance of a resource is not feasible, additional investigations must be conducted for the purpose of determining eligibility for listing in the NRHP. If any such resource is determined eligible for listing, Atlantic Shores must conduct Phase III data recovery investigations or implement another appropriate mitigation measure as determined through consultation for the purposes of resolving adverse effects in accordance with 36 CFR 800.6.	Avoidance would result in negligible impacts on these cultural resources, whereas additional investigations could result in minor to major impacts on individual resources on a case-by-case basis.
Terrestrial archaeological resource monitoring program and post-review discovery plan	Atlantic Shores must conduct archaeological monitoring during onshore construction in areas identified as having high or moderate archaeological sensitivity and must prepare and implement a terrestrial archaeological post-review discoveries plan.	Implementation of monitoring and a post-review discovery plan, which would include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and post-review discoveries procedures and contacts, would reduce potential impacts on any previously undiscovered but potential terrestrial archaeological resources encountered during construction. Enforcement of this measure would be under the jurisdiction of NJHPO. Implementation of a post-review discoveries plan would reduce potential impacts on previously undiscovered archaeological resources to a minor level by preventing further physical impacts on the resource during construction.

Mitigation Measure	Description	Effect
Historic Properties Treatment Plans	BOEM, with the assistance of Atlantic Shores, will develop and implement one or more HPTPs to address effects on historic properties that cannot be avoided or with the assistance of Atlantic Shores will develop a mitigation fund. The HPTPs will be developed in consultation with property owners and consulting parties who have demonstrated interest in specific historic properties. HPTPs will provide details and specifications for mitigation measures to resolve adverse effects, including cumulative visual effects on aboveground historic properties.	Development and implementation of HPTPs or mitigation fund would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would guide fulfillment of mitigation actions.

3.6.2.11 Comparison of Alternatives

None of the other action alternatives would affect the types, placement, or areal extent of the onshore components of the Project. As a result, all of the other action alternatives would have the same impacts on historic aboveground resources in the visual APE for Onshore Project components and terrestrial archaeological resources as for the Proposed Action.

All of the other action alternatives would affect the types, placement, or areal extent of the offshore components of the Project. As a result, impacts on historic aboveground resources in the visual APE for Offshore Project components and marine cultural resources are subject to change under the other action alternatives compared to the Proposed Action.

Three of the other action alternatives (i.e., Alternatives C, D1, D2, and F) may reduce the number of individual cultural resources subject to adverse impacts depending on the specific locations of affected Offshore Project components and cultural resources. However, while Alternatives D1 and D2 would reduce the impacts on cultural resources overall to a moderate level, Alternatives C and F would not reduce the overall impacts and would still result in major impacts. Several action alternatives (i.e., Alternatives C, D3, E, and F) may also result in the same or similar major impacts on cultural resources as the Proposed Action due to the largely comparable nature or physical extent of proposed activities under these alternatives compared to the Proposed Action. Lastly, two of the other action alternatives (i.e., Alternatives C and F) may increase the number of or scale to which individual cultural resources would be subject to adverse impacts, depending on the specific locations of affected Offshore Project components and cultural resources, and result in major impacts on cultural resources. In all of the other action alternatives, individual cultural resources are still subject to negligible to major impacts on a case-by-case basis.

3.6.3 Demographics, Employment, and Economics

This section discusses potential impacts on demographic, employment, and economic conditions from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area, as shown on Figure 3.6.3-1. The demographics, employment, and economics geographic analysis area includes the counties where proposed onshore infrastructure and potential port cities are located as well as the counties closest to the WTA: Atlantic, Cape May, Gloucester, Monmouth, Ocean, and Salem Counties in the State of New Jersey; Portsmouth City in the Commonwealth of Virginia[1]; and Nueces and San Patricio Counties in the State of Texas. Ports in Gloucester and Salem Counties, New Jersey, and Portsmouth City, Virginia, may be used to support Project construction and O&M. A port in Nueces and San Patricio Counties, Texas, may be used to support Project construction only. Atlantic City Harbor, Atlantic County, New Jersey, would be the site of the proposed O&M facility for the Project. These counties are the most likely to experience beneficial or adverse economic impacts from the proposed Project.

Tables B.4-1 through B.4-7 in Appendix B, *Supplemental Information and Additional Figures and Tables*, provide detailed demographic and employment information for these areas, which are most likely to be directly affected (note that all tables cited in this section are located in Appendix B). Data for the States of New Jersey, Virginia, and Texas are provided for reference. This section also considers the counties that may be affected by visual or recreation and tourism impacts, which may have impacts on property values or tourism and recreation (i.e., Atlantic, Cape May, Monmouth, and Ocean Counties in New Jersey). For these counties, data on the economic value of the Ocean Economy and tourism and recreation are provided in Tables B.4-8 through B.4-10 in Appendix B. The usage of ports (within Gloucester and Salem Counties in New Jersey, Portsmouth City in Virginia, and Nueces and San Patricio Counties in Texas) may have broad impacts on the Ocean Economy due to the anticipated increase in economic activity at these locations; therefore, data on the Ocean Economy was collected for these locations as well. Table B.4-11 in Appendix B provides data on the estimated number of jobs created throughout construction and development, as well as operation and decommissioning.

---

[1] Portsmouth City is a county-equivalent area according to the U.S. Census Bureau.

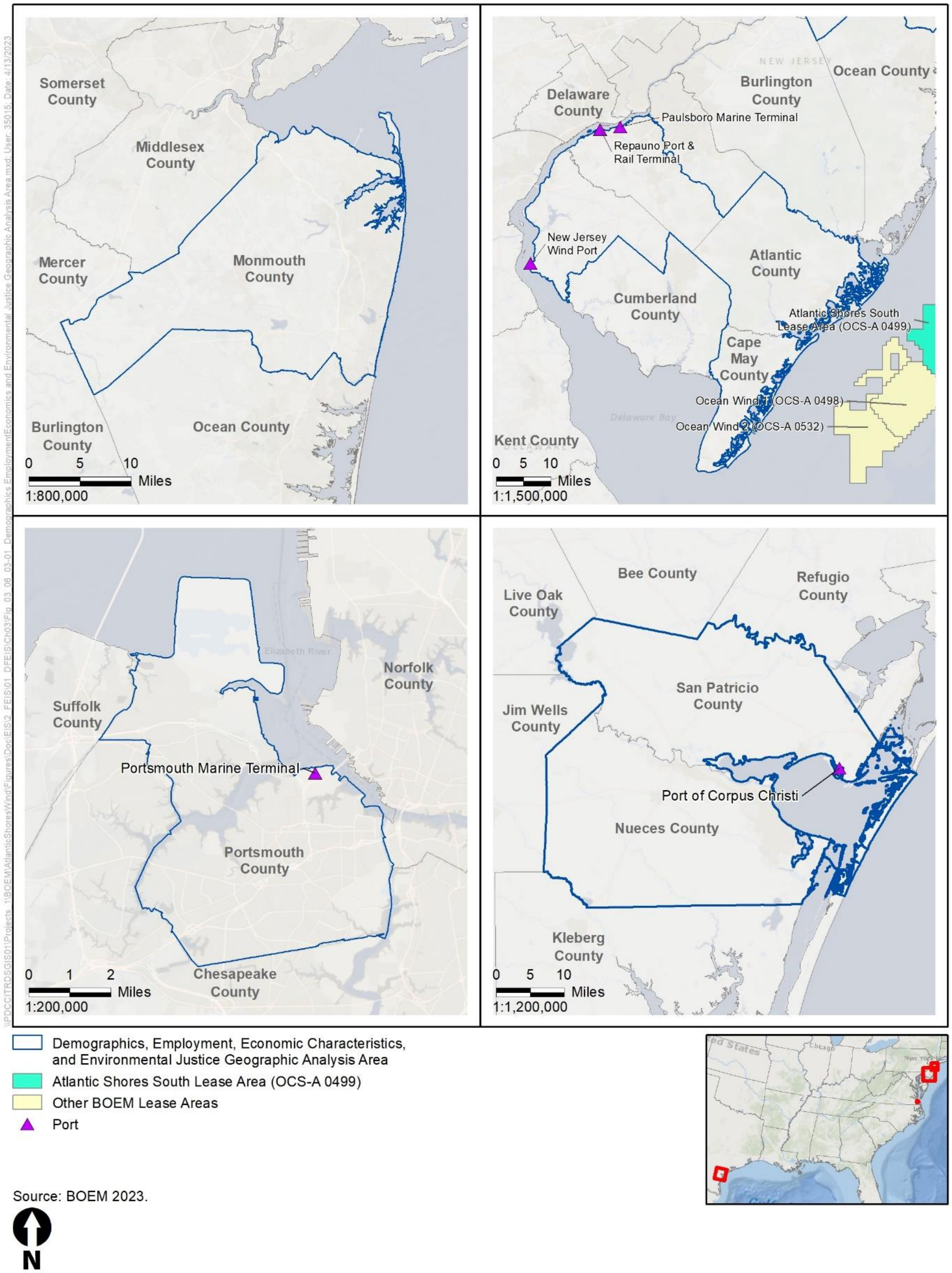


Figure 3.6.3-1. Demographics, employment, and economics geographic analysis area

3.6.3.1 Description of the Affected Environment and Future Baseline Conditions

Atlantic, Cape May, Monmouth, and Ocean Counties

Atlantic, Cape May, Monmouth, and Ocean Counties in New Jersey are some of the most densely populated coastal counties in the U.S. They are notable for coastal activities such as swimming, fishing, surfing, and sailing over the 127 miles (204 kilometers) of ocean beaches along the Jersey Shore from Sandy Hook to Cape May. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of visitors each year and benefit from high tourism employment. Many coastal amenities such as beaches do not directly generate employment, as they are accessible to the public for free, but stimulate the recreation and tourism businesses (COP Volume II, Section 7.3.1; Atlantic Shores 2023).

Data on population and demographics for the State of New Jersey and for Atlantic, Cape May, Monmouth, and Ocean Counties are provided in Tables B.4-1 and B.4-2 in Appendix B. The population of Monmouth and Ocean Counties grew by 2.1 percent and 10.5 percent, respectively, from 2010 to 2020, while the population of Atlantic and Cape May Counties declined by 0.01 percent (relatively no change) and 2.1 percent, respectively. Atlantic, Cape May, Monmouth, and Ocean Counties comprised 17.8 percent of New Jersey's population during that period (U.S. Census Bureau 2020). The population of Atlantic and Cape May Counties declined between 2010 and 2019, while the population of Monmouth and Ocean Counties and the State of New Jersey increased over the same period.

Table B.4-3 in Appendix B includes data on age distribution within the affected geographies. Of these counties, Monmouth County has the lowest percentage of residents over age 65 (17.1 percent), but still greater than in the State of New Jersey overall (15.9 percent).

Ocean County occupies about 629 square miles (1,629 square kilometers) of land area and contains 33 municipalities including its mainland and barrier island beaches. Ocean County is the second largest county in New Jersey (COP Volume II, Section 7.1.1.1; Atlantic Shores 2023). Atlantic County occupies about 556 square miles (1,440 square kilometers) of land in the coastal region of New Jersey. Atlantic County has three barrier islands along its eastern coast, which, like the other barrier islands in New Jersey, are separated from the mainland by the Intracoastal Waterway. Monmouth County occupies 469 square miles (1,215 square kilometers) of land area, including the northernmost barrier island, Sandy Hook (COP Volume II, Section 7.1.1.1; Atlantic Shores 2023). Cape May County occupies 251 square miles (650 square kilometers) of land area on the southern tip of New Jersey. The eastern part of Cape May County is composed of five barrier islands extending 32 miles (52 kilometers) from Cape May City to Ocean City. These barrier island beaches contain most of the county's infrastructure and are the heart of Cape May County's economy (Cape May County 2005).

The economies of Atlantic, Cape May, Monmouth, and Ocean Counties rely on tourism and visitors, and the counties have higher proportions of seasonal housing than New Jersey as a whole. Tables B.4-4 and B.4-5 in Appendix B include housing data for the geographic analysis area. Throughout New Jersey, 3.8 percent of housing units are seasonally occupied, compared to 4.8 percent in Monmouth County, 13.4 percent in Atlantic County, 13.8 percent in Ocean County, and 50.8 percent in Cape May County

(U.S. Census Bureau 2015-2019). About 95,000 year-long residents lived in Cape May County in 2020 (U.S. Census Bureau 2020). During summer months, the population increases to at least eight times the size of the permanent winter population because of tourism (Cape May County 2022). In 2013, Cape May County estimated its summer population at 796,695, or about eight times the permanent population (Cape May County 2013). Table B.4-6 in Appendix B presents economic data on residents in the affected environments. In 2019, unemployment was 4.9 percent in Monmouth County, 5.1 percent in Ocean County, 6.8 percent in Cape May County, and 8.4 percent in Atlantic County, compared to 5.5 percent in New Jersey (U.S. Census Bureau 2015–2019).

Table B.4-7 in Appendix B includes data on at-place employment by industry in the New York and New Jersey geographic analysis area. The industries that employ workers reflect recreation and tourism's importance to these counties. A greater proportion of workers in these counties are employed in accommodation and food services (31.1 percent in Atlantic County, 18.8 percent in Cape May County, 9.9 percent in Monmouth County, and 8.9 percent in Ocean County) than in New Jersey as a whole (7.7 percent) (U.S. Census Bureau 2019). With the exception of Atlantic County (10.5 percent), the proportion of jobs in retail trade (15.2 percent in Cape May County, 13.9 percent in Monmouth County, and 15.2 percent in Ocean County) in each county is greater than in New Jersey as a whole (11.0 percent) (U.S. Census Bureau 2019).

NOAA tracks economic activity dependent upon the ocean in its "Ocean Economy" data, which generally includes, among other categories, commercial fishing and seafood processing, marine construction, commercial shipping and cargo-handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal tourism and recreation. Table B.4-8 in Appendix B includes data on the Ocean Economy gross domestic product (GDP) for the affected geographies within the visual and recreation and tourism study areas. In Atlantic, Cape May, Monmouth, and Ocean Counties, tourism and recreation account for 95.8 percent, 86.1 percent, 92.3 percent, and 86.6 percent of the overall Ocean Economy GDP, respectively (NOAA 2019). The "living resource" sector of the Ocean Economy is smaller but contributes to the identity of local communities as well as tourism. This includes commercial fishing, aquaculture, seafood processing, and seafood markets.

Of the four coastal counties, Monmouth County has the largest tourism and recreation economy (Table B.4-9 in Appendix B). In 2019, Monmouth County had approximately 1,300 establishments, 18,000 employees, $403.5 million in total wages, and $770.6 million in GDP resulting from tourism and recreation. New Jersey overall had approximately 8,000 establishments, 99,000 employees, $2.3 billion in total wages, and $4.6 billion in GDP resulting from tourism and recreation in 2019 (NOEP 2019).

In addition to the significant Ocean Economy tourism and recreation sector, Table B.4-10 in Appendix B presents the data for the affiliated employment and industry sectors within the four counties. Employment sectors include marine construction, living resources, offshore mineral extraction, ship and boat building, tourism and recreation, and marine transportation. In 2019, Atlantic, Cape May, Monmouth, and Ocean Counties generated approximately 57,000 jobs within the Ocean Economy. The tourism and recreation jobs account for 97.9 percent, 93.4 percent, 97.1 percent, and 95.1 percent of the overall Ocean Economy employment for those four counties, respectively (NOAA 2019).

Gloucester and Salem Counties

Compared to Atlantic, Cape May, Monmouth, and Ocean Counties, which have more ocean-based economies with seasonal work and recreation and tourism, Salem County, which is along the Delaware Bay, and Gloucester County, which is on the Delaware River, are less reliant on coastal industries. However, these counties contain three of the potential ports that may be used to support project construction (the Paulsboro Marine Terminal and the Repauno Port and Rail Terminal are in Gloucester County and the New Jersey Wind Port is in Salem County). The Ocean Economy supports 8,293 jobs in Gloucester and 1,955 jobs in Salem County, with marine transportation being the largest Ocean Economy sector within both counties (6,384 and 1,226 jobs, respectively). While the Ocean Economy GDP in 2019 totaled $416.8 million in Gloucester, it made up only 3.2 percent of the county's total GDP. Similarly, Salem's total Ocean Economy GDP in 2019 was approximately $118.9 million, comprising 4.1 percent of the total county GDP (Table B.4-8 in Appendix B).

The population of Gloucester County grew by 4.9 percent from 2010 to 2020 while the population of Salem County decreased by 1.9 percent (U.S. Census Bureau 2020). The share of New Jersey's population in Gloucester and Salem Counties is approximately 4.0 percent. Median age in Gloucester and Salem Counties (41 and 42 years, respectively) is slightly older than in New Jersey as a whole (40 years) (U.S. Census Bureau 2015–2019).

Gloucester and Salem Counties are also less dependent on tourism than their coastal counterparts. The percentages of housing units that are seasonally occupied in these counties are 0.3 and 0.7 percent, respectively, compared to 4.8 to 50.8 percent for the coastal counties (U.S. Census Bureau 2015–2019). Transportation and warehousing, utilities, and manufacturing are more important to the economies of Salem County, as a larger portion of the workers in this county work in those sectors than those in New Jersey as a whole. Manufacturing, retail trade, and wholesale trade have greater representation in Gloucester County than in New Jersey (U.S. Census Bureau 2019).

Portsmouth City, Virginia

Portsmouth City is an independent city within the Commonwealth of Virginia. The city is one of the smaller affected geographies, with a total population of 97,915 in 2020, a 2.6 decrease from 2000 (U.S. Census Bureau 2020). The median age in Portsmouth is 35, with most residents falling within the 35 to 64 age group. While there is a negligible share of seasonal housing units within the housing supply (0.2 percent), roughly 10.7 percent of employees in Portsmouth work in the entertainment, recreation, accommodation, and food services industry sectors. As is the case with many of the affected areas, the largest industry sector of employment in Portsmouth is health care and social assistance (24.7 percent) (U.S. Census Bureau 2019).

In 2019, the Ocean Economy GDP for Portsmouth City totaled $1.45 billion. Roughly 5 percent, or $76.1 million, of the Ocean Economy GDP is attributed to the tourism and recreation sector. The Ocean

Economy supports 15,246 jobs across all sectors, including 11,247 in the ship and boat building sector (Table B.4-10 in Appendix B). The Ocean Economy GDP is 23.1 percent of the total GDP in Portsmouth City, the largest share of all affected areas (NOAA 2019).

Nueces and San Patricio Counties, Texas

The Port of Corpus Christi is located in Nueces and San Patricio Counties, Texas. The Port of Corpus Christi may be used to support Project construction.

Nueces County, Texas

In 2019, the National Ocean Economics Program totaled $1.4 billion in GDP across all ocean sectors in Nueces County. In 2019, Nueces County had approximately $571 million in GDP resulting from tourism and recreation (NOEP 2019). Roughly 3.2 percent of units in Nueces County were seasonal housing units (U.S. Census Bureau 2015–2019).

In 2020, the population of Nueces County totaled 353,178 people, an increase of 12.6 percent from 2000. The age distribution of the population of Nueces County is comparable to that of San Patricio County, with the largest share of residents falling into the 35–64 age bracket and the median age being 36 years old.

The unemployment rate in Nueces County (5.7 percent) is slightly higher than the rate in neighboring San Patricio County and the State of Texas overall (5.1 percent each) (U.S. Census Bureau 2015–2019).

A review of the industries that employ workers in Nueces County (Table B.4-7 in Appendix B) reveals that the county has roughly 13 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors. In terms of other industries that may be affected, Nueces County has a relatively modest proportion of retail trade jobs (9.8 percent). The other sectors with the highest proportion of jobs include health care and social assistance (20.8 percent) and construction (11.1 percent) (U.S. Census Bureau 2019).

In addition to the tourism and recreation sector, Nueces County employs individuals in offshore mineral extraction (2,417 employees) and marine transportation (579 employees). The Ocean Economy GDP is 7.0 percent of the total GDP in Nueces County (NOAA 2019) (see Table B.4-8 in Appendix B).

San Patricio County, Texas

The Ocean Economy GDP totaled $519.9 million across all ocean sectors in San Patricio County. In 2019, approximately $64.4 million in Ocean Economy GDP came from the tourism and recreation sector (National Ocean Economics Program 2019). Approximately 3.7 percent of housing units in San Patricio County are seasonal housing units (U.S. Census Bureau 2015–2019).

In 2020, the total population of San Patricio County was 68,755 individuals, a 6.1 percent increase from 2010, although the population experienced a slight decline between 2000 and 2010 (-3.5 percent). The age distribution of residents in San Patricio County is similar to that of Nueces County, with the largest share being aged 35–64. The median age of the county’s population is 36 years.

The unemployment rate in San Patricio County is 5.1 percent, which is the same as the rate for Texas overall (U.S. Census Bureau 2015–2019).

A review of the industries that employ workers in San Patricio County (Table B.4-7 in Appendix B) reveals that San Patricio County has 12.5 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors compared to 12.8 percent in Nueces County. In terms of other industries that may be affected, San Patricio County has a relatively high proportion of retail trade jobs (10.6 percent compared to 9.8 percent in Nueces County), and 31.2 percent of jobs are in construction (compared to 11.1 percent in Nueces County) (U.S. Census Bureau 2019).

In San Patricio County, tourism and recreation accounted for 12.4 percent of the overall Ocean Economy GDP, compared to 39.8 percent in Nueces County (NOAA 2019) (see Table B.4-8 in Appendix B). However, the Ocean Economy GDP makes up 22.6 percent of San Patricio County's total county GDP, the second largest share of all affected areas (NOAA 2019) (see Table B.4-8 in Appendix B).

3.6.3.2 Impact Level Definitions for Demographics, Employment, and Economics

This Draft EIS uses a four-level classification scheme to characterize potential impacts of the alternatives, including the Proposed Action, as shown in Table 3.6.3-1. See Section, 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

Table 3.6.3-1. Impact level definitions for demographics, employment, and economics

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	Either no effect or no measurable benefit.
Minor	Adverse	Impacts would not disrupt the normal or routine functions of the affected activity or geographic place.
	Beneficial	Small but measurable benefit on demographics, employment, or economic activity.
Moderate	Adverse	The affected activity or geographic place would have to adjust somewhat to account for disruptions due to impacts of the Project.
	Beneficial	Notable and measurable benefit on demographics, employment, or economic activity.
Major	Adverse	The affected activity or geographic place would experience disruptions to a degree beyond what is normally acceptable.
	Beneficial	Large local or notable regional benefit to the economy as a whole.

3.6.3.3 Impacts of Alternative A – No Action on Demographics, Employment, and Economics

When analyzing the impacts of the No Action Alternative on demographics, employment, and economics, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities (see Appendix D, *Ongoing and Planned Activities Scenario*).

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for demographics, employment, and economics described in Section 3.6.3.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities other than offshore wind within the geographic analysis area that contribute to impacts on demographics, employment, and economics include ongoing development of onshore solar and wind energy; growth in onshore and offshore development and modest growth in vessel traffic; ongoing installation or upgrades of piers, bridges, pilings, and seawalls or underground infrastructure; ongoing commercial shipping and recreational and commercial fishing; continued port upgrades and maintenance; and ongoing effects from climate change (e.g., damage to property and infrastructure related to sea level rise) (see Section D.2 in Appendix D for a description of ongoing activities). These activities contribute to numerous IPFs including implications for employment and state and regional energy markets; lighting, which can affect the recreational and commercial fishing economies; noise, which can affect residential and other sensitive populations; port utilization, which can affect jobs, populations, and economies; marine traffic, which can affect recreational and commercial fishing, shipping, and recreation and tourism; and land disturbance/onshore construction, which supports local population growth, employment, and economies. See Table D.A1-8 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for demographics, employment, and economics.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on commercial and for-hire recreational fisheries include:

- Continued O&M of the BIWF project (5 WTGs) installed in state waters
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497, and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

These ongoing activities are outside the geographic analysis area that would contribute to impacts on demographics, employment, and economics.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). In addition to ongoing activities, BOEM anticipates that the impacts of planned activities other than offshore wind development would result from: installation of new submarine cables and pipelines, increasing onshore construction, new barge route and dredging disposal sites, and port maintenance and upgrades (see Appendix D, Section D.2 for a description of planned activities).

Planned offshore wind activities include projects on the Atlantic OCS that have been determined by BOEM to be reasonably foreseeable, excluding the Proposed Action (see Appendix D for a description of planned offshore wind activities).

Offshore wind is a new industry for the Atlantic states and the nation. Although most offshore wind component manufacturing and installation capacity exists outside of the U.S., some studies acknowledge that domestic capacity is poised to increase.

A BVG Associates Limited study (BVG 2017) estimated that the percentage of associated jobs that would be sourced in the U.S. during the initial implementation of offshore wind projects along the U.S. northeast coast would range from 35 to 55 percent. As the offshore wind industry grows in the United States, this proportion would increase due to growth in the supply chain on the East Coast along with a growing number of maintenance and local operations jobs for established wind facilities. The proportion of jobs associated with offshore wind projected to be within the U.S. is projected to be approximately 65 to 75 percent from 2030 through 2056. Overseas manufacturers of components and specialized ships based overseas that are contracted for installation of foundations and WTGs would comprise the rest of the offshore wind–related jobs outside the U.S. (BVG 2017).

The American Wind Energy Association (AWEA; now known as American Clean Power) estimates that the offshore wind industry will invest between $80 and $106 billion in U.S. offshore wind development by 2030, of which $28 to $57 billion will be invested within the U.S. This figure depends on installation levels and supply chain growth, as other investment would occur in countries manufacturing or assembling wind energy components for U.S.-based projects. While most economic and employment impacts would be concentrated in Atlantic coastal states where offshore wind development will occur—there are over $1.3 billion of announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction—there would be nationwide effects as well (AWEA 2020). The AWEA report analyzes base and high scenarios for direct impacts of offshore wind, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 GW of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030, while the high scenario assumes 30 GW of offshore wind power by 2030 and domestic content increasing to 40 percent in 2025 and 60 percent in 2030. Offshore wind energy development will support $14.2 billion in economic output and $7 billion in value added by 2030 under the base scenario. Offshore wind energy development will support $25.4 billion in economic output and $12.5 billion in value added under the high scenario. The report does not specify where in the U.S. supply chain growth would occur.

The University of Delaware projects that offshore wind power will generate 30 GW along the Atlantic coast through 2030. This initiative would require capital expenditures of $100 billion over the next 10 years (University of Delaware 2021). Although the industry supply chain is global and foreign sources would be responsible for some expenditures, more U.S. suppliers are expected to enter the industry.

Compared to the $14.2 to $25.4 billion in offshore wind economic output (AWEA 2020), the 2020 annual GDP for Atlantic states with planned offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $60.6 billion in

Rhode Island to $1.72 trillion in New York (U.S. Bureau of Economic Analysis 2021) and totaled nearly $4.3 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.6 percent of the combined GDP of these states.

The AWEA estimates that in 2030, offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) full-time equivalent (FTE) jobs nationwide, including direct, supply chain, and induced jobs. Most offshore wind jobs (about 60 percent) would be created during the temporary construction phase while the remaining 40 percent would be long-term O&M jobs. The RODA in 2020 estimated that offshore wind projects would create 55,989 to 86,138 job-years through 2030 in construction and 5,003 to 6,994 long-term jobs in O&M (Georgetown Economic Services 2020). These estimates are generally consistent with the AWEA study in total jobs supported, although the RODA study concludes that a greater proportion of jobs would be in the construction phase. The two studies conclude that states hosting offshore wind projects would have more offshore wind energy jobs while states with manufacturing and other supply chain activities may generate additional jobs.

In 2019, employment in New Jersey was approximately 4.0 million (Table B.4-6 in Appendix B). While the extent to which there will be impacts on the geographic analysis area is unclear due to the geographic versatility of offshore wind jobs, a substantial portion of the planned offshore wind projects in New Jersey would likely be within commuting distance of ports in Atlantic City, Paulsboro, Lower Alloways Creek, and Newark in New Jersey; Portsmouth, Virginia; Charleston, South Carolina; and other ports that would be used for offshore wind manufacturing, staging, and operations and maintenance.

Other planned offshore wind activities in the geographic analysis area for demographics, employment, and economics are limited to the construction, O&M, and decommissioning of Ocean Wind 1 in Lease Area OCS-A 0498, Ocean Wind 2 in Lease Area OCS-A 0532, and Atlantic Shores North in Lease Area OCS-A 0549.

In addition to the regional economic impact of a growing offshore wind industry, BOEM expects planned offshore wind development to affect demographics, employment, and economics through the following primary IPFs.

Cable emplacement and maintenance: Cable emplacement for planned offshore wind projects would temporarily impact commercial/for-hire fishing businesses based in the geographic analysis area during cable installation and infrequent maintenance (see Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing).* The economic impact of cable emplacement and maintenance on commercial/for-hire fishing businesses is covered in more detail in Section 3.6.1 and would be localized and short term.

Land disturbance: Land disturbance could result in localized, short-term disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, short term, and both beneficial, in terms of jobs and revenues to local businesses that participate in onshore construction, and adverse, in terms of lost revenue due to construction disturbances. Land disturbance would result in minor beneficial impacts on demographics, employment, and economics due to increased employment, as well as potential negligible adverse temporary effects from noise and traffic.

Lighting: Offshore WTGs require aviation warning lighting that could have economic impacts in certain locations. Aviation hazard lighting from up to 366 WTGs in the geographic analysis area could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions (Appendix D, Table D.A2-1). Visitors may make different decisions on coastal locations to visit, and potential residents may choose to select different residences because of nighttime views of lights on offshore wind energy structures. A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The vast majority of the WTG positions envisioned offshore of the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs, and so impacts are anticipated to be undetectable. These lights would be incrementally added over the construction period and would be visible for the operating lives of planned offshore wind activities. Distance from shore, topography, and atmospheric conditions would affect light visibility.

If implemented, ADLS would reduce the amount of time that WTG lighting is visible. Visibility would depend on distance from shore, topography, and atmospheric conditions. Such systems would likely reduce impacts on demographics, employment, and economics associated with lighting. Lighting for transit or construction could occur during nighttime transit or work activities. Construction of three planned offshore wind projects would occur within the New York and New Jersey lease areas and the geographic analysis area between 2024 and 2030, with a maximum of two projects under construction concurrently during 2026 (Appendix D, Table D.A2-1). Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction.

Noise: Noise from O&M, pile driving, cable laying and trenching, and vessel traffic could result in short--term impacts on demographics, employment, and economics due to impacts on commercial/for-hire fishing businesses, recreational businesses, and marine sightseeing activities.

Noise from vessel traffic during the maintenance and construction phases could affect species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (see Section 3.6.1). Similarly, noise from pile driving from offshore wind activities would affect fish populations that are crucial to commercial fishing and marine recreational businesses (see Section 3.6.8, *Recreation and Tourism*). These impacts would be greater if multiple construction activities occur in close spatial and temporal proximity. An estimated 377 foundations (WTGs, offshore substations and met towers) would be installed within the geographic analysis area between 2024 and 2030 (Appendix D, Table D-3).

Onshore construction noise could possibly result in a short-term reduction of economic activity for businesses near installation sites for onshore cables or substations, temporarily inconveniencing workers, residents, and visitors. Noise would have intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Port utilization: Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would bolster port investment and employment while also supporting jobs and businesses in supporting industries. Planned offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area, including the ports of Atlantic City, New Jersey; Portsmouth Marine Terminal, Virginia; the Port of Corpus Christi (Nueces and San Patricio Counties), Texas; and the Paulsboro Marine Terminal, Repauno Port and Rail Terminal, and the New Jersey Wind Port (Lower Alloways Creek), New Jersey. While simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity, it would also generate considerable economic activity and benefit the regional economy and infrastructure investment.

Port utilization would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. Improvements to existing ports and channels would be beneficial to other port activity. Port utilization in the geographic analysis area would occur primarily during development and construction projects, anticipated to occur primarily between 2023 and 2030. Ongoing O&M activities would sustain port activity and employment at a lower level after construction.

Offshore wind activities and associated port investment and usage would have long-term, moderate beneficial impacts on employment and economic activity by providing employment and industries such as marine construction, ship construction and servicing, and related manufacturing. The greatest benefits would occur during offshore wind project construction between 2023 and 2030. If offshore wind construction results in competition for scarce berthing space and port service, port usage could potentially have short- to medium-term adverse impacts on commercial shipping. Overall, port utilization from offshore wind is anticipated to result in beneficial impacts on demographics, employment, and economics due to the creation of new construction jobs that are likely to be supported by the existing workforce in these areas, as well as specialized permanent jobs in amounts unlikely to exacerbate housing conditions.

Presence of structures: The potential for up to 377 offshore wind energy structures within the geographic analysis area could affect marine-based businesses (Appendix D, Table D-3). Commercial fishing operators, marine recreational businesses, and shore-based supporting services (such as seafood processing) could experience both short-term impacts during construction and long-term impacts from the presence of structures.

Fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial/for-hire recreational fishing industries (see Section 3.6.1). As a result of fish aggregation and reef effects associated with the presence of offshore wind structures, there would be long-term impacts on commercial fishing operations and support businesses such as seafood processing. These effects could simultaneously provide new business opportunities such as fishing and tourism.

The views of offshore WTGs could have impacts on certain businesses serving the recreation and tourism industry. Impacts could be adverse for particular locations if visitors and customers avoid certain businesses (i.e., hotels or rental dwellings) due to views of the WTGs; impacts could be neutral or beneficial if views do not affect visitor decisions or influence some visitors positively. See also Section 3.6.8.

Overall, the presence of offshore wind structures would have continuous, long-term moderate beneficial and negligible adverse impacts on demographics, employment, and economics. The commercial fishing industry is anticipated to be able to adjust to changes in fishing practices to maintain the viability of the industry in the presence of offshore wind structures. The presence of structures could also result in beneficial impacts for the recreational fishing and tourism industries.

Traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses and investment in ports. The magnitude of increased vessel traffic is described in more detail in Section 3.6.6, *Navigation and Vessel Traffic*, and would depend upon the vessel traffic volumes generated by each offshore wind project, the extent of concurrent or sequential construction of wind energy projects, and the ports selected for each project). Construction of three planned offshore wind projects could occur within the New York and New Jersey lease areas and the geographic analysis area between 2023 and 2030, with a maximum of two projects under construction concurrently during 2026 (Appendix D, Table D.A2-1). Impacts of short-term, increased vessel traffic during construction could include increased vessel traffic congestion, delays at ports, and a risk for collisions between vessels. Increased vessel traffic would be localized near affected ports and offshore construction areas. Congestion and delays could increase fuel costs (i.e., for vessels forced to wait for port traffic to pass) and decrease productivity for commercial shipping, fishing, and recreational vessel businesses, whose income depends on the ability to spend time out of port. Increased vessel traffic would have continuous, long-term beneficial impacts and short-term negligible adverse impacts on the economy and employment during all project phases due to the implementation of environmental protection measures.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends. Ongoing activities would continue to sustain and support economic activity and growth within the geographic analysis area based on anticipated population growth and ongoing development of businesses and industry. Tourism and recreation would continue to be important to the economies of the coastal areas, especially Atlantic, Cape May, Ocean, and Monmouth Counties. Marine industries such as commercial fishing and shipping would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies—including maintaining or increasing their year-round population—and protect environmental resources.

BOEM anticipates that ongoing activities in the geographic analysis area (continued commercial shipping and commercial and recreational fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy) will have **negligible** to **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics.

Cumulative Impacts of Alternative A – No Action. Under the No Action Alternative, existing environmental trends and activities would continue, and demographics, employment, and economics would continue to be affected by natural and human-caused IPFs. Planned activities for coastal and marine activity, other than offshore wind, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise.

BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area, would result in **negligible** to **minor** adverse impacts and **moderate beneficial** impacts on ocean-based employment and economics, driven primarily by the continued operation of existing marine industries, especially commercial and recreational fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise. Increased investment in land and marine ports, shipping, and logistics capability is expected to result along with component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. Additional manufacturing and servicing businesses would result either in the geographic analysis area or other locations in the U.S. if supply chains develop as expected. While it is not possible to estimate the extent of job growth and economic output within the geographic analysis area specifically, there will be notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially specialized job training, because of offshore wind development.

While many of the jobs generated by offshore wind projects are temporary construction jobs, the combination of these jobs over multiple projects will create notable benefits during project construction phases. This will particularly be the case as the domestic supply chain for offshore wind evolves over time. Offshore wind projects also support long-term O&M jobs (up to 25 to 35 years from project commissioning); long-term tax revenues; long-term economic benefits of improved ports and other industrial land areas; diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce. Therefore, BOEM anticipates that there will be cumulative moderate beneficial impacts from planned offshore wind activities in the geographic analysis area, combined with ongoing activities and planned activities other than offshore wind.

BOEM anticipates negligible adverse impacts on demographics, employment, and economics associated with planned offshore wind activities. Planned offshore wind activities are expected to affect commercial and for-hire fishing businesses and marine recreational businesses (tour boats, marine suppliers) primarily through cable emplacement, noise, and vessel traffic during construction, and the presence of offshore structures during operations. These IPFs would temporarily disturb marine species and displace commercial or for-hire fishing vessels, which could cause conflicts over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also lead to increased navigational constraints and risks and potential gear damage and loss for commercial fisheries. However, temporary disturbances such as from noise and traffic would not be expected to result in measurable adverse impacts on population, employment, or economics. It is expected that temporary adverse effects would be minimized and would not disrupt community cohesion or the economies of the affected areas. The long-term presence of structures is not expected to have adverse impacts on the economy overall; rather, employment impacts would be beneficial and there could be beneficial impacts on the commercial fishing and recreation and tourism economies as well.

3.6.3.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on demographic, employment, or economic characteristics:

- Overall size of the Project (approximately 1,510 MW for Project 1 and undetermined for Project 2) and number of WTGs (up to 200);
- The extent to which Atlantic Shores hires local residents and obtains supplies and services from local vendors;
- The port(s) selected to support construction, installation, and decommissioning; and
- The design parameters (e.g., spacing and number of WTGs) that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity (see Chapter 2, *Alternatives*).

The size of the Project would affect the overall investment and economic impacts; fewer WTGs would mean less materials purchased, fewer vessels, and less labor and equipment required. Beneficial economic impacts within the geographic analysis area would depend on the proportion of workers, materials, vessels, equipment, and services that can be locally sourced, and the specific ports used by the Project.

Atlantic Shores is working to maximize the positive economic and environmental impacts of the Project. Negative impacts would be minimized by consulting with stakeholders to identify potential issues, thoroughly investigating them, and devising strategies to avoid or minimize adverse effects. Onshore construction would be planned to minimize direct negative impacts on the Project region (i.e., Atlantic, Cape May, Gloucester, Monmouth, Ocean, and Salem Counties in New Jersey) during the summer tourist season (i.e., Memorial Day through Labor Day). Atlantic Shores is committed to maximizing the hiring and recruiting of its Project workforce from programs targeted at training and providing talent to the offshore wind industry from local New Jersey communities (COP Volume II; Atlantic Shores 2023).

3.6.3.5 Impacts of Alternative B – Proposed Action on Demographics, Employment, and Economics

The Proposed Action's beneficial impacts on demographics, employment, and economics depend on what proportion of workers, materials, vessels, equipment, and services can be locally sourced. The Proposed Action includes a number of EPMs to this end, including establishment of an O&M facility in Atlantic City, New Jersey, to be staffed primarily with local workers; hiring of a diverse and local workforce recruited from local training programs; and locally sourced construction materials and other supplies, to the extent possible and practical (DEM01-DEM-09, Appendix G, Table G-1).

In a study conducted by BW Research Partnership on behalf of E2, a national, nonpartisan group of advocates for policies that benefit both the economy and environment, every $1.00 spent building an offshore wind farm is estimated to generate $1.83 for New Jersey's economy (E2 2018). Atlantic Shores estimates that the Proposed Action would support the following employment in New Jersey alone in direct, indirect, and induced FTE job-years: an estimated 13,360 direct FTE job-years during development and construction, and 19,925 direct FTE job-years during operations and decommissioning, in addition to 17,640 indirect and 22,165 induced FTE job-years during all phases (COP Volume II; Atlantic Shores 2023).

The Proposed Action would generate employment during construction and installation, O&M, and decommissioning of the Project. The Proposed Action would support a range of positions for professionals such as engineers, environmental scientists, financial analysts, administrative personnel; trade workers such as electricians, technicians, steel workers, welders, and ship workers; and other construction jobs during construction and installation of the Proposed Action. O&M would create jobs for maintenance crews, substation and turbine technicians, and other support roles. The decommissioning phase would also generate professional and trade jobs and support roles. Therefore, all phases of the Proposed Action would lead to local employment and economic activity.

Assuming that conditions are similar to those of the Vineyard Wind 1 project, job compensation (including benefits) is estimated to average between $88,000 and $96,000 for the construction phase, with occupations including engineers, construction managers, trade workers, and construction technicians (Vineyard Wind 2021). O&M occupations would consist of turbine technicians, plant managers, water transportation workers, and engineers, with average annual compensation of approximately $99,000 (BOEM 2021). A study from the New York Workforce Development Institute provided estimates of salaries for jobs in the wind energy industry that concur with Vineyard Wind 1's projections. The expected salary range for trade workers and technicians ranges from $43,000 to $96,000, $65,000 to $73,000 for vessel crews and officers, and $64,000 to $150,000 for managers and engineers (Gould and Cresswell 2017).

The hiring of local workers would stimulate economic activity through increased demand for housing, food, transportation, entertainment, and other goods and services. A large number of seasonal housing units are available in the vicinity of the Project. During the summer, competition for temporary accommodations may arise, leading to higher rents. However, this effect would be temporary during the active construction period and could be reduced if construction is scheduled outside the busy summer season. Permanent workers are expected to reside locally; there is adequate housing supply to accommodate the increase in the local workforce.

Tax revenues for state and local governments would increase as a result of the Project. Equipment, fuel, and some construction materials would likely be purchased from local or regional vendors. These purchases would result in short-term impacts on local businesses by generating additional revenues and contributing to the tax base. Once the Project is operational, property taxes would be assessed on the value of the onshore facilities. The increased tax base during operations would be a long-term, beneficial impact on local governments in the affected area.

The Proposed Action alone would have long-term, minor beneficial impacts on employment and economic activity in the geographic analysis area, based upon anticipated short-term and modest long-term job creation, expenditures on local businesses, generation of tax revenues, and provision of grant funds. The Proposed Action alone would have negligible adverse impacts on demographics and housing within the geographic analysis area. The reasonably foreseeable environmental trends and impacts of the Proposed Action, in addition to ongoing activities, are described by IPFs below.

Onshore Activities and Facilities

Land disturbance: Construction of the Proposed Action would require onshore cable installation and new substation and/or converter station construction, and modification of existing substations for the POI. The disturbance of businesses near the onshore cable routes and substation and/or converter station construction sites and POI sites would result in localized, short-term, minor disruptions; however, it is not expected that construction activities would result in an adverse impact on demographics, employment, or economics because normal economic trends would not be affected. It is anticipated that the impacts from decommissioning of the Project would be similar to the impacts from construction and installation.

Lighting: During O&M, onshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Impacts related to structure lighting would have localized, long-term, and negligible impacts on demographics, employment, and economics.

Noise: Construction and installation, O&M, and decommissioning, of the proposed substations would generate noise. The disturbances during construction and installation and decommissioning would be temporary and localized, and extend only a short distance beyond the work area. In both instances noise would have localized, short-term, and negligible impacts on demographics, employment, and economics.

Infrequent trenching from cable-laying activities also produce noise. This noise could temporarily disrupt onshore recreational businesses. The use of trenchless technology at natural and sensitive landfall locations where possible would minimize direct impacts from construction noise. Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Operational activity would occur at the O&M facility in Atlantic City, New Jersey, as vessels transport workers to and from the offshore wind farm for daily maintenance. The O&M facility for the Ocean Wind 1 and 2 projects would also be located in Atlantic City and would contribute similar noise in a localized area at the facility. Noise impacts would be limited to vessel traffic and typical daily activities at the O&M facility and would not be significantly noisier than existing land uses in the area.

Port utilization: Proposed Action activities at ports would support port investment and employment and would also support jobs and businesses in supporting industries and commerce. Atlantic Shores plans to utilize five ports to support construction of the proposed Project:

- New Jersey Wind Port (Salem County)
- Paulsboro Marine Terminal (Gloucester County, New Jersey)
- Portsmouth Marine Terminal (City of Portsmouth, Virginia)
- Repauno Port and Rail Terminal (Gloucester County, New Jersey)
- Port of Corpus Christi (Nueces and San Patricio Counties, Texas)

These ports would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. The economic benefits associated with port utilization would be greatest during construction when the most jobs and most economic activity at ports supporting the Proposed Action would occur. The Proposed Action would have a minor beneficial impact on demographics, employment, and economics from port utilization due to greater economic activity and increased employment at ports used by the Proposed Action.

During O&M, port activities would be concentrated at the onshore O&M facility for the Project in Atlantic City, New Jersey, and the following ports: (1) New Jersey Wind Port (Salem County), (2) Paulsboro Marine Terminal (Gloucester County, New Jersey), (3) Portsmouth Marine Terminal (City of Portsmouth, Virginia), and (4) Repauno Port and Rail Terminal (Gloucester County, New Jersey).

The O&M facility would help to diversify the local economy by providing a source of skilled, year-round jobs. The number of workers at the O&M facility would fluctuate seasonally and by Project phase and would be dependent on the final engineering design and service strategy (COP Volume II; Atlantic Shores 2023). The Proposed Action would have a minor beneficial impact on demographics, employment, and economics from port utilization due to greater economic activity and increased employment at ports used by the Proposed Action.

Traffic: During construction and installation and decommissioning of the onshore facilities (e.g., onshore substations or converter stations and buried duct banks, upgrades to the POI), vehicular traffic would increase, and construction equipment would be present at the landfall site, along the buried interconnection cable route, at the proposed onshore substations or converter stations, and at the POIs. While this activity would result in short-term traffic effects, it would be largely confined to roads and previously disturbed/developed sites (COP Volume II, Section 5.2.4; Atlantic Shores 2023) and, therefore, would be expected to have negligible impacts on demographics, employment, and economics.

Offshore Activities and Facilities

Lighting: The anticipated increase in vessel traffic would result in growth in the nighttime traffic of vessels with lighting during construction and installation, O&M, and decommissioning. Lighting from vessels would occur during nighttime Project construction or maintenance. This lighting would be visible from coastal businesses, especially near the ports used to support Proposed Action construction. Short--term vessel lighting is not anticipated to discourage tourist-related business activities and would not affect other businesses; therefore, the impact of vessel lighting would be short term and negligible during construction and installation and decommissioning.

During O&M, offshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Offshore, aviation hazard lighting on WTGs could affect employment and economics in these areas if the lighting discourages visits or vacation home rentals or purchases in coastal locations where the Proposed Action's WTG lighting is visible. Atlantic Shores would implement an ADLS, if permitted, to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity to the wind farm (COP Volume II, Section 5.2.6; Atlantic Shores 2023). Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on the local economy. Impacts related to structure lighting would have localized, long-term, and negligible impacts on demographics, employment, and economics.

Noise: The Proposed Action could increase noise levels during construction and installation, O&M, and decommissioning. During construction and installation, noise from vessel traffic could have economic effects on commercial fishing businesses and recreational businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (see Section 3.6.1).

Offshore pile driving proposed for foundation installation and nearshore vibratory piling proposed for the cofferdam installation and associated noise would have localized, short-term, and negligible impacts on demographics, employment, and economics.

Infrequent trenching from cable-laying activities emit noise. This noise could temporarily disrupt commercial fishing, marine recreational businesses, and onshore recreational businesses. Noise from trenching and trenchless technology would affect marine life populations, which would in turn affect commercial and recreational fishing businesses (see Section 3.6.1). Impacts on marine life would also affect onshore recreational businesses due to noise near public beaches, parks, residences, and offices (see Section 3.6.8). Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Vessel noise could affect marine species relied upon by commercial fishing businesses, marine recreational businesses, recreational boaters, and marine sightseeing activities. Vessel traffic would occur between ports (outside the recreation and tourism geographic analysis area) and offshore wind work areas. Most vessel traffic would travel to the WTG installation area, with fewer vessels needed along the cable installation routes. Noise from vessels would have short-term, intermittent, negligible impacts on demographics, employment, and economics.

Presence of structures: The Proposed Action would result in the presence of structures visible during construction and installation and O&M. During Project construction, viewers on the Jersey Shore may see the upper portions of tall equipment such as mobile cranes. These cranes would move from turbine to turbine as construction progresses, and thus would not be long-term fixtures. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a short-term, negligible impact on demographics, employment, and economics.

The Proposed Action would add up 200 WTGs, up to 10 OSSs, and up to 1 met tower with foundations and scour protection, and cable protection, where needed, along the interarray and offshore export cables. These structures could affect marine businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) through impacts such as entanglement and gear loss/damage, navigational hazards and risk of allisions, fish aggregation, habitat alteration, and space use conflicts. These structures may cause vessel operators to reroute, which would affect their fuel costs, operating time, and revenue. Due to the risk of gear entanglement, fisheries using bottom gear may be permanently displaced, which would result in moderate impacts on the commercial and for-hire recreational fisheries (see Section 3.6.1). However, the Project would not be expected to disrupt community cohesion, and loss of revenues from fisheries is expected to be minimal. There may be positive impacts on fisheries that result from presence of structures. Thus, this IPF would result in continuous, long-term, and negligible impacts on demographics, employment, and economics.

Offshore wind structures could encourage fish aggregation and generate reef effects that attract recreational fishing vessels. These effects would only affect the minority of recreational fishing vessels that reach the wind energy facilities. This would have long-term, negligible benefits on demographics, employment, and economics. Offshore structures associated with the Proposed Action could increase economic activity associated with offshore sightseeing because these structures create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons. These forms of marine life could attract private or commercial recreational sightseeing vessels. This would have long-term, negligible beneficial impacts on demographics, employment, and economics.

Views of WTGs could have impacts on businesses serving the recreation and tourism industry. The presence of offshore wind structures could affect shore-based activities, surface water activities, wildlife and sightseeing activities, diving/snorkeling, and recreational boating routes (see Section 3.6.8). The

Project's offshore wind energy facilities would be located a minimum of 8.7 miles (14 kilometers) east of the New Jersey coast (COP Volume I, Section 1.1; Atlantic Shores 2023). The majority of landward Project visibility (155 square miles [401 square kilometers]) occurs within 10–20 miles (16–32 kilometers) of the Project over uninhabited inland bays. Areas of potential visibility diminish significantly between 30 and 40 miles (48 and 64 kilometers) (see Section 3.6.9, *Scenic and Visual Resources*; see also COP Volume II, Section 5.1; Atlantic Shores 2023). From many viewpoints along the coast the Project would not be visible (i.e., those locations at which all WTGs would be beyond 20 miles [32 kilometers]), and from the vast majority of sites substantial portions of the full WTG array would not be visible, even during the relatively rare occurrence of days with very clear viewing conditions. Under less clear conditions, which are estimated to occur during 75 percent of the daylight hours, a smaller portion of the WTA and WTGs would be visible (COP Volume II, Section 5.2.3; Atlantic Shores 2023).

Traffic: The Proposed Action would generate vessel traffic in the Project area and to and from the ports supporting Project construction and installation and decommissioning, as well as O&M. Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning.

The vessel traffic generated by the Proposed Action alone would result in increased business for marine transportation and supporting services in the geographic analysis area with continuous, short-term, and minor beneficial impacts during construction. Vessel traffic associated with the Proposed Action could also result in temporary, periodic congestion within and near ports, leading to potential delays and an increased risk for collisions between vessels and allisions, which would result in economic costs for vessel owners and port owners. As a result of potential delays from increased congestion and increased risk of damage from collisions/allisions, the Proposed Action could result in minor short-term disruptions to businesses, but these disruptions would be negligible as it is anticipated that community cohesion would remain intact.

Impacts of the Connected Action

As described in Chapter 2, improvements to the existing marine infrastructure within an approximate 20.6-acre (8.3-hectare) site at the Atlantic City, New Jersey, Inlet Marina area are planned in connection with construction of the O&M facility of the Proposed Action. The connected action includes construction of a new 356-foot (109-meter) bulkhead composed of steel or composite vinyl sheet piles to replace the existing and deteriorating 250-foot (76-meter) bulkhead. Additionally, the connected action would include maintenance dredging at the site to be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. Atlantic Shores is proposing to implement the construction of the new bulkhead, and the City of Atlantic City would complete the maintenance dredging at the site.

BOEM expects the connected action to affect demographics, employment, and economics through the following primary IPFs.

Noise: Installation of sheet piles for construction of the new bulkhead may include impact or vibratory pile driving and vessel operation, which would generate intermittent noise during the construction period. As discussed in Section 3.6.1, because there is minimal fishing activity near the marina where the connected action would be sited, displacement of fish and invertebrates associated with behavioral impacts of noise is not expected to result in measurable revenue loss for commercial or recreational fisheries. Therefore, any impacts on marine industries are likely to be negligible.

Construction vessel activity would also generate noise during connected action activities. Such vessel noise would be localized and temporary, ceasing once the vessel leaves the area. Therefore, any impacts on demographics, employment, and economics would be negligible.

Port utilization: The connected action would facilitate conversion of a retired marine terminal to the Proposed Action's O&M facility, thereby resulting in an increase in port utilization. The connected action would be sited in Atlantic City, which generates approximately $19 million in annual revenue from commercial fisheries (see Section 3.6.1). Commercial and for-hire recreational fishing vessels traveling to and from Atlantic City may experience delays from increased vessel traffic associated with the connected action. Impacts from port utilization associated with the Proposed Action are expected to be localized and long term, occurring during the construction and O&M periods. Impacts on demographics would be negligible. There would be minor beneficial impacts on employment and economics.

Because there is minimal fishing activity near the marina where the connected action would be sited, displacement of fish and invertebrates associated with dredging is not expected to result in measurable revenue loss for commercial or recreational fisheries or industries.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action.

Onshore Activities and Facilities

Land disturbance: The extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations or converter stations and POIs for planned offshore wind energy projects. Therefore, the incremental, negligible impacts contributed by the Proposed Action to the cumulative land disturbance impacts would be short term and undetectable.

Lighting: The incremental impacts contributed by the Proposed Action to the cumulative onshore lighting impacts on demographics, employment, and economics would be undetectable.

Noise: The incremental impacts contributed by the Proposed Action to the cumulative noise impacts on demographics, employment, and economics would be short term and undetectable.

Port utilization: Other offshore wind energy activity would provide business activities at the same ports as the Proposed Action as well as other ports within the geographic analysis area. Port investments are ongoing and planned in response to offshore wind activity. Maintenance and dredging of shipping channels are expected to increase, which would benefit other port users.

The Proposed Action's incremental impacts combined with impacts of other ongoing and planned activities would result in cumulative long-term, noticeable beneficial impacts on port utilization, and the associated trained and skilled offshore wind workforce would contribute to economic activity in port communities and the region as a whole.

Traffic: The Proposed Action's incremental traffic impacts would be undetectable.

Offshore Activities and Facilities

Lighting: Between 2023 and 2030, there may be 11 offshore wind projects within the New York and New Jersey lease areas, not including Atlantic Shores South (Appendix D, Table D-3). WTG lighting in planned offshore wind activities would be visible from the same locations as the Proposed Action in addition to New Jersey coastal locations.

The incremental impacts contributed by the Proposed Action to the cumulative impacts on demographics, employment, and economics from offshore lighting would be undetectable.

Noise: Construction of the Proposed Action is anticipated to overlap with construction of the adjacent Ocean Wind 1 offshore wind project for up to 1 year (2025), potentially contributing to increased noise impacts during simultaneous construction activity (Appendix D, Table D.A2-1).

Noise would result from operating WTGs and from maintenance and repair operations at the offshore wind energy facilities where commercial and recreational fishing operators and recreational boaters use areas of the OCS (see Section 3.6.1). That noise would be most noticeable in areas close to WTGs, which would be spaced 1 nautical mile (1.9 kilometers) apart, and would therefore not likely contribute to cumulative noise impacts. O&M vessels would typically work within the offshore wind facilities on a daily basis but would be few in number and moving between locations (i.e., temporary). Noise from O&M activities would have localized, intermittent, long-term, negligible impacts on demographics, employment, and economics associated with these uses.

While offshore operational activity would overlap with the Ocean Wind 1 offshore wind project, noise impacts during operations would be far less than during construction (see COP Volume II, Section 7.3.2.3; Atlantic Shores 2023).

The incremental impacts contributed by the Proposed Action to the cumulative impacts on demographics, employment, and economics from noise would be short term and undetectable during construction and installation, and long term and undetectable during O&M.

Presence of structures: WTGs from other planned offshore wind projects could also be visible from coastal and elevated locations in the geographic analysis area. Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year.

The Proposed Action and other ongoing and planned activities including planned offshore wind would have a long-term, undetectable impact on demographics, employment, and economics, due to impacts on commercial and for-hire recreational fishing, and recreational boating, as well as viewshed impacts on tourism both onshore and offshore.

Traffic: Increased vessel traffic from the Proposed Action and other ongoing and planned activities including planned offshore wind would produce demand for supporting marine services, with noticeable beneficial impacts on employment and economics during all Project phases.

Conclusions

Impacts of Alternative B – Proposed Action. BOEM anticipates that the Proposed Action would have negligible impacts on demographics within the analysis area. While it is likely that some workers would relocate to the area due to the Proposed Action, this volume of workers would not be substantial compared to the current population and housing supply. The Proposed Action alone would affect employment and economics through job creation, expenditures on local businesses, tax revenues, grant funds, and support for additional regional offshore wind development, which would have minor beneficial impacts. Construction would have a minor beneficial impact on employment and economics due to jobs and revenue creation over the short duration of the construction period. The beneficial impact of employment and expenditures during O&M would be modest in magnitude over the approximately 30-year duration of the Project (Table 3.6.3-2). Although tax revenues and grant funds would be modest, they would also provide a beneficial impact on public expenditures and local workforce and supply chain development for offshore wind. When the Project is decommissioned, the impacts on demographics, employment, and economics would be minor and beneficial due to the employment and labor necessary to remove wind facility structures and equipment. After decommissioning, the Proposed Action would no longer affect employment or produce other offshore wind-related revenues.

Table 3.6.3-2. Anticipated Project schedule

Phase	Start	End	Duration (Years)
Project 1			
Development	2018	2024	7
Construction	2024	2027	3
Operations	2028	2057	30[1]
Decommissioning	2058	2060	3
Project 2			
Development	2018	2024	7
Construction	2024	2027	3
Operations	2029	2058	30[1]
Decommissioning	2059	2061	3

Source: COP Volume II, Table 7.1-10; Atlantic Shores 2023.
[1] Atlantic Shores' Lease Agreement OCS-A 0499 includes a 25-year operating term, which may be extended or otherwise modified in accordance with applicable regulations in 30 CFR Part 585.

While the Proposed Action's investments in wind energy would largely benefit the local and regional economies through job creation, workforce development, and income and tax revenue, adverse effects on individual businesses and industry sectors would also occur. Short-term increases in noise during construction, cable emplacement, land disturbance, and the long-term presence of offshore lighting and structures would have negligible adverse impacts on demographics, employment, and economics. The commercial fishing industry and other businesses that depend on local seafood production would experience impacts during construction and operations (see Section 3.6.1). Overall, the impacts on commercial and for-hire recreational fisheries and onshore seafood businesses would be expected to result in minimal loss of revenues, and the amount of fishing activity that could be affected within the Lease Area is a small fraction of the amount of fishing activity in the geographic analysis area. Thus, the Proposed Action would have negligible impacts on demographics, employment, and economics as a result of its impacts on commercial and for-hire recreational fisheries. The IPFs associated with the Proposed Action alone would also result in impacts on certain recreation and tourism businesses (see Section 3.6.8) with an anticipated overall minor beneficial impact on employment and economic activity for this component of the analysis area's economy.

In summary, the Proposed Action would have **negligible** adverse impacts and **negligible** to **minor beneficial** impacts on demographics, employment, and economics resulting from individual IPFs. Overall, the Proposed Action would have **negligible** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics.

BOEM expects that the connected action alone would have **negligible** adverse impacts on demographics, employment, and economics, and **minor beneficial** impacts on employment and economics.

Cumulative Impacts of the Proposed Action. BOEM anticipates that cumulative impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including planned offshore wind would result in **negligible** to **minor** adverse and **moderate beneficial** impacts on demographics, employment, and economics in the geographic analysis area. The beneficial impacts would primarily be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the adverse impacts would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions/allisions during construction, and land disturbance.

3.6.3.6 Impacts of Alternatives C, D, E, and F on Demographics, Employment, and Economics

Impacts of Alternatives C, D, E, and F. Alternatives that could install fewer WTGs (Alternatives C [Habitat Impact Minimization/Fisheries Habitat Impact Minimization], D [No Surface Occupancy at Select Locations to Reduce Visual Impacts], and E [Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1]), or use a range of foundation types (Alternative F [Foundation Structures]) would not have measurable impacts on demographics, employment, and economics that are materially different from the impacts of the Proposed Action. Alternatives C, D, and E would all include a reduction in the number of WTGs compared to the Proposed Action. Therefore, the beneficial impacts on employment and the economy would be somewhat less than with the Proposed Action because there would be fewer construction workers or shorter employment durations for workers, and less supply chain spending; these benefits would still be considered long term and minor beneficial. Adverse impacts from Alternatives C, D, E, and F on demographics, employment, and economics would still be expected to be negligible.

Onshore Activities and Facilities

Cumulative Impacts of Alternatives C, D, E, and F. The incremental onshore impacts during the construction and installation, O&M, and decommissioning periods of the Project by Alternatives C, D, E, and F to the cumulative impacts on the demographics, employment, and economics of the affected communities would be similar to those described for the Proposed Action.

Offshore Activities and Facilities

Cumulative Impacts of Alternatives C, D, E, and F. The incremental offshore impacts during the construction and installation, O&M, and decommissioning periods of the Project by Alternatives C, D, E, and F to the cumulative impacts on the demographics, employment, and economics of the affected communities would be similar to those described for the Proposed Action.

Conclusions

Impacts of Alternatives C, D, E, and F. I The Project's incremental impacts during the construction, O&M, and decommissioning periods as a result of Alternatives C, D, E, and F on the demographics, employment, and economics of the geographic analysis area would be similar to those described for the Proposed Action. Beneficial impacts would be considered long term and **minor beneficial,** primarily due to the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements. Adverse impacts due to aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions/allisions during construction, and land disturbance would be expected to be **negligible** because any impacts would not be expected to disrupt normal demographic, employment, and economic trends.

Cumulative Impacts of Alternatives C, D, E, and F. The incremental impacts contributed by the Proposed Action to the cumulative impacts on demographics, employment, and economics would be **negligible** to **minor** and **moderate beneficial**.

3.6.3.7 Proposed Mitigation Measures

No measures to mitigate impacts on demographics, employment, and economics have been proposed for analysis.

3.6.3.8 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F from would be similar to those of the Proposed Action. The beneficial effects would be considered long term and **minor beneficial**. Adverse impacts from Alternatives C, D, E, and F on demographics, employment, and economics would be **negligible**.

3.6.4 Environmental Justice

This section discusses environmental justice impacts from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area for environmental justice, as shown on Figures 3.6.4-1 through 3.6.4-8, includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties or incorporated cities in closest proximity to the WTA and the offshore and inshore ECCs: New Castle County in Delaware; Atlantic, Gloucester, Monmouth, Ocean, and Salem Counties in New Jersey; Delaware and Philadelphia Counties in Pennsylvania; the City of Portsmouth in Virginia; and the Port of Corpus Christi in Nueces and San Patricio Counties, Texas. These counties and incorporated cities are the most likely to experience beneficial or adverse environmental justice impacts from the proposed Project related to onshore and offshore construction and use of port facilities.

Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major using the four-level classification scheme outlined in Section 3.6.4.2, *Impact Level Definitions for Environmental Justice*. A determination of whether impacts are "disproportionately high and adverse" (DHAI) in accordance with EO 12898 is provided in the conclusion sections for the Proposed Action and action alternatives.

3.6.4.1 Description of the Affected Environment and Future Baseline Conditions

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Subsection 1-101). When determining whether environmental effects are DHAI, agencies are to consider whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Native American tribe, including ecological, cultural, human health, economic, or social impacts; and whether the effects appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997). Although the analysis below focuses on DHAI, it also identifies benefits to environmental justice, as appropriate for a more complete picture of the impacts of offshore wind activities.

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA 2021a). EO 12898 directs federal agencies to actively scrutinize the following issues with respect to environmental justice as part of the NEPA process (CEQ 1997):

- The racial and economic composition of affected communities;
- Health-related issues that may amplify project effects to minority or low-income individuals; and

- Public participation strategies, including community or tribal participation in the NEPA process.

In line with EO 12898, this assessment is focused on low-income and minority populations in the geographic analysis area for environmental justice, where these populations could potentially be impacted by activities associated with the proposed Project. This analysis considers both geographically defined populations and geographically dispersed sets of individuals who experience common conditions (e.g., migrant workers or Native Americans) and who may be impacted by project activities.

USEPA Environmental Justice Community Definition

According to USEPA guidance, environmental justice analyses must address DHAI on minority populations (i.e., residents who are non-white, or who are white but have Hispanic ethnicity) and low-income populations when they comprise over 50 percent of an affected area. Low-income populations are those that are two times the annual statistical poverty thresholds from the U.S. Department of Commerce, Bureau of the Census Population Reports, Series P-60 on Income and Poverty (USEPA 2016). Environmental justice analyses must also address affected areas where minority or low-income populations are "meaningfully greater" than the minority percentage in the "reference population"—defined as the population of a larger area in which the affected population resides (i.e., a county, state, or region depending on the geographic extent of the analysis area). CEQ and USEPA guidance do not define *meaningfully greater* in terms of a specific percentage or other quantitative measure. For the purposes of this analysis, an environmental justice community is defined as the union of federal- and, if available, state-specific criteria.

State of New Jersey Environmental Justice Community Definition

New Jersey, following N.J.S.A 12:1D-157, identifies an environmental justice community as a U.S. Census block group that meets one or more of the following criteria (NJDEP 2021a):

- At least 35 percent of the households qualify as low-income households (at or below twice the poverty threshold as determined by the U.S. Census Bureau);
- At least 40 percent of the residents identify as minority or as members of a state-recognized tribal community; or
- At least 40 percent of the households have limited English proficiency (without an adult that speaks English "very well" according to the U.S. Census Bureau). For the purposes of this analysis, limited English proficiency is defined as meeting the U.S. Census criteria for "linguistic isolation," specifically households where no one over the age of 14 speaks only English or English very well.

Due to the presence of state-specific criteria, for New Jersey, environmental justice communities are defined as the union of USEPA's (see *USEPA Environmental Justice Community Definition* for more detail) and New Jersey's criteria.

Environmental justice communities in the New Jersey portion of the geographic analysis area census block groups that meet the specific criteria are clustered around larger cities and towns near potential cable landing sites and potential ports in Atlantic City (Figure 3.6.4-2), Paulsboro (Figure 3.6.4-3), and the Cardiff onshore cable route substation (Figure 3.6.4-4).

Commonwealth of Virginia Environmental Justice Community Definition

The Commonwealth of Virginia, following the Virginia Environmental Justice Act of 2020, identifies an environmental justice community as a U.S. Census block group that meets one or more of the following criteria (Commonwealth of Virginia, 2020):

- The population of color, expressed as a percentage of the total population of such area, is higher than the population of color in the Commonwealth expressed as a percentage of the total population of the Commonwealth; or
- Any census block group in which 30 percent or more of the population is composed of people with low income (defined as: "having an annual household income equal to or less than the greater of: an amount equal to 80 percent of the median income of the area in which the household is located, as reported by [U.S.] Department of Housing and Urban Development, and 200 percent of the Federal Poverty Level").

Due to the presence of state-specific criteria, for the Commonwealth of Virginia, environmental justice communities are defined as the union of USEPA's (see *USEPA Environmental Justice Community Definition* for more detail) and Virginia's criteria.

Environmental justice communities in the Virginia portion of the geographic analysis area census block groups that meet the specific criteria are clustered around larger cities and ports near Portsmouth Virginia (Figure 3.6.4-5).

State of Texas Environmental Justice Community Definition

The State of Texas does not provide specific thresholds for defining environmental justice; thereby, USEPA guidance will be used to define environmental justice communities in Texas. Environmental justice communities in the Texas portion of the geographic analysis area census block groups that meet the specific criteria are clustered around the Port of Corpus Christi (Figure 3.6.4-6).

State of Delaware Environmental Justice Community Definition

Delaware, following House Bill Number 466, identifies an environmental justice community as a U.S. Census block group that meets one or more of the following criteria (State of Delaware 2022, Section 6003A):

- 35 percent or more of the residents are below 185 percent of the federal poverty level;
- At least 25 percent or more of the residents identify as minority, or as members of state or federally recognized tribal communities, or as immigrants to the U.S., as defined by the U.S. Census Bureau;

- 25 percent or more of the households have limited English proficiency as defined by the U.S. Census Bureau; or
- Geographic locations that potentially experience harms and risk as determined by the Environmental Justice Board.

Due the presence of state-specific criteria, for Delaware, environmental justice communities are defined as the union of the USEPA's (see *USEPA Environmental Justice Community Definition* for more detail) and Delaware's criteria.

Environmental justice communities in the Delaware portion of the geographic analysis area census block groups that meet the specific criteria are present throughout New Castle County (Figure 3.6.4-7) and are along the Delaware River, which is being used for the New Jersey Wind Port, the Paulsboro Marine Terminal, and the Repauno Port and Rail Terminal (Figure 3.6.4-1)

State of Pennsylvania Environmental Justice Community Definition

Pennsylvania, following work by the Environmental Justice Work Group in 2001, identifies an environmental justice community as a U.S. Census block group that meets one or more of the following criteria (State of Pennsylvania Environmental Justice Work Group 2001):

- A minimum of 30 percent for a minority community designation; or
- A minimum of 20 percent for a low-income community.

Due to the presence of a state-specific criteria, for Pennsylvania, environmental justice communities are defined as the union of the USEPA's (see *USEPA Environmental Justice Community Definition* for more detail) and Pennsylvania's criteria.

Environmental justice communities in the Pennsylvania portion of the geographic analysis area census block groups that meet the specific criteria are present throughout Delaware and Philadelphia Counties (Figure 3.6.4-8) and are along the Delaware River, which is being used for the Paulsboro Marine Terminal, and the Repauno Port and Rail Terminal (Figure 3.6.4-1).

Environmental Justice Criteria Trends in the Geographic Analysis Area

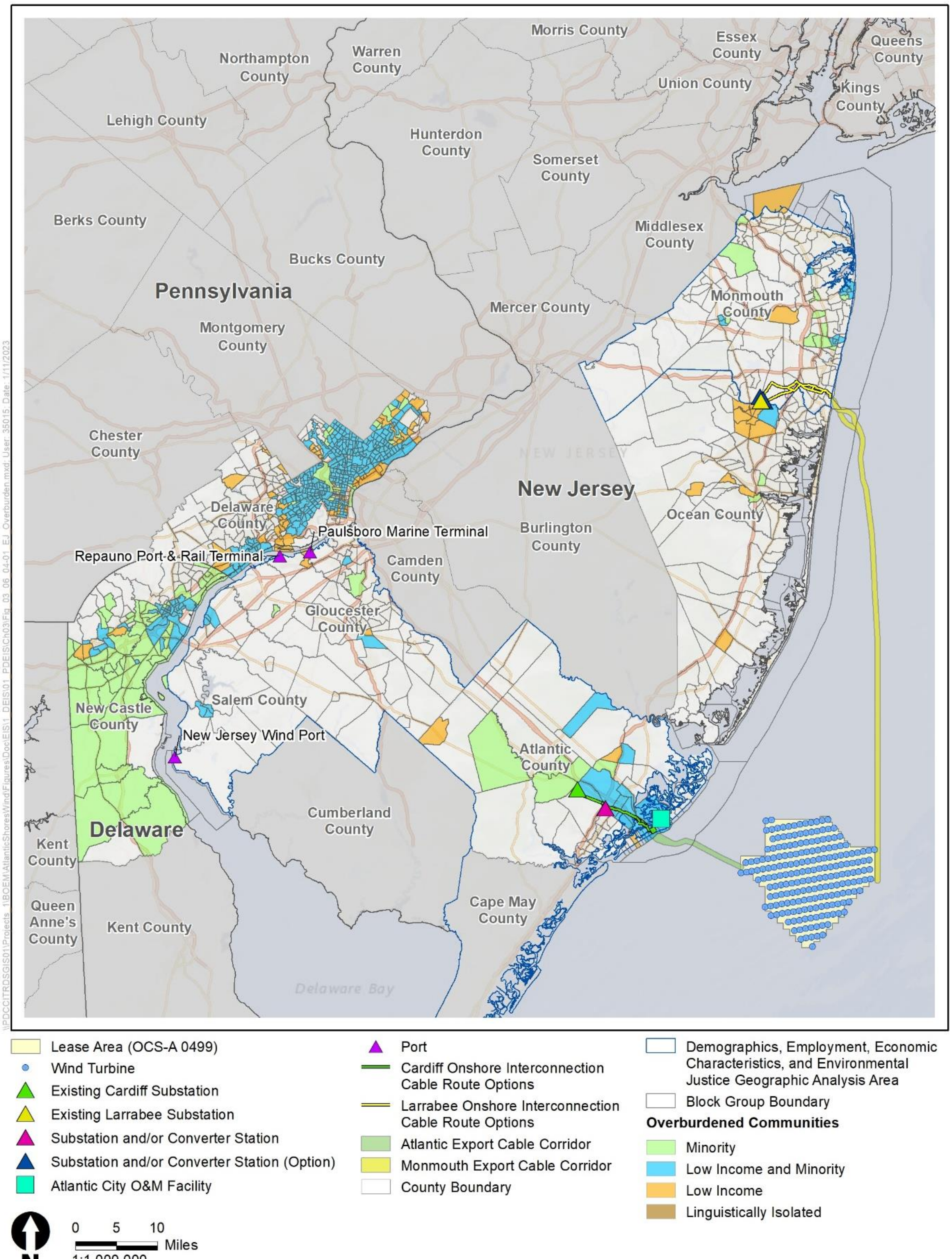
Table 3.6.4-1 summarizes trends for non-white populations and the percentage of residents with household incomes below the federally defined poverty line in the cities and counties studied in the geographic area of analysis. The non-white population percentage generally increased throughout the geographic area between 2000 and 2020. The percentage of population living under the poverty level has generally increased from 2000 to 2010 and declined slightly by 2020.

Table 3.6.4-1. State and county/city minority and low-income status

Jurisdiction	Percentage of Population Below the Federal Poverty Level 2000	2010	2020	Non-White Population Percentage[1] 2000	2010	2020
State of Delaware						
New Castle County	18.9	11.3	10.7	29.3	38.3	37.4
State Total	19.3	11.8	11.4	27.5	34.2	32.3
State of Pennsylvania						
Delaware County	17.4	9.7	9.9	20.4	28.6	32.3
Philadelphia County	31.6	26.7	23.1	57.5	63.4	61.0
State Total	*22.8*	*13.4*	*12.0*	*15.9*	*20.2*	*20.3*
State of New Jersey						
Atlantic County	20.2	14.3	13.5	36.1	42.0	36.8
Gloucester County	19.2	6.3	7.0	14.3	19.0	18.9
Monmouth County	15.4	6.6	6.5	19.4	23.2	18.5
Ocean County	13.7	11.2	9.9	10.1	13.9	10.3
Salem County	19.9	11.3	13.8	20.4	23.1	20.3
State Total	*18.4*	*14.9*	*13.6*	*34.0*	*40.6*	*34.3*
State of Texas						
San Patricio County	29.8	23.1	15.2	54.2	58.1	12.2
Nueces County	29.0	19.6	16.2	62.3	67.3	17.6
State Total	*25.0*	*17.9*	*14.2*	*47.6*	*54.8*	*30.7*
Commonwealth of Virginia						
City of Portsmouth	16.2	18.1	16.8	54.9	59.2	60.1
State Total	*9.6*	*11.1*	*10.6*	*29.8*	*35.0*	*37.9*

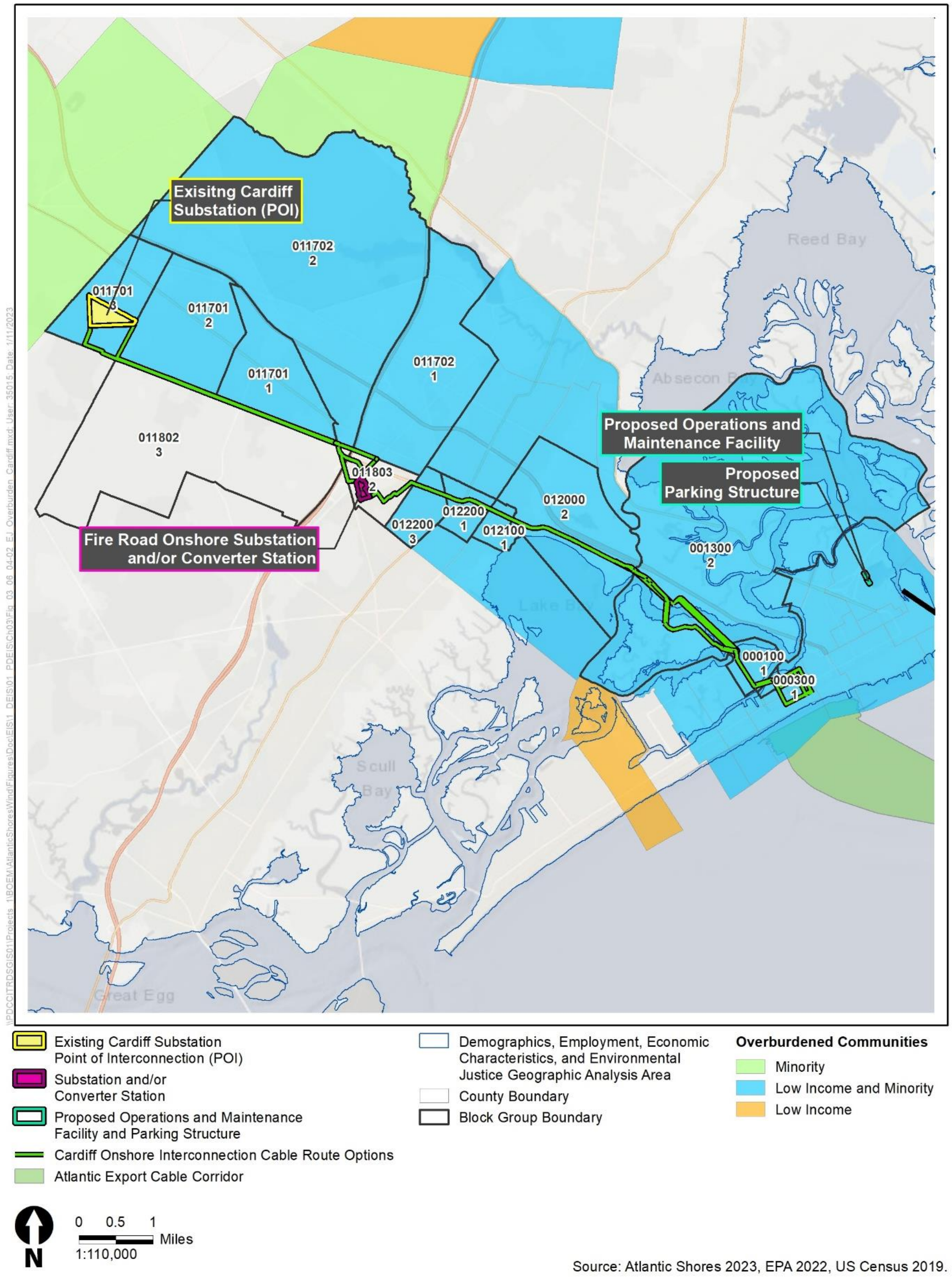
Sources: USCB 2000a, 2000b, 2010, 2020.
[1] Non-White Population Percentage is considered the White alone, not Hispanic or Latino population.

Figure 3.6.4-1 through 3.6.4-7 show the locations within these counties of census block groups in New Jersey, Virginia, and Texas identified as minority, low-income, or both based on EJ Screen data (USEPA 2021b). Due to the lack of environmental justice community presence near the Monmouth County onshore cable route (Figure 3.6.4-1), no route-specific map is provided.



Source: Atlantic Shores 2023, EPA 2022, US Census 2019.

Figure 3.6.4-1. Environmental justice populations in the geographic analysis area



Source: Atlantic Shores 2023, EPA 2022, US Census 2019.

Figure 3.6.4-2. Environmental justice populations around the Cardiff onshore cable route

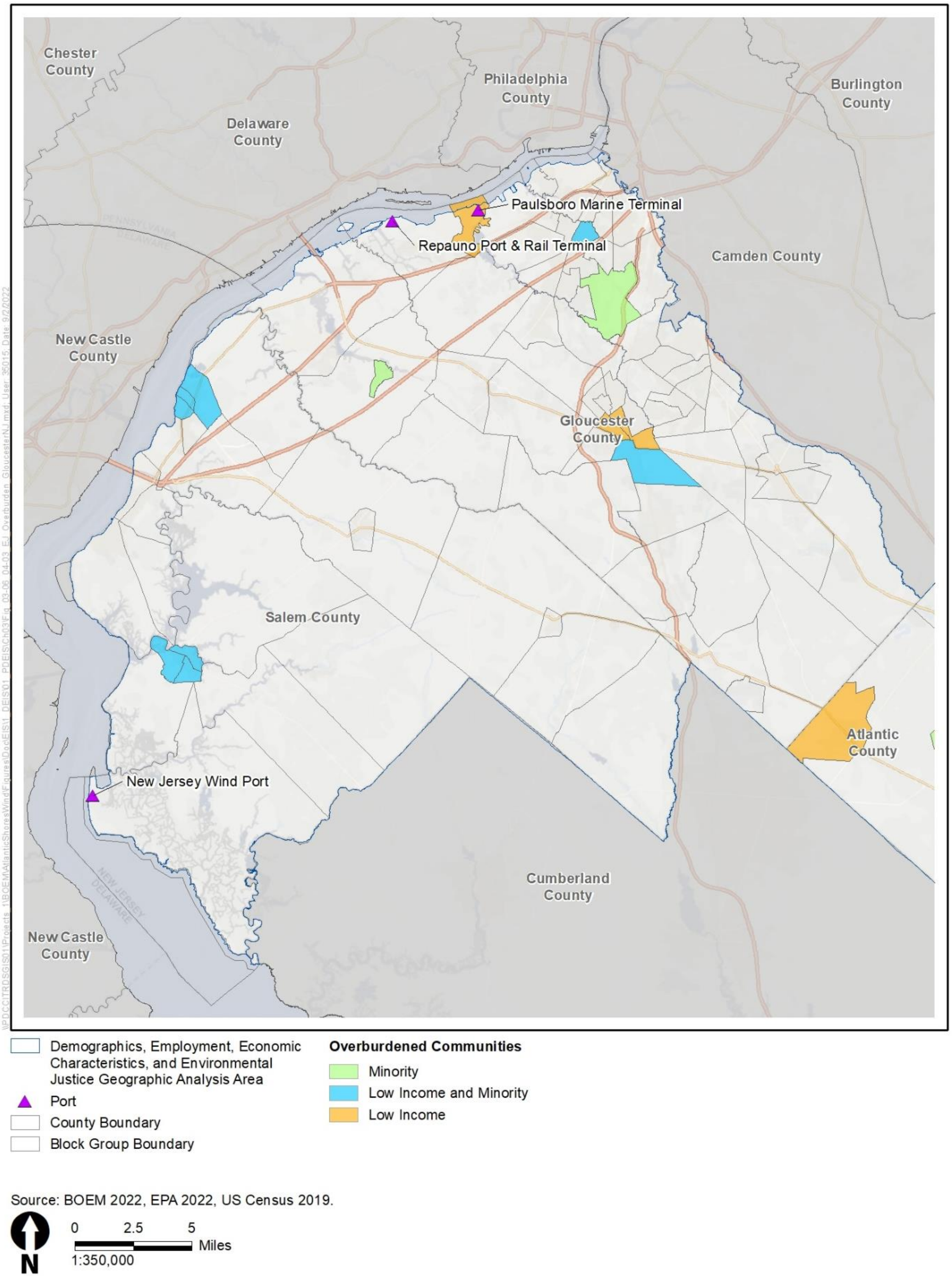


Figure 3.6.4-3. Environmental justice populations around Gloucester and Salem Counties, New Jersey

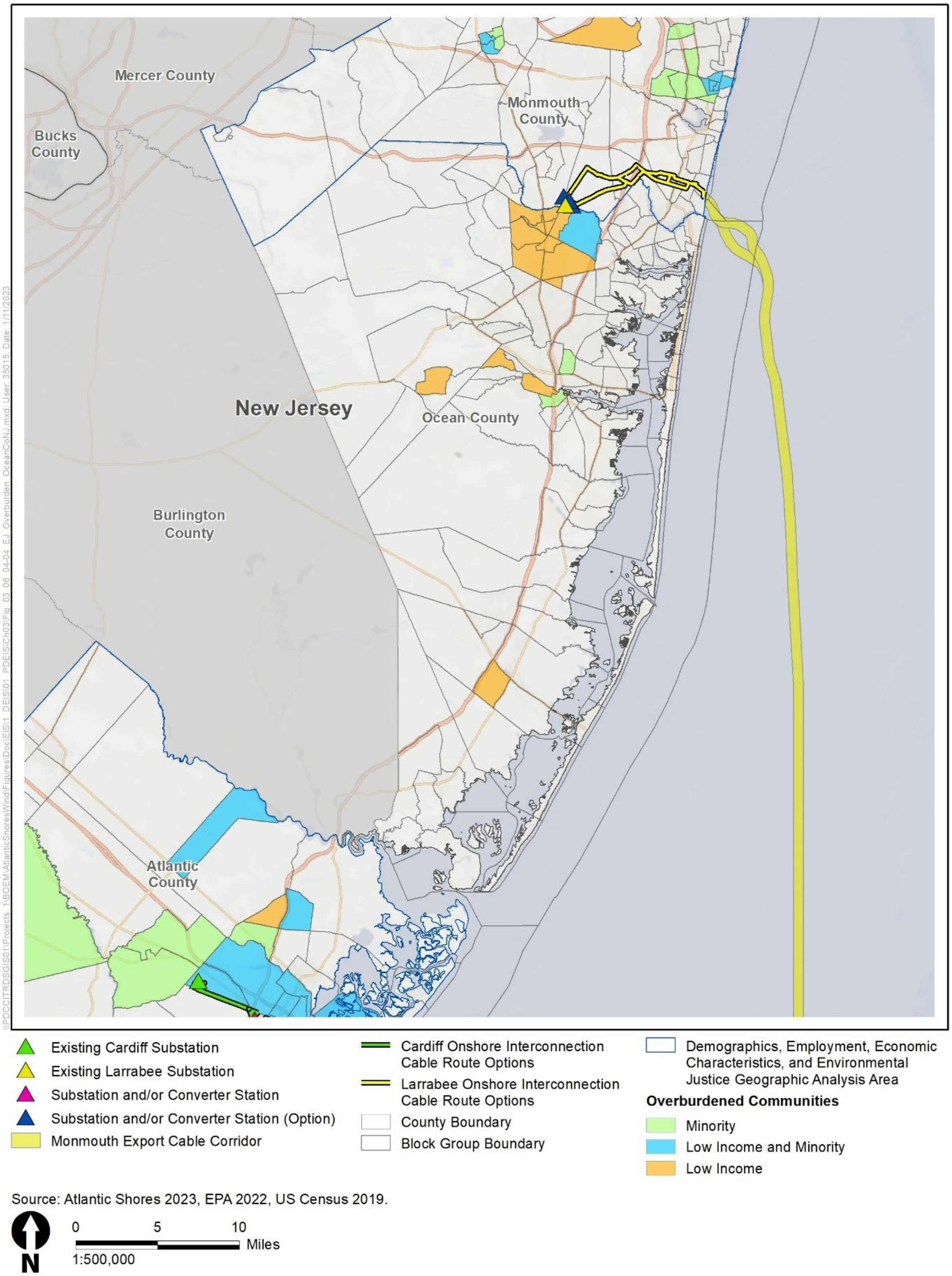


Figure 3.6.4-4. Environmental justice populations around Ocean and Monmouth Counties, New Jersey

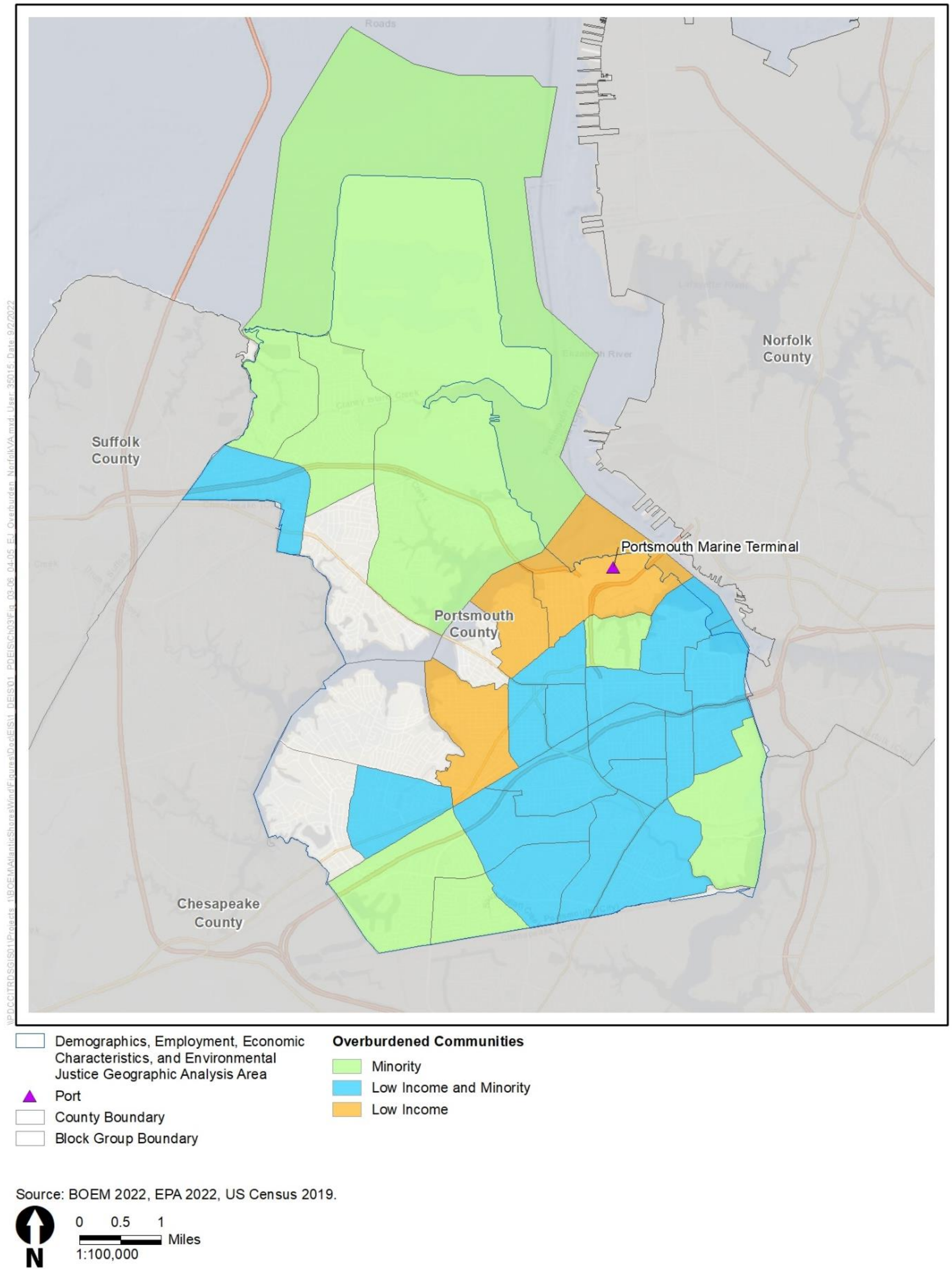


Figure 3.6.4-5. Environmental justice populations around Portsmouth City, Virginia

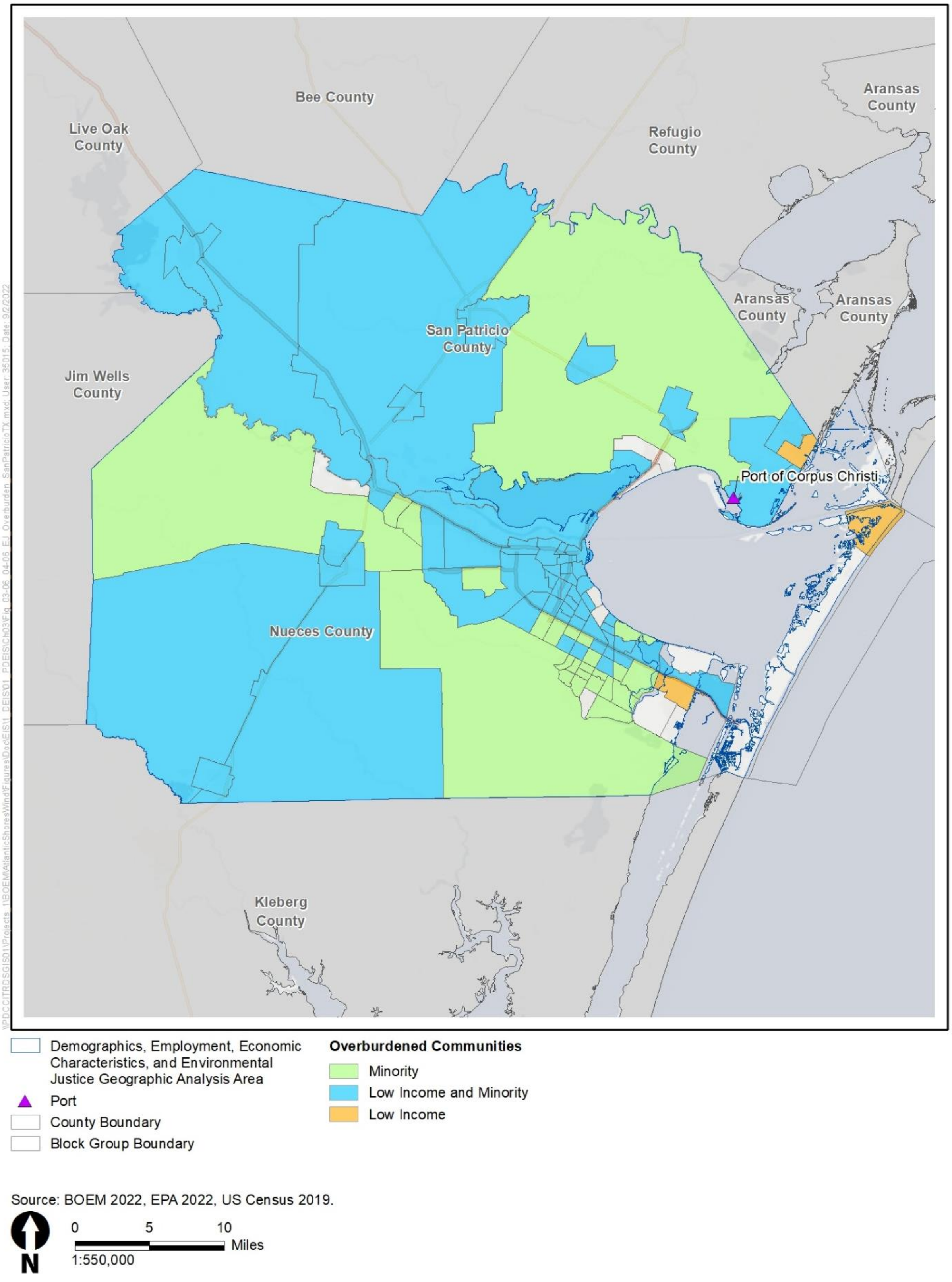


Figure 3.6.4-6. Environmental justice populations around San Patricio, Texas

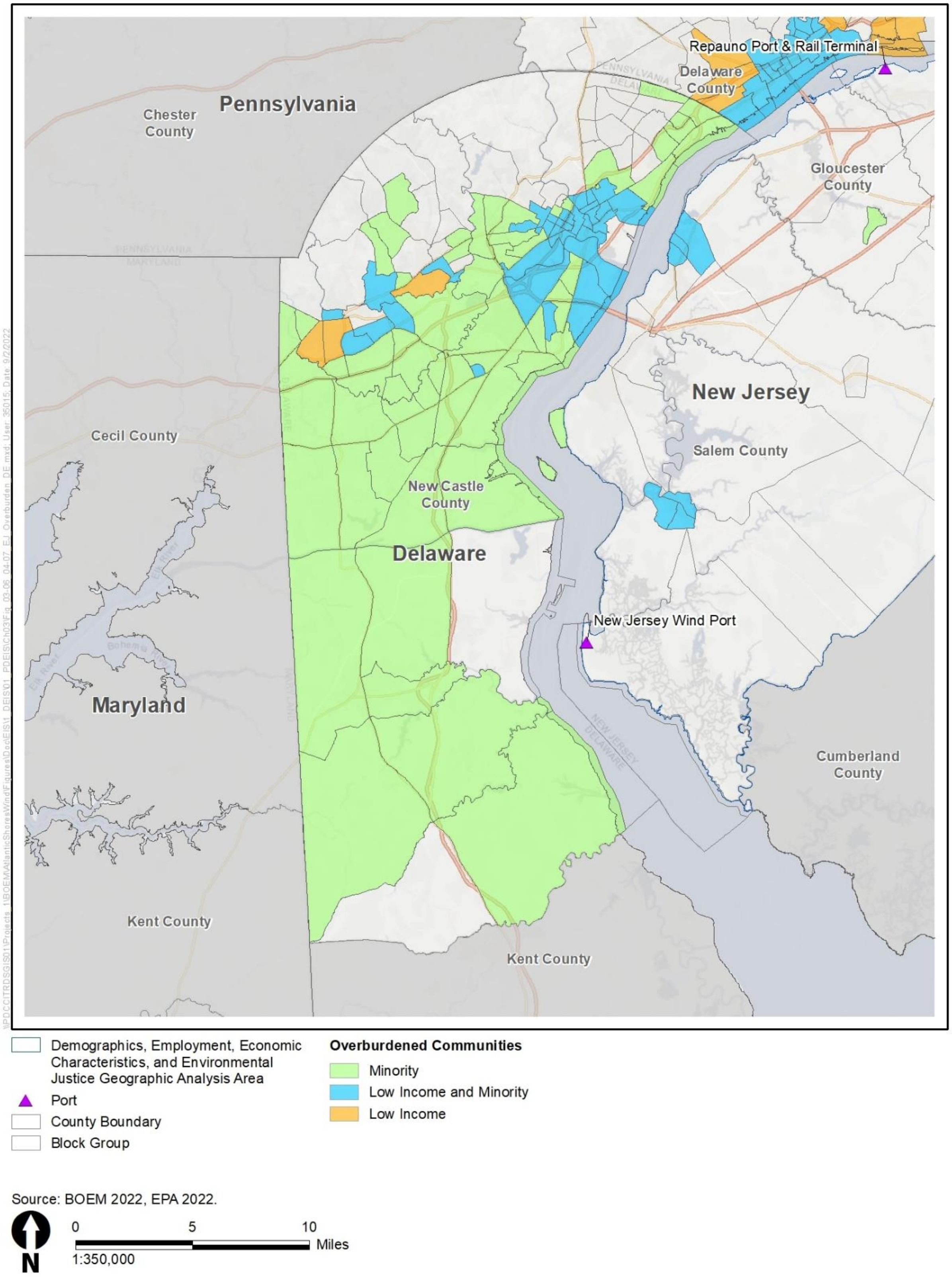


Figure 3.6.4-7. Environmental justice populations around New Castle County, Delaware

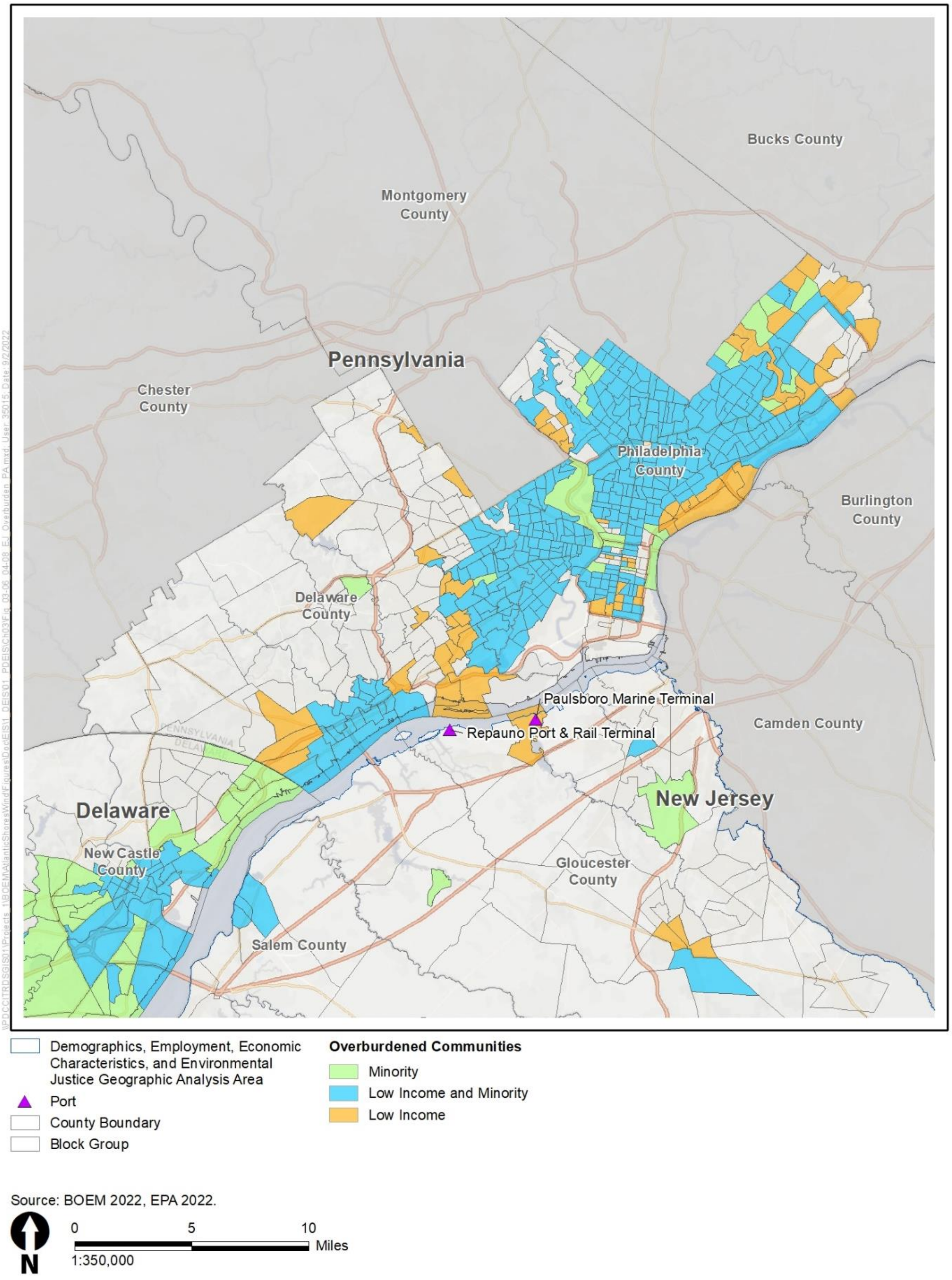


Figure 3.6.4-8. Environmental justice populations around Delaware and Philadelphia Counties, Pennsylvania

Ocean Economy Considerations

Low-income workers are employed by the commercial fishing and supporting industries that provide employment in marine trades, vessel and port maintenance, and marine industries such as marinas or boat yards, boat builders, and marine equipment suppliers and retailers.

NOAA's social indicator mapping (NOAA 2022) was used to identify low-income or minority populations that also have a high level of recreational or commercial fishing engagement or a high level of recreational or commercial fishing reliance. Due to the negligible contribution to port activity in the Virginia and Texas regions of the geographic analysis area, those ports and surrounding communities were not considered in this portion of the analysis. The NOAA social indicator index was mapped to identified environmental justice communities so as to analyze reliance and engagement of recreational and commercial fishing. The fishing engagement and reliance indices portray the importance or level of dependence of commercial or recreational fishing to coastal communities:

- Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high rank indicates more engagement.
- Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity. A high rank indicates more reliance.
- Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates. A high rank indicates more engagement.
- Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community. A high rank indicates increased reliance.

As shown on Figure 3.6.4-9, the coastal communities of Atlantic City and Brigantine (Atlantic County), and Belmar and South Belmar (Monmouth County), and Barnegat Light (Ocean County) New Jersey, have a high or medium-high level of commercial fishing engagement. Of these communities, only Barnegat Light has high levels of commercial fishing reliance. Within these communities that have a high level of commercial fishing engagement or reliance, Atlantic City is determined to contain environmental justice populations (see Figure 3.6.4-1). The coastal communities of Atlantic City and Brigantine (Atlantic County), and those along the northern end of Barnegat Bay (such as Bayville) New Jersey, have a high level of recreational fishing engagement, as do the coastal communities of Belmar, South Belmar, and Avon-by-the-Sea (Monmouth County), New Jersey (see Figure 3.6.4-9). Within these communities that have a high level of recreational fishing engagement, Atlantic City is determined to contain environmental justice populations. Atlantic City and Brigantine *(*Atlantic County), and Belmar, South Belmar, and Avon-by-the-Sea (Monmouth County), New Jersey, also have moderate levels of recreational fishing reliance (see); of these, only Atlantic City in Atlantic County contains an environmental justice population (see Figures 3.6.4-1 and 3.6.4-2 for environmental justice communities in the geographic analysis area). The Atlantic City port that may be used for the Project is in an area with high levels of commercial or recreational fishing engagement or reliance.

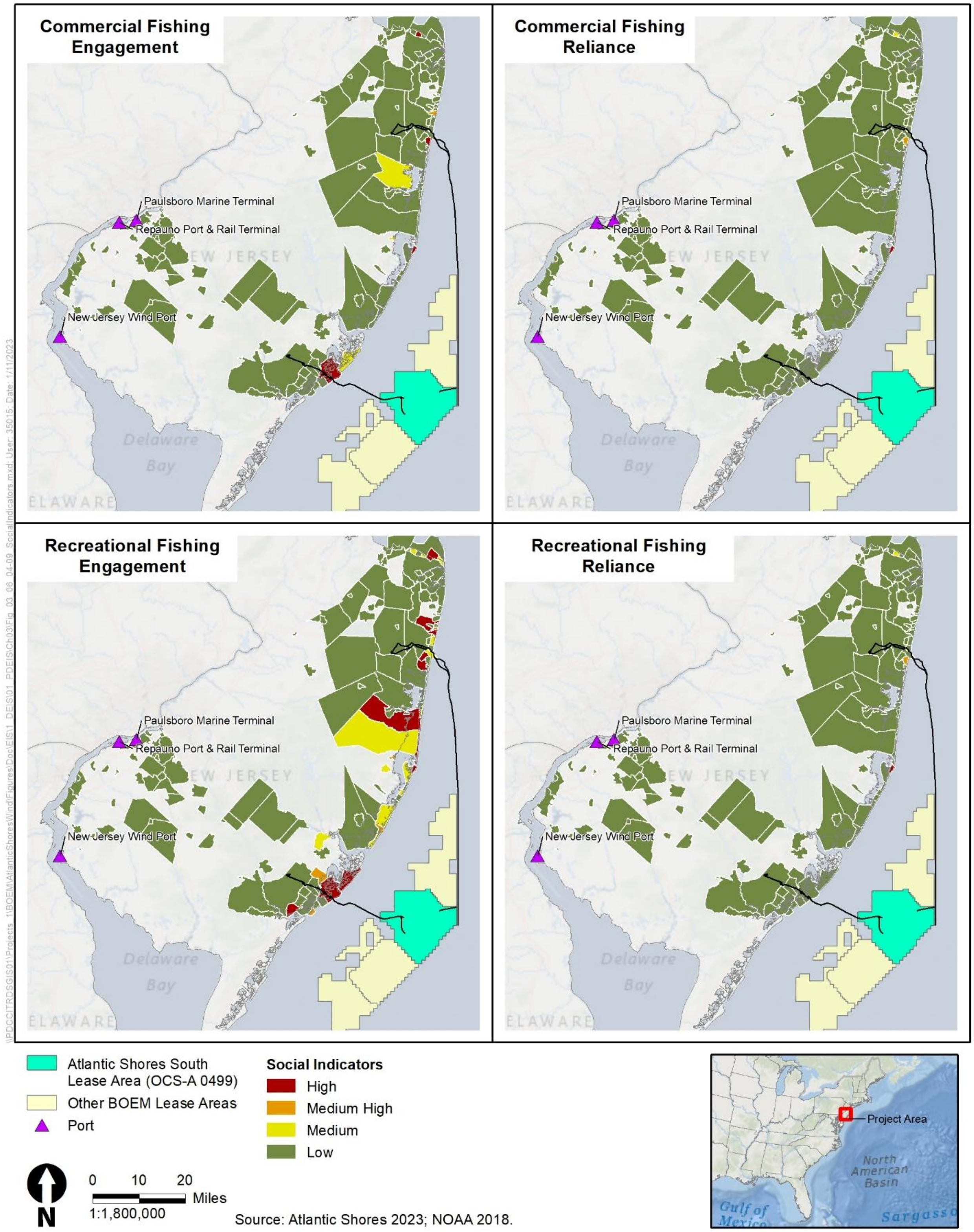


Figure 3.6.4-9. Fishing engagement and reliance of environmental justice communities in the geographic analysis area

To better understand the potential impacts on ocean economy activity from the Project, saltwater fishing access locations (NJDEP 2021b) in the geographic analysis area are mapped with identified environmental justice communities (Figure 3.6.4-10). Utilizing the reliance and engagement indices from Figure 3.6.4-9, the Cardiff and Larrabee onshore cable routes as well as the Atlantic City O&M facility are in areas of high commercial and recreational fishing engagement. However, in all three cases, the reliance index values for both commercial and recreational fishing are low. In addition to low reliance at the potentially impacted sites, there are numerous substitute saltwater fishing sites nearby (Figure 3.6.4-10).

NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2022). The gentrification pressure indicators measure factors that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront, including infrastructure. Gentrification indicators are measure factors related to housing disruption, retiree migration, and urban spawl:

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including change in mortgage value. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.
- Retiree migration characterizes communities with a higher concentration of retirees and elderly people in the population including households with inhabitants over 65 years, individuals receiving social security or retirement income, and level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek out the amenities of coastal living.
- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

Mapping for gentrification indices shows medium-high to high levels of housing disruption and retiree migration in coastal communities such as Deal, Spring Lake, Sea Girt (Monmouth County), Brigantine, Margate, and Long Port (Atlantic County), New Jersey, along the New Jersey shore between Atlantic City and Monmouth County, New Jersey, with the exception that Atlantic City has a low level of retiree migration. Urban sprawl across the same area exhibits low to medium pressure. Overall, mapping identifies lower gentrification pressure in the Atlantic City area compared to other nearby coastal areas due to low levels of retiree migration and low levels of urban sprawl.

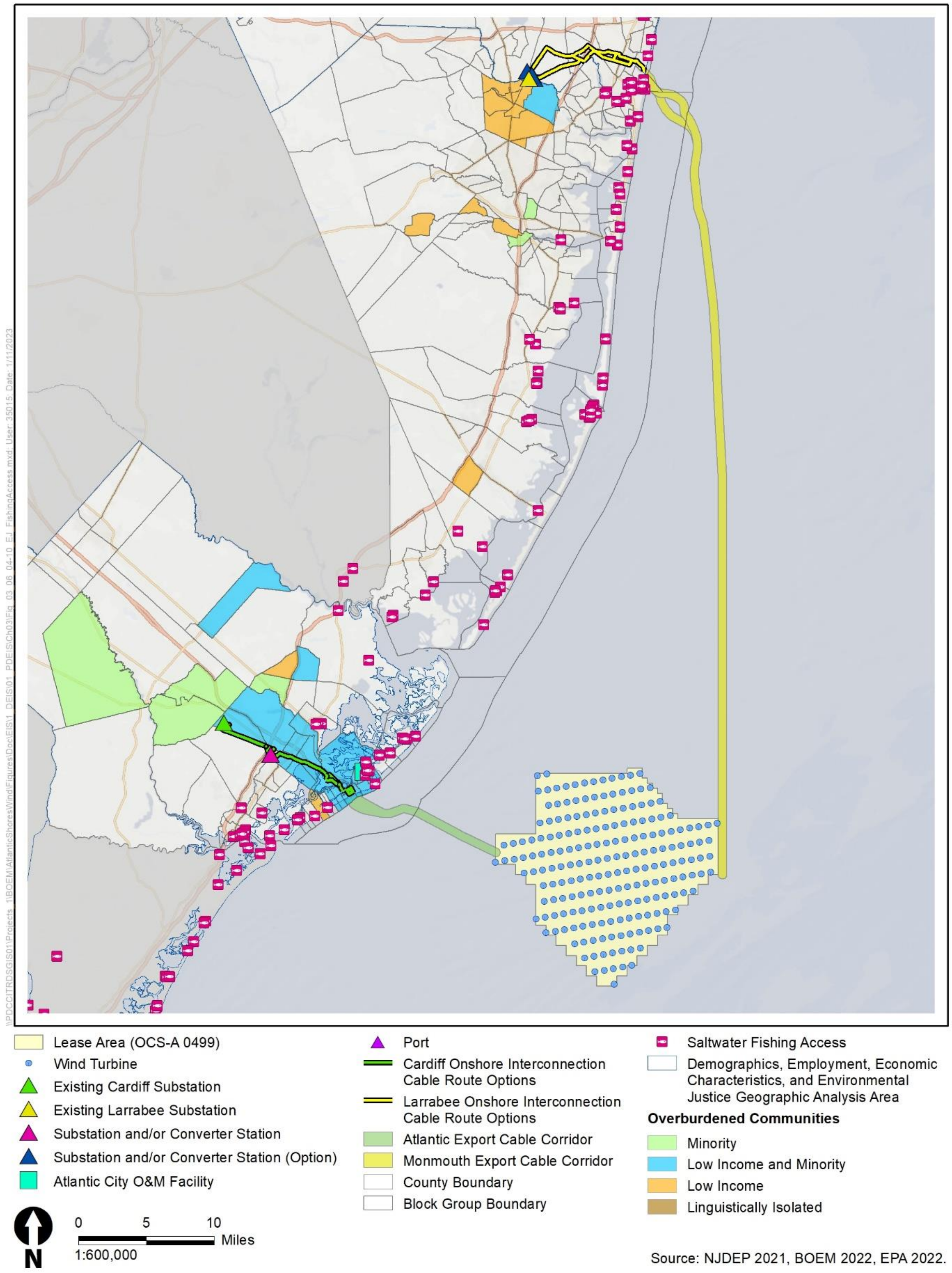


Figure 3.6.4-10. Saltwater fishing access locations and environmental justice communities in the geographic analysis area

Environmental justice analyses must also address impacts on Native American tribes. Federal agencies should evaluate "interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action," and "recognize that the impacts within…Indian tribes may be different from impacts on the general population due to a community's distinct cultural practices" (CEQ 1997). Factors that could lead to a finding of DHAI to environmental justice populations include loss of significant cultural or historical resources and the impact's relation to other cumulatively significant impacts (USEPA 2016). BOEM is holding ongoing government-to-government consultations on the proposed Project with the following federally recognized tribes: the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, Mashpee Wampanoag Tribe, Mashantucket (Western) Pequot Tribe, Narragansett Indian Tribe, Shawnee Tribe, Shinnecock Indian Nation, and Wampanoag Tribe of Gay Head (Aquinnah). BOEM has asked the following state-recognized tribes to be NHPA Section 106 consulting parties on the proposed Project: the Lenape Indian Tribe of Delaware, Nanticoke Indian Tribe, Nanticoke Lenni-Lenape Tribal Nation, Powhatan Renape Nation, Ramapough Lenape Indian Nation, and Ramapough Mountain Indians. The NHPA Section 106 process for the Project has been formally initiated by BOEM (Appendix A, *Required Environmental Permits and Consultations,* Section A.2.2.3).

With respect to tribal and indigenous peoples, New Jersey formally recognizes the Nanticoke Lenni-Lenape Indians, Powhatan Renape Indians, Ramapough Lenape Indian Nation, and Inter-Tribal People, none of which are federally recognized[1] (USEPA 2021c; State of New Jersey 2021b).

There are no tribal reservations or headquarters in the geographic analysis area, but coastal and inland areas of the region, including the Delaware River area of New Jersey, are part of the Lenni-Lenape Tribe's historical territory (Licht et al. 2009). Offshore regions in the geographic analysis area were likely part of historical sturgeon fishing grounds (Delaware Tribe of Indians 2013). The Nansemond Indian Nation, located in Suffolk, Virginia, is the closest tribe to the City of Portsmouth, Virginia. The Nansemond Indian Nation lived in settlements along the Nansemond River fishing, harvesting oysters, hunting, and farming (Nansemond Indian Nation n.d.). For the three federally and state-recognized tribes in Texas (Alabama-Coushatta Tribe, Kickapoo Traditional Tribe, and Ysleta Del Sur Pueblo), none of their historical territories are in the vicinity of Nueces or San Patricio Counties, Texas.

3.6.4.2 Environmental Consequences

Scope of the Environmental Justice Analysis

To define the scope of the environmental justice analysis, BOEM reviewed the impact conclusions for each resource analyzed in EIS Section 3.4.1 through Section 3.6.9 to assess whether the Proposed Action and action alternatives would result in major impacts that would be considered "high and adverse" and whether major impacts had the potential to affect environmental justice populations given the geographic extent of the impact relative to the locations of environmental justice populations. Major

[1] *Inter-Tribal People* refers to American Indian people who reside in New Jersey but are members of federally or State-recognized tribes in other states.

impacts that had the potential to affect environmental justice populations were further analyzed to determine if IPFs would produce DHAI. Although the environmental justice analysis considers impacts of other ongoing and planned activities, including other planned offshore wind projects, determinations as to whether impacts on environmental justice populations would be DHAI are made for the Proposed Action and action alternatives alone.

As shown on Figure 3.6.4-1, Onshore Project infrastructure—including cable landfalls, onshore export cable routes, onshore substations, and POIs—would be in areas where environmental justice populations have been identified and would thus affect environmental justice populations. Therefore, onshore impacts during construction and installation, O&M, and decommissioning are carried forward for analysis of DHAI in this environmental justice analysis under the *Land disturbance, Noise, Port utilization*, *Noise,* and *Air emissions* IPFs.

Atlantic Shores has identified the following locations for ports that could support construction of the Project: New Jersey Wind Port and Paulsboro Marine Terminal, and Repauno Port and Rail Terminal in New Jersey, Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas. In addition, Atlantic Shores plans to use an O&M facility in Atlantic City for long-term O&M of the Project. As shown on Figure 3.6.4-1 through Figure 3.6.4-7, the ports of Atlantic City Harbor and Paulsboro Marine Terminal in New Jersey, the Portsmouth Marine Terminal in Virginia, and Port of Corpus Christi in Texas and the proposed location for the O&M facility in Atlantic City are in areas where environmental justice populations have been identified. Therefore, port utilization and use of the O&M facility in Atlantic City are carried forward for analysis of DHAI effects in this environmental justice analysis under the *Port utilization* and *Air* e*missions* IPFs.

Construction and installation, O&M, and decommissioning of offshore structures (WTGs, OSSs, and met towers) could have major impacts on some commercial fishing operations that use the Lease Area, with potential for indirect impacts on employment in related industries that could affect environmental justice populations. Cable emplacement and maintenance and construction noise would also contribute to impacts on commercial fishing. The long-term presence of offshore structures (WTGs, OSSs, and met towers) would also have major impacts on scenic and visual resources and viewer experience from some onshore viewpoints that could affect environmental justice populations. Therefore, impacts of construction and installation, O&M, and decommissioning of Offshore Project components is carried forward for analysis of DHAI in this environmental justice analysis under the *Presence of structures*, *Cable emplacement and maintenance*, and *Noise* IPFs.

Section 3.6.2, *Cultural Resources*, determined that construction of offshore wind structures and cables could result in major impacts on ancient, submerged landforms if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction. BOEM has committed to working with the lessee, consulting parties, Native American tribes, and the New Jersey SHPO to develop specific treatment plans to address impacts on ancient, submerged landforms that cannot be avoided. Development and implementation of Project-specific treatment plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on ancient, submerged landforms; however, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts, unless these ancient submerged landforms can be avoided. The tribal significance of ancient, submerged landforms identified in the Lease Area and cable corridors has not yet been determined, and consultation with tribes via NHPA Section 106 consultation and government-to-government consultation is ongoing. No other tribal resources such as cultural landscapes, traditional cultural properties, burial sites, archaeological sites with tribal significance, treaty-reserved rights to usual and accustomed fishing or hunting grounds, or other potentially affected tribal resources have been identified to date. BOEM will continue to consult with Native American tribes throughout development of the EIS and will consider impacts on tribal resources identified through consultation in the environmental justice analysis if they are discovered.

Other resource impacts that concluded less-than-major impacts for the Proposed Action and action alternatives or were unlikely to affect environmental justice populations were excluded from further analysis of environmental justice impacts. This includes impacts related to bats; benthic resources; birds; coastal habitat and fauna; finfish, invertebrates, and EFH; land use and coastal infrastructure; marine mammals; navigation and vessel traffic; recreation and tourism; sea turtles; visual resources; water quality; and wetlands.

3.6.4.3 Impact Level Definitions for Environmental Justice

This Draft EIS uses a four-level classification scheme to characterize potential environmental justice impacts, as shown in Table 3.6.4-2. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions and the characterization of incremental impacts. A determination of whether impacts are "disproportionately high and adverse" in accordance with EO 12898 is provided in the conclusions sections for the Proposed Action and action alternatives.

Definitions of potential impact levels are provided in Table 3.6.4-2. Determination of a "major" impact corresponds to a "high and adverse" impact for the environmental justice analysis. Major (or high and adverse) impacts will be further analyzed to determine if those impacts would be disproportionately high and adverse for low-income and minority populations.

Table 3.6.4-2. Impact level definitions for environmental justice

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on environmental justice populations would be small and unmeasurable.
	Beneficial	Beneficial impacts on environmental justice populations would be small and unmeasurable.
Minor	Adverse	Adverse impacts on environmental justice populations would be small and measurable but would not disrupt the normal or routine function of the affected population.
	Beneficial	Environmental justice populations would experience a small and measurable improvement in human health, employment, facilities, or community services, or other economic or quality-of-life improvement.

Impact Level	Impact Type	Definition
Moderate	Adverse	Environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts.
	Beneficial	Environmental justice populations would experience a notable and measurable improvement in human health, employment, facilities, or community services, or other economic or quality-of-life improvement.
Major	Adverse	Environmental justice populations would have to adjust to significant disruptions due to notable and measurable adverse impacts. The affected population may experience measurable long-term effects.
	Beneficial	Environmental justice populations would experience a substantial long-term improvement in human health, employment, facilities, or community services, or other economic or quality-of-life improvements.

3.6.4.4 Impacts of Alternative A – No Action on Environmental Justice

When analyzing the impacts of the No Action Alternative on environmental justice, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for environmental justice. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in *Appendix D, Ongoing and Planned Activities Scenario.*

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for environmental justice described in Section 3.6.4.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities that have the potential to affect environmental justice populations include undersea transmission lines, gas pipelines and submarine cables, tidal energy projects, dredging and port improvement projects, marine minerals use and ocean-dredged material disposal, military use, marine transportation, fisheries use management, and monitoring surveys, global climate change, oil and gas activities, and onshore development activities (see Appendix D, Section D.2). These activities would contribute to periodic disruptions to environmental justice communities but are typical occurrences along the New Jersey coastline and would not substantially affect environmental justice communities. See Appendix D, Table DA-9 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for environmental justice.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on environmental justice communities include:

- Continued O&M of the BIWF project (5 WTGs) installed in state waters,
- Continued O&M of the CVOW pilot project (2 WTGs) installed in OCS-A 0497, and

- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

The ongoing activities of the BIWF, CVOW, Vineyard Wind 1, and South Fork projects are outside the geographic analysis area that would affect environmental justice communities through the primary IPFs of air emissions, cable emplacement and maintenance, land disturbance, noise, port utilization, and presence of structures. Ongoing offshore wind activities would have the same type of impacts from these IPFs as those described in *Cumulative Impacts of the No Action Alternative* for planned offshore wind activities but the impacts would be of lower intensity.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned non-offshore wind activities that may affect environmental justice include development projects, onshore construction, and port expansions (see Appendix D for a detailed description of planned activities). These activities may result in temporary and permanent impacts on environmental justice communities. See Table D.A1-9 for a summary of potential impacts associated with planned activities by IPF for environmental justice.

The sections below summarize the potential impacts of planned offshore wind activities on environmental justice during construction and installation, O&M, and decommissioning of the Project. Currently, the following offshore wind projects in the geographic analysis area are planned to overlap in timing with the Proposed Action within Lease Areas OCS-A 0498 (Ocean Wind 1), OCS-A 0532 (Ocean Wind 2), OCS-A 0549 (Atlantic Shores North), OCS-A 0538 (Attentive Energy), OCS-A 0539 (Bight Wind Holdings), OCS-A 0541 (Atlantic Shores Offshore Wind Bight), and OCS-A 0542 (Invenergy Wind Offshore). These projects are estimated to collectively install 803 WTGs, 18 OSSs and met towers, and 2,896 miles (4,661 kilometers) of submarine export cables and interarray cables in the geographic analysis area between 2024 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2).

BOEM expects planned offshore wind development activities to affect environmental justice populations through the following primary IPFs.

Air emissions: Emissions at offshore locations under the No Action Alternative from other offshore wind projects would have regional impacts, with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts depending upon the ports that are being used, the ambient air quality, and the increase in emissions at any given port. Onshore, some industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such Atlantic City are encouraging redevelopment of large areas of vacant lands within the downtown area and along the beach, boardwalk, inlet, and bay areas through redevelopment (City of Atlantic City 2016). These redevelopment areas would have lower emissions than the industrial areas they replace, reducing the impact of air emissions to proximal environmental justice communities

Emissions attributable to the No Action Alternative affecting any neighborhood have not been quantified; however, it is assumed that emissions from the No Action Alternative at ports would comprise a small proportion of total emissions from those facilities. Therefore, air emissions during construction would have small, short-term, variable impacts on environmental justice communities due to temporary increases in air emissions. The air emissions impacts would be greater if multiple offshore wind projects simultaneously use the same port for construction staging. If construction staging is distributed among several ports, the air emissions would not be concentrated near certain ports, and impacts on proximal environmental justice communities would be less. If construction staging is distributed over time, air emissions would be less concentrated than if multiple projects were operating simultaneously; however, impacts would then be extended over a longer period of time.

As explained in Section 3.4.1, *Air Quality,* operational activities under the No Action Alternative within the air quality geographic analysis area would generate 40–180 tons per year of CO, 159–746 tons per year of NO_X, 6-25 tons per year of PM_{10}, 5–24 tons per year of $PM_{2.5}$, 1–3 tons per year of SO_2, 4–15 tons per year of VOCs, and 11,752–51,412 tons per year of CO_2 (Section 3.4.1.3). Operational emissions would overall be intermittent and widely dispersed throughout the combined 241,609-acre (97,776-hectare) lease areas for Ocean Wind 1 and 2 and Atlantic Shores North and the vessel routes from the onshore O&M facility, and would generally contribute to small and localized air quality impacts (Appendix D, Table D.A2-4). Emissions would largely be due to vessel traffic related to O&M and emergency diesel generator operation. These emissions would be intermittent and widely dispersed, with small and localized air quality impacts. Only the portion of those emissions resulting from ship engines and port-based equipment operating within and near the ports (Paulsboro Marine Terminal, New Jersey Wind Port, Repauno Port and Rail Terminal in New Jersey; Portsmouth Marine Terminal in Virginia; and Port of Corpus Christi in Texas) and O&M facility (Atlantic City Harbor, New Jersey) would affect environmental justice communities. Therefore, during operations of offshore wind projects, the air emissions resulting from port activities are not anticipated to be large enough to have impacts on environmental justice communities.

The power generation capacity of offshore wind could potentially lead to lower regional air emissions by displacing fossil fuel plants for power generation, which is analyzed in further detail in Section 3.4.1. A 2019 study found that nationally, exposure to fine particulate matter from fossil fuel electricity generation in the United States varied by income and by race, with average exposures highest for Black individuals, followed by non-Hispanic white individuals. In addition to the reduction in particulate matter and other pollutants, displacing fossil fuel plants for power generation will also result in reduced GHG emissions. Exposures for other groups (i.e., Asian, Native American, and Hispanic) were somewhat lower. Exposures were higher for lower-income populations than for higher-income populations, but disparities were larger by race than by income (Thind et al. 2019). Specific to the Northeast, a 2019 study found a higher percentage increase in mortality associated with $PM_{2.5}$ in census tracts with more Blacks, lower home value, or lower median income (Yitshak-Sade et al. 2019).

Exposure to air pollution is linked to health impacts, including respiratory illness, increased health care costs, and mortality. A 2016 study for the mid-Atlantic region found that offshore wind could produce measurable benefits measured in health costs and reduction in loss of life due to displacement of fossil fuel power generation (Buonocore et al. 2016). Environmental justice populations tend to have disproportionately high exposure to air pollutants, likely leading to disproportionately high adverse health consequences. Accordingly, offshore wind generation analyzed under the No Action Alternative would have potential benefits for environmental justice populations through reduction or avoidance of air emissions and concomitant reduction or avoidance of adverse health impacts at a regional level. Localized adverse impacts could still persist and impact environmental justice communities (see Section 3.4.1 for more detail).

Cable emplacement and maintenance: As described in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, under the No Action Alternative cable installation and maintenance from other offshore wind projects would have localized, short-term impacts on the revenue and operating costs of commercial and for-hire fishing businesses (see *Land disturbance* for onshore cable emplacement). Commercial fishing operations may temporarily be less productive during cable installation or repair, resulting in reduced income; this may also lead to short-term reductions in business volumes for seafood processing and wholesaling businesses that depend upon the commercial fishing industry. Although the commercial and for-hire fishing businesses could temporarily adjust their operating locations to avoid revenue loss, the impacts would be greater if multiple cable installation or repair projects are underway offshore of the environmental justice geographic analysis area at the same time. Business impacts could affect environmental justice populations due to the potential loss of income or jobs by low-income workers in the commercial fishing industry. In addition, cable installation and maintenance could temporarily disrupt subsistence fishing, resulting in short-term, localized impacts on low-income residents who rely on subsistence fishing as a food source.

Land disturbance: Under the No Action Alternative, other offshore wind projects would require onshore cable installation, substation construction or expansion, and possibly expansion of shore-based port facilities. Depending on siting, land disturbance could result in temporary, localized, variable disturbances of neighborhoods and businesses near cable routes and construction sites due to typical construction impacts such as increased noise, dust, traffic, and road disturbances. Potential short-term, variable impacts on environmental justice communities could result from land disturbance, depending on the particular location of onshore construction for each offshore wind project.

Noise: As described in greater detail in Section 3.6.3, *Demographics, Employment, and Economics,* Section 3.6.8, *Recreation and Tourism,* and Section 3.6.9, *Visual Resources,* under the No Action Alternative, noise from site assessment G&G survey activities, pile driving, trenching, and vessels of other offshore wind projects is likely to result in temporary revenue reductions for commercial fishing and marine recreational businesses that operate in the areas offshore from the geographic analysis area for environmental justice populations. Construction noise, especially site assessment G&G surveys and pile driving, would affect fish and marine mammal populations, with impacts on commercial and for-hire fishing and marine sightseeing businesses. The severity of impacts would depend on the proximity and temporal overlap of offshore wind survey and construction activities, and the location of noise-generating activities in relation to preferred locations for commercial/for-hire fishing and marine tours.

The localized impacts of offshore noise on fishing could also have an impact on subsistence fishing by low-income residents. As mentioned in Section 3.6.8, most recreational fishing occurs within 3 miles (4.8 kilometers) of the shore, and some highly migratory species are fished farther offshore. Due to the lack of subsistence fishing reliance indicators, this analysis uses recreation fishing reliance, as defined by the NOAA social indicator, as a proxy for subsistence fishing reliance. Based on the NOAA social indicator mapping (Figure 3.6.4-6), there are no environmental justice communities that have high levels of recreational fishing reliance. In addition, noise would affect some for-hire fishing businesses or marine sightseeing businesses, as these visitor-oriented services are likely to avoid areas where noise is being generated due to the disruption for the customers.

Impacts of offshore noise on marine businesses would be short term and localized, occurring during surveying and construction, with no noticeable impacts during operations and only periodic, short-term impacts during maintenance. Noise impacts during surveying and construction would be more widespread when multiple offshore wind projects are under construction at the same time. The projects within the geographic analysis area for environmental justice could have 821 offshore WTGs, OSSs, and met towers installed by 2030 (Appendix D, Table D.A2-2). The impacts of offshore noise on marine businesses and subsistence fishing would have short-term, localized impacts on low-income workers in marine-dependent businesses as well as residents who practice subsistence fishing and clamming, resulting in impacts on environmental justice populations.

Onshore construction noise would temporarily inconvenience visitors, workers, and residents near sites where onshore cables, substations, or port improvements are installed to support offshore wind. In addition to inconvenience, construction noise has been documented to cause cardiovascular disease, cognitive impairment, sleep disturbance, and tinnitus (WHO 2011). Impacts would depend upon the location of onshore construction in relation to businesses or environmental justice communities. Impacts on environmental justice communities could be short term and intermittent, similar to other onshore utility construction activity.

Noise generated by offshore wind staging operations at ports would potentially have impacts on environmental justice communities if the port is located near such communities. Within the geographic analysis area for environmental justice populations, the ports of Atlantic City, Paulsboro Marine Terminal, New Jersey Wind Port, and Repauno Port and Rail Terminal in New Jersey; Portsmouth Marine Terminal, in the City of Portsmouth in Virginia; and the Port of Corpus Christi in Nueces and San Patricio Counties, in Texas are within or near environmental justice communities. The noise impacts under the No Action Alternative from other offshore wind projects' increased port utilization would be short term and variable, limited to the construction period, and would increase if a port is used for multiple offshore wind projects during the same time period. Noise impacts would be reduced if intervening buildings, roads, or topography lessen the intensity of noise in nearby residential neighborhoods, or if noise reduction mitigations are used for motorized vehicles and equipment.

Port utilization: If other offshore wind projects would use the ports of Atlantic City Harbor and Paulsboro Marine Terminal in New Jersey, the Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas that are located near predominantly environmental justice communities (Figures

3.6.4-1 and 3.6.4-2), under the No Action Alternative, impacts would result from increased air emissions and noise generated by port utilization or expansion (see the *Air emissions* and *Noise* IPFs). Port use and expansion resulting from offshore wind would have beneficial impacts on employment at ports. Port utilization for offshore wind would have short-term beneficial impacts for environmental justice populations during construction and decommissioning, resulting from employment opportunities, the support for other local businesses by the port-related businesses, and employee expenditures. Beneficial impacts would also result from port utilization during offshore wind operations, but these impacts would be of lower magnitude.

Presence of structures: As described in Sections 3.6.3, 3.6.8, and 3.6.9, under the No Action Alternative, the offshore structures required for offshore wind projects, including WTGs, offshore substations, and offshore cables protected with hard cover, would affect employment and economic activity generated by marine-based businesses.

Commercial fishing businesses would need to adjust routes and fishing grounds to avoid offshore work areas during construction, and to avoid WTGs and offshore substations during operations. Concrete cable covers and scour protection could result in gear loss and would make some fishing techniques unavailable in locations where the cable coverage exists. For-hire recreational fishing businesses would also need to avoid construction areas and offshore structures. A decrease in revenue, employment, and income within commercial fishing and marine recreational industries is likely to impact low-income workers, resulting in impacts on environmental justice populations. The impacts during construction would be short term and would increase in magnitude when multiple offshore construction areas exist at the same time. As many as three offshore wind projects (Atlantic Shores North, Ocean Wind 1, and Ocean Wind 2) could be under construction simultaneously in the New Jersey lease areas. Impacts during operations would be long term and continuous but may lessen in magnitude as business operators adjust to the presence of offshore structures and as any temporary marine safety zones needed for construction are no longer needed.

In addition to the potential impacts on marine activity and supporting businesses, WTGs are anticipated to provide new opportunity for subsistence and recreational fishing, through fish aggregation and reef effects, and to provide attraction for recreational sightseeing businesses, potentially benefitting subsistence fishing and low-income employees of marine-dependent businesses.

Views of offshore WTGs could also have impacts on individual locations and businesses serving the recreation and tourism industry, based on visitor decisions to select or avoid certain locations. Because the service industries that support tourism are a source of employment and income for low-income workers, impacts on tourism would also result in impacts on environmental justice populations. As stated in Section 3.6.9, portions of all 803 WTGs within the environmental justice geographic analysis area associated with the No Action Alternative (Appendix D, Table D.A2-1) could potentially be visible from shorelines, depending on vegetation, topography, weather, and atmospheric conditions. While WTGs could be visible from some shoreline locations in the geographic analysis area, WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. The impact of visible WTGs on recreation and tourism is likely to be limited to individual decisions by some visitors and is unlikely to affect most shore-based tourism businesses or the geographic analysis area's tourism industry as a whole (Section 3.6.9). Therefore, views of offshore WTGs are not anticipated to result in impacts on environmental justice populations, specifically low-income employees of tourism-related businesses.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, environmental justice populations within the geographic analysis area would continue to be affected by existing regional environmental, demographic, and economic trends. While the proposed Project would not be built under the No Action Alternative, BOEM expects ongoing activities to have continuing impacts on environmental justice populations through the following trends: ongoing population growth and new development; resulting traffic increases and industrial development, possibly increasing emissions near environmental justice communities; ongoing commercial fishing, seafood processing, and tourism industries that provide job opportunities for low-income residents; and construction-related air pollutant emissions and noise when these occur near environmental justice communities. BOEM anticipates that the environmental justice impacts as a result of ongoing activities associated with the No Action Alternative would be **minor**.

Reasonably foreseeable trends affecting environmental justice populations, other than offshore wind, include changes in the commercial fishing and seafood processing industries due to climate change and environmental stress; growing recreational and tourism industries for coastal economies; new development that would result in increased motor vehicle emissions; historically industrial waterfront locations redeveloping; and continued pressure to balance development pressure and coastal activity with protection of air and water quality. BOEM anticipates that the impacts of these trends and planned actions on environmental justice populations would be **minor**.

Cumulative Impacts of Alternative A – No Action. BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in **moderate** adverse impacts. This reflects short-term impacts on minority and low-income communities from cable emplacement, construction-phase noise and vessel traffic, and the long-term presence of offshore structures, which could affect marine-dependent businesses, resulting in job losses for low-income workers. Construction-related port activities could have impacts on environmental justice communities near ports through air emissions, traffic, or noise.

BOEM also anticipates that the impacts associated with planned offshore wind activities in the geographic analysis area would result in **minor beneficial** effects on minority and low-income populations through economic activity and job opportunities in marine trades and the offshore wind industry. Additional **minor beneficial** effects may result from reductions in air emissions if offshore wind displaces energy generation using fossil fuels.

3.6.4.5 Relevant Design Parameters and Potential Variances in Impacts

Effects on environmental justice communities would occur when the Proposed Action's adverse effects on other resources, such as air quality, water quality, employment and economics, cultural resources, recreation and tourism, commercial fishing, or navigation, are felt disproportionately within environmental justice communities, due either to the location of these communities in relation to the Proposed Action or to their higher vulnerability to impacts.

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the following sections. The following proposed Project design parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of environmental justice impacts:

- Overall size of project (approximately 1,510 MW for Project 1 and yet to be determined for Project 2) and number of WTGs;
- The Project layout including the number, type, height, and placement of the WTGs and OSS, and the design and visibility of lighting on the structures;
- The extent to which Atlantic Shores hires local residents and obtains supplies and services from local vendors;
- The port(s) selected to support construction, installation, and decommissioning and the port(s) selected to support O&M;
- The design parameters that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity;
- Arrangement of WTGs and accessibility of the WTA to recreational boaters; and
- The time of year during which onshore and near shore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix C. The following summarizes the potential variances in impacts on all members of environmental justice communities and especially those who depend on subsistence fishing or jobs in commercial/for-hire fishing or marine recreation:

- WTG number, size, location, and lighting: More WTGs and larger turbine sizes closer to shore could increase visual impacts that affect local populations, onshore recreation and tourism, and recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- WTG arrangement and orientation: Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.
- Time of construction: Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and

Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season.

3.6.4.6 Impacts of Alternative B – Proposed Action on Environmental Justice

Impacts on environmental justice communities from the Proposed Action would result from views of WTGs and impacts on shellfish, fish, and marine mammal populations. The Proposed Action would also result in impacts on low-income workers in the commercial/for-hire fishing, marine recreation, and supporting industries. The most impactful IPFs would likely include cable emplacement, vessel traffic during construction, and the presence of offshore structures, due to the potential impacts of these IPFs on submerged landforms, marine businesses (fishing and recreational), views of WTGs, and subsistence fishing.

Air emissions: Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts, depending upon the ports that are used. The Proposed Action's contributions to increased air emissions at the ports of Atlantic City, Paulsboro Marine Terminal in New Jersey; Portsmouth Marine Terminal, City of Portsmouth in Virginia; and the Port of Corpus Christi, Nueces and San Patricio Counties, in Texas (Figure 3.6.4-1 and Figure 3.6.4-2), which are predominantly environmental justice communities, are not specifically evaluated; however, as stated in Section 3.4.1, overall air emissions impacts would be minor during Proposed Action construction and installation, O&M, and decommissioning, with the greatest quantity of emissions produced in the WTA and by vessels transiting from ports to the WTA. Construction of the Proposed Action would primarily use ports within the geographic analysis area that could be used for offshore wind staging and shipping (Atlantic City (Atlantic County), Paulsboro Marine Terminal, and Repauno Port and Rail Terminal (Gloucester County) and New Jersey Wind Port (Salem County) in New Jersey; Portsmouth Marine Terminal (City of Portsmouth) in Virginia); and the Port of Corpus Christi (Nueces and San Patricio Counties) in Texas. Increased short-term and variable emissions from Proposed Action construction and installation, O&M, and conceptual decommissioning would have negligible to minor disproportionate, adverse impacts on the communities near the ports of Atlantic City and Paulsboro in New Jersey, Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas; and negligible disproportionate, adverse impacts on the communities near the other ports.

Net reductions in air pollutant emissions resulting from the Proposed Action alone would result in long-term benefits to communities (regardless of environmental justice status) by displacing emissions from fossil-fuel-generated power plants. As explained in Section 3.4.1, by displacing fossil fuel power generation, once operational, the Proposed Action would result in annual avoided emissions of 3,536 tons of NO_X, 250 tons of $PM_{2.5}$, 4,170 tons of SO_2, and 6,484,000 tons of CO_2. Estimates of annual avoided health effects would range from 243.3 to 550.5 million dollars in health benefits and 22 to 50 avoided mortality cases (Section 3.4.1, Table 3.4-5). Minority and low-income populations are disproportionately affected by emissions from fossil fuel power plants nationwide and by higher levels of air pollutants. Therefore, the Proposed Action alone could benefit environmental justice communities by displacing fossil fuel power-generating capacity within or near the geographic analysis area. The

Proposed Action, in addition to ongoing and planned offshore wind projects, could benefit environmental justice communities to a greater extent by displacing more fossil fuel power-generating capacity within or near the geographic analysis area.

Cable emplacement and maintenance: Offshore cable emplacement for the Proposed Action would temporarily affect commercial and for-hire fishing businesses, marine recreation, and subsistence fishing during cable installation and infrequent maintenance (see the *Land disturbance* IPF for onshore cable emplacement). As noted in Sections 3.6.1 and 3.6.3, installation of the Proposed Action's cables would have short-term, localized, negligible to minor impacts on marine businesses (commercial fishing or recreation businesses). Installation and construction of offshore components (cable placement, seabed profile alterations, sediment deposition, and cable protection mattress and rock placement) for the Proposed Action could therefore have a short-term, minor impact on low-income workers in marine businesses. As shown in Figure 3.6.4-10, there are a number of fishing access sites near environmental justice communities, and two are within 1 mile (approximately 2,503 feet [763 meters] and 4,888 feet [1,490 meters]) of the Larrabee cable landfall. Near the Atlantic City landfall, there are also several fishing access sites, all three of which are greater than 1 mile away (approximately 8,218 feet [2,505 meters], 9,100 feet [2,774 meters], and 11,434 feet [3,485 meters]). These environmental justice communities may experience short-term variable disturbance and space-use conflicts during cable installation; however, short-term impacts are anticipated to be negligible. Following cable installation, no prolonged disturbance or space use conflicts are anticipated, and long-term impacts are anticipated to be negligible.

Land disturbance: As shown on Figure 3.6.4-1, the existing Larrabee onshore substation and the O&M facility in Atlantic City are adjacent to neighborhoods that meet environmental justice criteria. The proposed locations for the Cardiff cable route and O&M facility are primarily in medium- and high-intensity developed areas and contain urban development and forest (COP Volume II, Figure 7.5-1; Atlantic Shores 2023). The Larrabee onshore cable route and substation are also adjacent to environmental justice communities (Figure 3.6.4-1). The proposed location for the Larrabee onshore substation and cable route contains urban development and forest (COP Volume II, Figure 7.5-1; Atlantic Shores 2023). Construction of the onshore export cable route, which is also adjacent to environmental justice communities, would temporarily disturb neighboring land uses through construction noise, vibration, and dust and other air emissions, and cause delays in travel along the affected roads, but would have only short-term, variable, moderate impacts on environmental justice communities. The proposed onshore export and interconnection cables will be located on existing ROWs and previously disturbed areas to the extent practicable (COP Volume I, Sections 4.8.3, 7.5.2, and 7.5.3; Atlantic Shores 2023). During operation and conceptual decommissioning, impacts from land disturbance are determined to be negligible to minor.

Noise: Noise from Proposed Action construction (primarily pile driving) could temporarily affect fish and marine mammal populations, hindering fishing and sightseeing near construction activity within the WTA, which could discourage some businesses from operating in these areas during pile driving (see Sections 3.6.1 and 3.6.8). This would result in a localized, short-term, negligible impact on low-income jobs supported by these businesses, as well as on subsistence fishing.

Noise generated by the Proposed Action's staging operations at ports would potentially affect environmental justice communities if the port is near such communities. The Proposed Action would use port facilities at Atlantic City, Paulsboro Marine Terminal in New Jersey; Portsmouth Marine Terminal in the City of Portsmouth in Virginia;, or the Port of Corpus Christi in Nueces and San Patricio Counties in Texas, during construction and installation, O&M, and conceptual decommissioning, which are predominantly environmental justice communities. These ports have other industrial and commercial sites, as well as major roads, which generate ongoing noise. Therefore, noise from the Proposed Action alone would have short-term, variable, minor impacts on environmental justice communities near the ports. The noise impacts from increased port utilization would increase if a port is used for more than one offshore wind project. Onshore Project construction activities are planned to be scheduled to fall within local noise ordinances (EJ-05 Appendix G, *Mitigation and Monitoring,* Table G-1).

Port utilization: The Proposed Action would require port facilities for berthing, staging, and loadout. Air emissions and noise generated by the Proposed Action's activities would potentially affect environmental justice communities during construction, operation, and conceptual decommissioning at ports in or near these communities, including Atlantic City, New Jersey Wind Port, Paulsboro Marine Terminal, and Repauno Port and Rail Terminal in New Jersey; Portsmouth Marine Terminal, City of Portsmouth, in Virginia, and Port of Corpus Christi, Nueces and San Patricio Counties, in Texas (see discussions in Section 3.6.4.3, *Impacts of Alternative B – Proposed Action*, under the *Air emissions* and *Noise* IPFs). The Proposed Action would potentially have a minor beneficial impact on environmental justice from port utilization due to greater economic activity and increased employment at the ports in the geographic analysis area, primarily during construction and decommissioning and to a lesser extent during operations.

Presence of structures: The Proposed Action's establishment of offshore structures, including up to 200 WTGs, up to 10 OSSs, and hardcover for cables, would result in both adverse and beneficial impacts on marine businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) and subsistence fishing. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for subsistence fishing, tour boats, and for-hire recreational fishing businesses. Impacts would result from navigational complexity within the WTA, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hardcover, leading to possible equipment loss and limiting certain commercial fishing methods. Overall, during construction and installation, O&M, and conceptual decommissioning, the offshore structures for the Proposed Action alone would have minor to moderate impacts on marine businesses (Sections 3.6.1, 3.6.3, and 3.6.8), resulting in long-term, continuous, negligible to minor impacts on environmental justice populations due to the impact on low-income workers in marine industries and low-income residents who rely on subsistence fishing. Atlantic Shores expects to hire local workers to the extent practical for non-specialized skilled labor (COP Volume II, Section 7.2.2.2; Atlantic Shores 2023). Hiring locally could reduce the impacts on environmental justice populations if doing so results in job opportunities for low-income or minority populations, but it is not anticipated to reduce the overall impact level.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). The bulkhead site and dredging activities are in-water activities that would be conducted entirely within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area, specifically Farley's Marina Fuel and Clam Creek. The connected action includes construction of a new 356-foot (109-meter) bulkhead to replace the existing and deteriorating 250-foot (76-meter) bulkhead. Additionally, the connected action will include maintenance dredging at the site. Atlantic Shores is proposing to implement the construction of the new bulkhead and the City of Atlantic City would complete the maintenance dredging at the site.

BOEM expects the connected action to affect environmental justice through the following primary IPFs.

Land Disturbance: The proposed construction activities could result in localized, temporary disturbance to environmental justice communities near the construction site. The connected action is anticipated to have temporary and minor impacts on environmental justice communities due to land disturbance.

Noise: Noise from the operation of construction equipment and associated vehicle traffic could result in impacts on environmental justice by increasing the noise levels of surrounding areas. Noise from the connected action would have temporary and minor impacts on environmental justice.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action.

The most impactful IPFs of the Proposed Action in addition to ongoing activities, and planned activities would include higher levels of air emissions and noise at port facilities, as well as the presence of offshore structures that would affect navigation, commercial fishing, and visual resources. Beneficial economic effects would result from port utilization and reduction in air emissions, resulting from displacement of fossil fuel electricity generation. Impacts are characterized by onshore and offshore activities during each period of the Project (construction and installation, operations and maintenance, and conceptual decommissioning).

Air emissions: As noted in Appendix D, other offshore wind projects using ports within the geographic analysis area for environmental justice populations would overlap with the Project's operations phase, and short-term air quality impacts during the construction and operation phases would be likely to vary from negligible to minor significance levels. The incremental impacts contributed by the Proposed Action to the cumulative air quality impacts on environmental justice populations from ongoing and planned activities including planned offshore wind would likely be noticeable, and negligible to minor, due to short-term emissions near ports.

Cable emplacement and maintenance: Specific offshore cable locations associated with planned offshore wind projects have not been identified within the geographic analysis area with the exception of the Ocean Wind 1 and Atlantic Shores South Project cables. The cable routes of Ocean Wind 1 and the Proposed Action have similar routes to their respective Ocean City and Monmouth County landfalls, which will add to the cumulative impacts from cable emplacement and maintenance on environmental justice communities. The uncertain offshore cable routes associated with the other planned offshore wind activities would likely have some impact on environmental justice communities due to changes in subsistence fishing and employment; however, due to the lack of information on routes, those impacts cannot be determined. The Proposed Action would require export cables that would cross 441 miles (710 kilometers), while interarray cables could cross a maximum total cable length of 547 miles (880 kilometers) (Appendix D, Table D.A2-1). The incremental impacts contributed by the Proposed Action to the cumulative offshore cable emplacement impacts on environmental justice populations from ongoing and planned activities including planned offshore wind would likely be noticeable, short term, and minor during construction and installation, O&M, and conceptual decommissioning, resulting from the impact on subsistence fishing and employment, and income from marine businesses.

Land disturbance: The Proposed Action's onshore land disturbance activities are not anticipated to overlap in location with other offshore wind projects. If land disturbance overlaps with planned offshore wind projects, the contribution of the Proposed Action to the cumulative onshore land disturbance impacts on environmental justice populations from ongoing and planned activities would likely be noticeable, short term, variable, and moderate.

Noise: Depending upon the specific ports selected to support construction and installation, noise from the Proposed Action, in combination with ongoing and planned activities, would have a variable, short-term, minor impact on environmental justice communities. The incremental impacts contributed by the Proposed Action to the cumulative noise impacts on environmental justice populations would be noticeable and minor, based on the assessment of potential impacts of pile driving on boating, fisheries, and marine mammals.

Port utilization: The incremental impacts contributed by the Proposed Action to the cumulative port utilization impacts would be noticeable and negligible to minor, due to emissions and noise generated from port activity.

Presence of structures: The Proposed Action's offshore structures are anticipated to negatively impact navigation through the geographic analysis area (see Section 3.6.6 for additional details), reduce the available area for commercial fishing (see Section 3.6.1 for additional details), and cause visual impacts (see Section 3.6.9 for additional details) for environmental justice communities. The incremental impacts contributed by the Proposed Action to the cumulative navigation, commercial fishing, and visual impacts on environmental justice populations from ongoing and planned activities including planned offshore wind would likely be noticeable, long term, and minor.

Conclusions

Impacts of Alternative B – Proposed Action. During installation of the onshore cables and substation, the IPFs associated with the Proposed Action alone would result in **minor** impacts on environmental justice communities due to air emissions and noise at ports and onshore construction sites. During both construction and operations, the impacts on low-income employees of marine industries and supporting businesses (commercial fishing, support industries, marine recreation, and tourism) from all IPFs would range from **negligible** to **moderate**. The **moderate** impacts would result from activities causing land disturbance. **Minor beneficial** impacts would result from long-term reductions in air emissions that historically disproportionately impact environmental justice communities. In summary, BOEM anticipates that the Proposed Action would have overall **minor** to **moderate** adverse impacts and **negligible** to **minor beneficial** impacts on all environmental justice populations.

BOEM expects that the connected action alone would have **minor** adverse impacts on environmental justice populations due to land disturbance and noise activities.

Cumulative Impacts of Alternative B – Proposed Action. Impacts resulting from individual IPFs on environmental justice populations from ongoing and planned actions, including the Proposed Action, would be **moderate**. Impacts on environmental justice communities near ports and onshore construction areas due to air emissions and noise would be minor. Impacts on low-income employees of marine industries and supporting businesses (commercial fishing, support industries, marine recreation and tourism) would be **minor**, based upon the anticipated temporary disruption of marine activities due to offshore cable installation and construction noise, and increased vessel traffic during construction, as well as long-term impacts on the marine-dependent businesses resulting from the long-term presence of offshore structures. Potentially beneficial impacts on environmental justice populations would result from port utilization and increased vessel traffic, and the resulting employment and economic activity. Beneficial impacts could also result if wind energy displaces fossil fuel energy generation in locations that improve air quality and health outcomes for environmental justice populations, and would range from **minor** to **moderate beneficial** (Section 3.4.1).

BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with impacts from ongoing and planned actions including planned offshore wind, would be noticeable and **moderate**. The main drivers for the impact ratings are the long-term, **minor** impacts associated with the presence of offshore structures, which affect marine-dependent businesses (commercial fishing, for-hire recreational fishing, boat tours and other marine recreational businesses) that may hire low-income workers. The Proposed Action would contribute to the overall impact rating primarily through the same IPFs. The overall impact rating is also supported by anticipated **negligible** to **minor** impacts from air emissions and noise, **minor** impacts from offshore construction-related noise and cable emplacement, and construction-related vessel traffic, which would be short term and variable, but not DHAI.

3.6.4.7 Impacts of Alternatives C, D, E, and F on Environmental Justice

Impacts of Alternatives C, D, E, and F. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative C, D, E, or F would be similar to those described under the Proposed Action. The onshore impacts of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts, E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) on environmental justice communities would be the same as those of the Proposed Action for all impacts except for land disturbance, and noise derived from construction. Alternative C could install fewer WTGs (up to 29 fewer WTGs), OSSs (1 fewer substation), and associated interarray cables, which would slightly reduce the construction impact footprint and installation period. The removal of these WTGs would result in a negligible reduction of impacts on visual resources from the presence of structures compared to the Proposed Action. Alternative D would reduce the number of WTGs closest to the shore for the Project, lowering the impact on visual resources from the presence of structures compared to the Proposed Action. Alternative E would alter the layout of the WTGs through the exclusion or micrositing of up to 5 WTGs, which could lower the impact on visual resources from the presence of structures compared to the Proposed Action. Alternative F would either use monopile and piled jacket, suction bucket, or gravity-based foundations.

The offshore impacts of Alternatives C, D, E, and F on environmental justice communities would be similar to those of the Proposed Action for all impacts during construction and installation, O&M, and conceptual decommissioning except for noise, and vehicle traffic derived from construction. Alternative C could install fewer WTGs (up to 29 fewer WTGs), OSSs (1 fewer substation), and associated interarray cables, which would slightly reduce the construction impact footprint and installation period. The removal of these WTGs would result in a negligible reduction of impacts on visual resources compared to the Proposed Action. Alternative D would alter the number of these WTGs to reduce visual impacts. Alternative E would modify the wind turbine array layout through the creation of a 0.81-nautical mile (1,500-meter) to 1.08-nautical mile (2,000-meter) setback between WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) and Ocean Wind 1 Lease Area (OCS-A 0498). This setback would be an improvement to vessel navigation and SAR considerations over no separation between lease areas. This setback would allow for the transit of larger fishing vessels through the WTA and address navigational safety concerns as recommended by USCG. The setback could potentially reduce gear entanglements and loss as well as allisions, and recreational fishing may see a slight decrease due to fewer structures providing reef habitat for targeted species. Fewer vessels and vessel trips would be expected, which would reduce the risk of discharges, fuel spills, and trash in the area. Alternative F's different foundation types could influence fish aggregation due to the "reef effect," potentially increasing recreational fishing.

Cumulative Impacts of Alternatives C, D, E, and F. The contribution of Alternative C, D, E, or F to the impacts of individual IPFs from ongoing and planned activities would be similar to those of the Proposed Action. The cumulative impacts on environmental justice populations from ongoing and planned activities in combination with Alternative C, D, E, or F would be similar to the level as described under the Proposed Action.

Conclusions

Impacts of Alternatives C, D, E, and F. The **minor** to **moderate** impacts and **negligible** to **minor beneficial** impact associated with the Proposed Action would not change substantially under Alternatives C, D, E, and F. The impacts associated with Alternatives C, D, E, and F would be slight improvements over the Proposed Action's impacts, but the impact level would not change.

Cumulative Impacts of Alternatives C, D, E, and F. The impacts resulting from individual IPFs associated with ongoing and planned activities including Alternatives C, D, E, and F would be the same as those of the Proposed Action. Impacts on environmental justice communities are expected to be noticeable and to be **moderate** adverse and **minor** to **moderate beneficial**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternatives C, D, E, and F when each combined with ongoing and planned activities including planned offshore wind would likely be **moderate** and **minor** to **moderate beneficial**.

3.6.4.8 Proposed Mitigation Measures

No measures to mitigate impacts on environmental justice have been proposed for analysis.

3.6.4.9 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F from air emissions, land disturbance, lighting, cable emplacement, noise, and traffic would be similar to those of the Proposed Action, ranging from **negligible** to **moderate** adverse and **minor** adverse to **minor beneficial** (related to the presence of structures). The Proposed Action and alternatives could negatively impact environmental justice communities during construction and installation, but be localized and short term. During operations, the presence of offshore structures would increase navigational complexity in the Lease Area, and scour and cable protection could increase the risk of gear entanglement or loss, and difficulty with anchoring (Section 3.6.1). Beneficial impacts on environmental justice would result from the reef effect (providing additional locations for recreational for-hire fishing trips) and sightseeing attraction of offshore wind energy structures supporting local economies (Smythe et al. 2020) and generating employment for low-income communities, who are employed by the coastal service industry.

By installing fewer structures, Alternative C would slightly reduce the construction impact footprint and installation period. By altering the number of WTGs, Alternative D would reduce negative visual impacts. By modifying the wind turbine layout through the exclusion of WTG positions to create a setback between WTGs in the Atlantic Shores South Lease Area and the Ocean Wind 1 Lease Area, Alternative E would improve vessel navigation and safety for recreational fishing vessels in the WTA. Alternatives C, D, and E could also reduce gear entanglements and loss as well as allisions. There would be fewer vessels and vessel trips, reducing the risk of discharges, fuel spills, and trash in the area and decreasing the risk of collision with marine mammals and sea turtles. However, the presence of fewer structures could reduce reef habitat for targeted species, decreasing recreational fishing in the area.

By using different foundation structures, Alternative F could either encourage or discourage fish aggregation due to the “reef effect,” potentially increasing or decreasing recreational fishing in the area.

This page was intentionally left blank.

3.6.5 Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.6.5-1, includes Atlantic City (Atlantic City Harbor), Howell Township, and Egg Harbor Township, New Jersey; and municipal boundaries surrounding ports in Salem and Gloucester Counties, New Jersey; Norfolk County, Virginia; and San Patricio and Nueces Counties, Texas, that may be used for the Project. In addition, Atlantic Shores proposes to construct an O&M facility in Atlantic City, New Jersey. These areas encompass locations where BOEM anticipates impacts associated with proposed onshore facilities and ports.

3.6.5.1 Description of the Affected Environment and Future Baseline Conditions

Existing land use within the geographic analysis area is diverse, including water, wetlands, barren land, forest, urban, and agricultural land uses (Howell Township 2016; Atlantic County GIS 2019a). The Project includes two proposed landing sites. The Atlantic ECC would landfall on a parcel of land that is currently used as a public parking lot bounded by Pacific, South Belmont, and South California Avenues within Atlantic City, New Jersey (COP Volume I, Section 4.7; Atlantic Shores 2023). The Monmouth ECC would landfall at the U.S. Army NGTC, located within the Borough of Sea Girt in Monmouth County, New Jersey (COP Volume I, Section 4.7; Atlantic Shores 2023).

The proposed location for the Atlantic Landfall Site and the proposed Atlantic City O&M facility is on land zoned as resort commercial development, designated by Atlantic County (Atlantic County GIS 2019a). The proposed location for the Monmouth Landfall Site is on land zoned for public/government use (GovPilot 2022). The proposed location of the onshore substations and/or converter stations at the existing Cardiff Substation POI is located on land zoned for commercial use, and the land on which the existing Larrabee Substation POI is located is zoned for special economic development (Atlantic County GIS 2019a, 2019b). Commercial areas are conditionally designated for industrial and office parks and must be buffered from residential areas (Township of Egg Harbor 2002). Special economic development areas are areas where highway and rail infrastructure are readily available and are designated for utility, construction, and commercial uses (Township of Howell 2011). Areas immediately adjacent to the Onshore Project area are zoned as residential, commercial, and recreational (Atlantic County GIS 2019a).

In the vicinity of the Onshore Project area, the existing land use includes public beaches; boardwalks; multi- and single-family homes; and office, retail, and event spaces (Atlantic County GIS 2019a).Proposed onshore cable corridors for the Cardiff Onshore Interconnection Cable Route are sited in Atlantic County. All proposed onshore export and interconnection cable route segments would be within medium- and high-intensity developed areas.

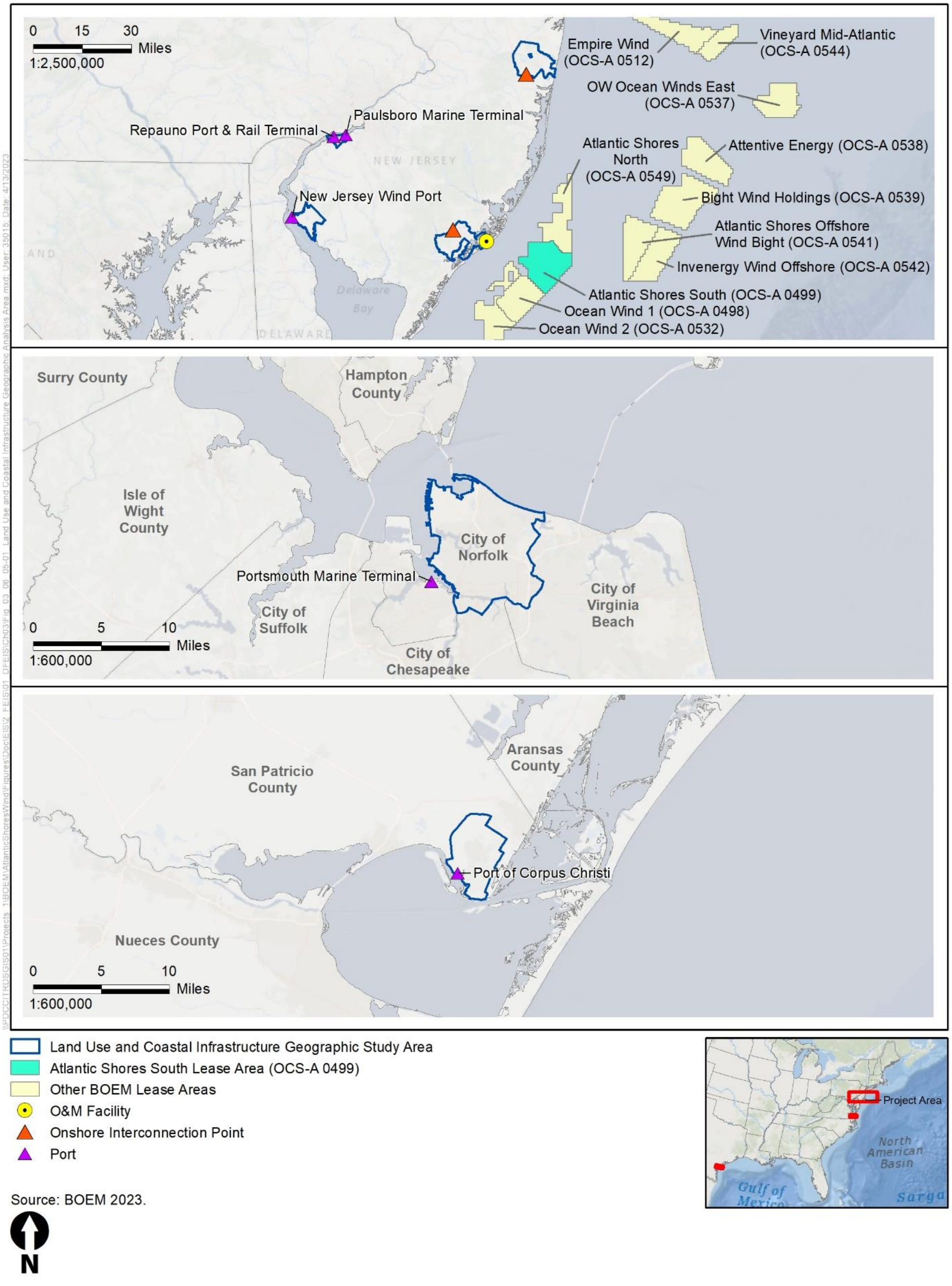


Figure 3.6.5-1. Land use and coastal infrastructure geographic analysis area

The existing land use within the Monmouth Onshore Project area is predominantly medium-intensity developed land (Monmouth County 2015). The Monmouth Landfall is located within the Borough of Sea Girt at the NGTC and sited in medium- and high-intensity developed areas, within low-intensity and open space developed areas (COP Volume II, Section 7.5.3; Atlantic Shores 2023). Proposed onshore cable corridors for the Larrabee Onshore Interconnection Cable Route are in Monmouth County. All proposed onshore export and interconnection cable route segments would be within medium- and high-intensity developed areas.

The proposed site for the Cardiff onshore substation and/or converter station is in Egg Harbor Township, New Jersey; it encompasses approximately 20 acres (8 hectares) and is bordered by Fire Road (County Road 651) to the north and Hingston Avenue to the south. The Cardiff onshore substation and/or converter station site is within medium- and high-intensity developed areas and contains urban development and forest (COP Volume II, Figure 7.5-1; Atlantic Shores 2023). The Cardiff POI would be located on a parcel that is currently a vacant lot zoned for commercial uses (Atlantic County GIS 2019b; COP Volume II, Section 7.5.2; Atlantic Shores 2023).

The proposed sites for the onshore substation and/or converter station for Larrabee are in Howell Township, New Jersey. The potential Lanes Pond Road onshore substation and/or converter station site is zoned as Agricultural Rural Estate 2 and 3 within medium-intensity developed areas (Howell Township 2016), which does not permit construction, utilities, and other industrial uses (Township of Howell 2011); the potential Randolph Road onshore substation and/or converter station site is zoned as Special Economic Development and Agricultural Rural Estate 2, which permits construction, utilities, and other industrial uses (Township of Howell 2011); the potential Brook Road onshore substation and/or converter station site is zoned as Special Economic Development, which permits construction, utilities, and other industrial uses (Township of Howell 2011). The Larrabee POI would be sited on a parcel that is currently used as an active mulching site (COP Volume II, Section 7.5.3; Atlantic Shores 2023).

In addition to the landfall locations, onshore substations and/or converter stations, and the O&M facility, the Project would use various ports for construction and installation and O&M. The ports under consideration for construction and installation include New Jersey Wind Port, Paulsboro Marine Terminal, Portsmouth Marine Terminal, Repauno Port and Rail Terminal, and Port of Corpus Christi. Four of the five construction ports are also anticipated for O&M activities (the Port of Corpus Christi is not included). Land use surrounding New Jersey Wind Port falls primarily within medium- and high-intensity developed land and is zoned as industrial district (New Jersey Economic Development Authority 2020). The Paulsboro Marine Terminal is surrounded by land zoned as the marina industrial business park (Borough of Paulsboro 2010). Portsmouth Marine Terminal is characterized by land zoned as industrial and is surrounded by land zoned as light industrial and urban residential (City of Portsmouth 2022). Repauno Port and Rail Terminal (formerly Dupont) Port of Wilmington falls primarily within medium- and high-intensity developed land and is zoned as a manufacturing district, surrounded by land zoned as residential and manufacturing (Gloucester County 2022). The Port of Corpus Christi falls primarily within medium- and high-intensity developed land, with light and heavy industrial uses along the shipping channel and professional office space, other commercial uses, public open spaces, and low-density residential uses along the Corpus Christi Bay (City of Corpus Christi 2016).

3.6.5.2 Impact Level Definitions for Land Use and Coastal Infrastructure

This Draft EIS uses a four-level classification scheme to characterize potential impacts of the Proposed Action, as shown in Table 3.6.5-1. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

Table 3.6.5-1. Impact level definitions for land use and coastal infrastructure

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

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

When analyzing the impacts of the No Action Alternative on land use and coastal infrastructure, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for land use and coastal infrastructure. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario.*

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for land use and coastal infrastructure in the geographic analysis area described in Section 3.6.5.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities, particularly related to onshore development activities and port improvement projects (Appendix D, Sections D.2.13 and D.2.6, respectively). The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and zoning regulations. See Appendix D, Table D.A1-11 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for land use and coastal infrastructure. There are no ongoing offshore wind activities within the geographic analysis area for land use and coastal infrastructure.

The geographic analysis area is highly developed, and most construction projects would likely affect land that has already been disturbed from past development, although some development of undeveloped land may also occur. Several development plans are set to commence within the geographic analysis area, including the development of student housing, residential buildings, supermarkets, and other infrastructure in Atlantic City (Jackson 2022). Some of these projects will build on land that is currently undeveloped or on land currently designated for parking. Ports in the geographic analysis area would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on land use and coastal infrastructure during construction and installation, O&M, and decommissioning of the projects.

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

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials may increase because of planned offshore wind activities. Accidental release risks would be highest during construction and installation, but still pose a risk during O&M and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. Accidental releases could result in restrictions on use of affected properties during the cleanup process; however, the impacts would be localized and long term. The exact extent of impacts would depend on the locations of landfall, substations, and cable routes, as well as the ports that support offshore wind energy projects. The impacts of accidental releases on land use and coastal infrastructure would be negligible (except in the case of very large spills that affect a large land or coastal area).

Land disturbance: Construction and installation of onshore substations and/or converter stations, O&M facilities, landfalls, buried onshore export cables, and overhead or underground transmission connections to the regional power grid for planned offshore wind projects would cause land disturbance in the geographic analysis area. Land disturbance for installation of landfalls and buried export cables would be short term, with areas restored to preexisting conditions following construction. Construction and installation of new aboveground infrastructure such as onshore substations and/or converter stations and O&M facilities could result in the long-term conversion of land from existing conditions to use for electric power generation and transmission. BOEM expects that disturbed areas not occupied by new facilities would be revegetated or otherwise stabilized for erosion control in compliance with stormwater permits for general construction. Impacts on land use and coastal infrastructure from land disturbance would be negligible, because impacts would be localized and short term.

Lighting: Aviation warning lights on offshore WTGs would be visible from some beaches and coastlines within the geographic analysis area. Visibility would depend on distance from shore, topography, atmospheric conditions, and whether ADLS technology is implemented, but would be long term (COP Volume I, Section 5.3; Atlantic Shores 2023). Nighttime lighting for construction and decommissioning of landfalls, onshore export cables, and interconnection cables could disrupt existing uses on adjacent properties. These impacts would be localized and short term. Nighttime lighting from operation of onshore substations and/or converter stations, O&M facilities, and port facilities could disrupt existing or planned uses on adjacent properties in the long term, depending on the specific location of these facilities, the land use and zoning of adjacent properties, and the extent of visual screening incorporated into the design of planned offshore wind facilities. Given the existing level of development in the geographic analysis area and that facilities would be sited consistent with local zoning regulations, BOEM anticipates the impact of facility lighting would be minor.

Noise: Offshore wind projects would generate noise, primarily associated with onshore cable trenching and substation construction. Noise from offshore wind construction activities is not expected to reach the geographic analysis area. This IPF may affect land use if noise levels influence business activity or residents' and visitors' decisions on where to visit or live. Ongoing noise from human activity (e.g., transportation, construction projects) occurs frequently in populated areas in the mid-Atlantic. The intensity and extent of noise from construction is due to clearing, grading, excavation, and trenchless cable installation, but impacts are local and short term. Noise from onshore construction activity is anticipated to be similar to noise from other ongoing construction projects in the geographic analysis area and would be temporary in duration, so impacts would be negligible.

Port utilization: Ports and navigation channels leading to Repauno Port and Rail Terminal, Paulsboro Marine Terminal, Port of Wilmington, and New Jersey Wind Port would be improved to support planned offshore wind projects and other uses (see Appendix D, Section D.2.6 and Section D.2.13). These improvements would occur within the boundaries of existing port facilities or repurposed industrial facilities, and would be similar to existing activities at the ports, and would support state strategic plans and local land use goals for the development of waterfront infrastructure. Therefore, ports would experience long-term major beneficial impacts from greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind.

To meet the demand from planned offshore wind projects, the City of Atlantic City is completing a marina upgrade, namely dredging in the marina and at Absecon Inlet (NJDOT 2021). Ocean Wind 1 is planning on upland improvements, including office and warehouse, which are being reviewed and authorized by USACE and state and local agencies (Ocean Wind 2022). BOEM expects that ports would experience long-term major beneficial impacts on land use and coastal infrastructure from greater economic activity and increased employment due to increased utilization of ports for planned offshore wind projects. State and local agencies would be responsible for minimizing the potential adverse impacts of these planned port expansions through zoning regulations and permitting of planned improvements.

Presence of structures: Planned offshore wind projects would add onshore substations and/or converter stations, O&M facilities, and overhead or underground transmission connections to the regional power grid. Improvements to coastal infrastructure such as bulkheads or marinas could also be made to support planned offshore wind activities. BOEM expects that onshore export cables would generally be buried and would not introduce aboveground structures to the geographic analysis area for land use and coastal infrastructure. Onshore substations and/or converter stations, O&M facilities, and overhead electric power transmission lines would be sited consistent with local zoning regulations and ordinances. Given the existing level of development in the geographic analysis area and that facilities would be sited consistent with local zoning regulations, BOEM anticipates the addition of onshore infrastructure for planned offshore wind would have minor impacts on land use. Improvements made to coastal infrastructure such as bulkheads or marinas to support planned offshore wind activities would have beneficial impacts on land use and coastal infrastructure.

Traffic: Offshore wind projects could result in increased road traffic and congestion that may affect land use and coastal infrastructure because traffic volumes may dictate where residents and businesses choose to locate. Onshore construction of cables for offshore wind projects would likely disrupt road traffic for a short period of time. Occasional, temporary traffic delays would result from repairs and maintenance. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for offshore wind energy projects and traffic management plans developed with local governments. Traffic impacts on land use and coastal infrastructure are anticipated to be negligible.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, land use and coastal infrastructure would continue to be affected by existing environmental trends.

BOEM expects ongoing activities to have continuing temporary and permanent impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure are accidental releases, nighttime lighting of onshore construction activity and structures, port utilization and expansion, viewshed impacts of offshore structures, presence of onshore infrastructure, and land disturbance, noise, and traffic from construction. BOEM anticipates that the impacts as a result of ongoing activities associated with the No Action Alternative, especially onshore and coastal commerce, industry, and construction projects, would have both **negligible** to **minor** adverse impacts and **minor beneficial** impacts in the geographic analysis area. Accidental releases and land disturbance could have long-term adverse impacts on local land uses but, overall, ongoing use and development sustains the region's diverse mix of land uses and provides support for continued maintenance and improvement of coastal infrastructure.

Cumulative Impacts of Alternative A – No Action. BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area, would result in overall **minor** adverse impacts and **minor beneficial** impacts. Offshore wind would adversely affect land use through land disturbance (during installation of onshore cable and substations), accidental releases during onshore construction, and traffic (depending on landfall locations, onshore routes, and time of year), as well as through the presence of offshore lighting on wind energy structures and views of the structures themselves that could affect the use and value of onshore properties. Beneficial impacts on land use and coastal infrastructure would result because the development of offshore wind would support the productive use of ports and related infrastructure designed or appropriate for offshore wind activity (including construction and installation, O&M, and decommissioning).

3.6.5.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on land use and coastal infrastructure:

- The time of year during which construction occurs. Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). If Project construction were to occur during this season, impacts on roads and land uses during the busy tourist season would be exacerbated.

Changes to the turbine design capacity would not alter the maximum potential impacts on land use and coastal infrastructure for the Proposed Action and other alternatives because the capacity or number of turbines would not affect onshore infrastructure or port utilization.

Atlantic Shores has committed to measures to minimize impacts on land use and coastal infrastructure by developing crossing and proximity agreements with utility owners prior to utility crossings, complying with NJDEP and applicable local government noise regulations, and implementing a construction schedule to minimize onshore construction activities during the peak summer recreation and tourism season (COP Volume II, Section 7.7.10 and Section 7.3.2.4; Atlantic Shores 2023).

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

The Proposed Action would affect land use and coastal infrastructure in the geographic analysis area through the following IPFs.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during staging and assembly of Project components at ports, or during construction and installation, O&M, and possible decommissioning of landfalls and onshore export cables (COP Volume I, Section 6.2.6; Atlantic Shores 2023). Atlantic Shores would develop and implement a SWPPP, SPCC Plan, and OSRP to manage accidental spills or releases of oil, fuel, or hazardous materials during construction, O&M, and decommissioning of the Project (GEO-08, GEO-16, and WAT-09; Appendix G, Table G-1). The SPCC Plan, which is under development by Atlantic Shores, will include a discussion of mitigation for nearby residents and receptors. Should accidental releases occur, there could be temporary restrictions placed on the use of affected properties during the cleanup process. Accordingly, accidental releases from the Proposed Action alone would have localized, long-term, negligible to minor impacts on land use.

Land disturbance: The Proposed Action would construct one onshore substation and/or converter station and the Cardiff POI for the Atlantic ECC and one onshore substation and/or converter station and the Larrabee POI for the Monmouth ECC. The Proposed Action also includes an O&M facility in Atlantic City, New Jersey. Atlantic City Harbor is in a developed area zoned for marine commercial use (Atlantic County GIS 2019a); therefore, construction, O&M, and decommissioning of an onshore substation and/or converter station and O&M facility at Atlantic City Harbor would have minor impacts on land use and coastal infrastructure due to land disturbance.

Construction, O&M, and decommissioning of the Proposed Action landfalls and onshore export cable and interconnection cables would result in temporary land disturbance during construction, maintenance, and decommissioning activities. To minimize disturbance; Atlantic Shores is planning to use HDD for installation of export cable landfalls at the Atlantic Landfall Site and the Monmouth Landfall Site for the Cardiff Onshore Interconnection Cable Route and Larrabee Onshore Interconnection Cable Route, respectively, and would site proposed onshore export and interconnection cables in existing ROWs and previously disturbed areas to the extent practicable (LAN-03 and -04; Appendix G, Table G-1). If the onshore interconnection cable route would cross sensitive resources, trenchless installation such as HDD, jack and bore, or pipe jacking would be used to minimize impacts. Once construction is completed, areas of temporary disturbance would be returned to preconstruction conditions, and at the onshore substations and/or converter stations, land would be appropriately graded, graveled, or grassed to prevent future erosion (LAN-03; Appendix G, Table G-1).

The Cardiff onshore substation and/or converter station would be on an approximately 20-acre (8-hectare) vacant parcel, and impacts on land use from land disturbance at the facility would be negligible (COP Volume I, Section 4.9.1; Atlantic Shores 2023). The Larrabee onshore substation and/or converter station would be on a maximum 100-acre (40.5-hectare) parcel (the Brook Road parcel) (COP Volume I, Section 4.9.1; Atlantic Shores 2023). Modifications for the Cardiff onshore substation and/or converter station could require removal of up to approximately 18 acres (7.3 hectares) of trees, and modifications for the Larrabee onshore substation and/or converter station could require removal of up to 14 acres (5.7 hectares) of trees at the potential Lanes Pond Road Site or Randolph Road Site (COP Volume I, Table 4.9-1; Atlantic Shores 2023). Tree clearing and other site preparation activities at the potential Brook Road Site would be performed by MAOD (or the designated lead state or federal agency, as appropriate) as part of the development under the SAA and is thereby not included as part of the Proposed Action.

Atlantic Shores would implement measures to avoid and minimize impacts resulting from land disturbance, including fully restoring disturbed areas, limiting construction beyond existing disturbed areas, implementing erosion and sediment control plans, and conducting site-specific mitigation (LAN-05 and -09; Appendix G, Table G-1). Given the nature of the existing conditions of the Onshore Project areas; Atlantic Shores' commitment to measures to avoid and reduce impacts related to land disturbance, and the temporary nature of construction, BOEM expects that impacts on land use and coastal infrastructure from land disturbance would be minor.

Lighting: Aviation warning lights on offshore WTGs would be visible from beaches and coastlines within the geographic analysis area. Visibility from a specific viewpoint would depend on distance from shore, topography, and atmospheric conditions. Atlantic Shores would implement an ADLS on WTGs to activate a hazard lighting system in response to detection of nearby aircraft, subject to confirmation of commercial availability, technical feasibility, and agency review and approval (COP Volume I, Section 5.3; Atlantic Shores 2023). With an ADLS, the synchronized flashing of the navigational lights would only occur when aircraft are present, resulting in substantially reduced night sky impacts. BOEM does not expect that intermittent nighttime lighting of WTGs offshore would affect existing land uses onshore given the extent of high- and medium-intensity developed areas present within the geographic analysis area.

Nighttime lighting for construction and decommissioning of Proposed Action landfalls, onshore export cables, and interconnection cables could disrupt existing uses on adjacent properties. These impacts would be localized and short term. BOEM does not expect that nighttime lighting from operation of the proposed onshore substation and/or converter stations; Cardiff and Larrabee POIs; and Atlantic City O&M facility would have adverse effects on existing land uses because these facilities are proposed in commercial or economic development zoning districts that are designated for heavy industry. Atlantic Shores would incorporate lighting reduction measures (i.e., only at nighttime during repairs or detailed inspections) into the design for the onshore substations and/or converter stations to reduce lighting impacts to the extent practicable (COP Volume II, Section 5.2.5; Atlantic Shores 2023) and use vegetative screening, as needed, to screen views of the onshore substation and/or converter station by nearby residents (COP Volume II, Section 5.2.3; Atlantic Shores 2023). With implementation of these measures, BOEM expects that modifications to the Cardiff and Larrabee onshore substations and/or converter stations would have negligible impacts on existing land use due to lighting.

Noise: The Proposed Action would comply with NJDEP noise regulations and local noise regulations, to the extent practicable, to minimize impacts on nearby communities (COP Volume II, Sections 4.7.1 and 8.1.5; Atlantic Shores 2023). Typical construction equipment ranges from a generator or refrigerator unit at 73 A-weighted decibels (dBA) at 50 feet (15 meters) to an impact pile driver at 101 dBA at 50 feet (15 meters). As the Proposed Action would be built 8.7 miles (14 kilometers) offshore, noise effects from offshore construction noise would be short term and negligible. New Jersey Administrative Code 7:29 limits noise from industrial facilities at residential property lines to 50 dBA during nighttime and 65 dBA during daytime. Temporarily increased noise levels during construction may affect local sensitive receptors (such as religious locations, recreational areas, schools, and other places that are particularly sensitive to construction) but would be minimized through BMPs and would not change existing land uses.

Port utilization: Atlantic Shores would enter into short-term or long-term lease agreements for use of WTG component staging and construction at New Jersey Wind Port, Paulsboro Marine Terminal, Portsmouth Marine Terminal, Repauno Port and Rail Terminal, and Port of Corpus Christi. To meet the planned demand of the Proposed Action and other planned offshore wind projects, many port entities have plans to upgrade or further develop port facilities in support of the burgeoning offshore wind industry. For instance, the New Jersey Economic Development Authority, on behalf of the State of New Jersey, is constructing an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County, approximately 7.5 miles (12.1 kilometers) southwest of the city of Salem (New Jersey Wind Port 2021). The Delaware River Channel dredging project will improve port access to the New Jersey Offshore Wind Port, Paulsboro Marine Terminal, and Repauno Port and Rail Terminal. Additionally, the State of New Jersey announced a $250 million investment in a manufacturing facility to build steel components for offshore wind turbines at the Paulsboro Marine Terminal on the Delaware River in New Jersey (State of New Jersey 2020). Construction of the facility began in January 2021, with production anticipated to begin in 2023. A channel deepening project at the Port of Virginia is currently underway in Norfolk Harbor and Newport News, Virginia, and is anticipated to be completed in 2024, which will improve port access to the Portsmouth Marine Terminal (USACE 2019). Atlantic Shores has proposed to voluntarily implement an Environmental Protection Measure (LAN-01) and would use a Marine Coordinator to manage any increase in vessel movements during Project construction, O&M, and decommissioning (see Appendix G, *Mitigation and Monitoring*).

BOEM expects that ports would experience long-term major beneficial impacts from greater economic activity and increased employment due to increased utilization of ports for WTG fabrication, staging, and assembly, as well as through increased demand for vessel maintenance services, vessel berthing, loading and unloading, warehousing, capital investment for improvements such as repairs to existing bulkheads/docks, and other business activity related to offshore wind.

Overall, the construction and installation, O&M, and decommissioning of the Proposed Action alone would have minor beneficial impacts on land use and coastal infrastructure due to port utilization by supporting designated uses and infrastructure improvements in Atlantic City, New Jersey.

Presence of structures: Portions of all the Proposed Action WTGs could be visible from certain coastal and elevated areas of the geographic analysis area mainland, depending upon vegetation, topography, and atmospheric conditions. At its closet point, WTGs would be approximately 8.7 statute miles (14 kilometers) from the coastal viewers, which would be within the predominant focus of visual attention (COP Volume II, Section 5.2.3; Atlantic Shores 2023). The Proposed Action alone would have a long-term, continuous, negligible impact on land use and coastal infrastructure in the geographic analysis area because while WTGs would be visible onshore, their presence is not anticipated to result in changes to land use or zoning.

The Proposed Action would construct an onshore substation and/or converter station along each of the Cardiff and Larrabee interconnection cable routes (COP Volume I, Section 4.9; Atlantic Shores 2023). The Proposed Action also includes establishing an O&M facility in Atlantic City, New Jersey, that would consist of an office space, warehouse space, harbor area and quayside, a communications antenna, and an outdoor area and parking (COP Volume I, Section 5.5; Atlantic Shores 2023). Construction of the O&M facility would also include repairs to existing docks and installation of new dock facilities (COP Volume II, Section 7.5.2; Atlantic Shores 2023). Construction, building the O&M facility, and ongoing

O&M in Atlantic City, New Jersey, would be consistent with existing land use and zoning, which is within a marine commercial zoning district (Atlantic County GIS 2019a). The Atlantic ECC would landfall on a parcel of land that is currently used as a public parking lot bounded by Pacific, South Belmont, and South California Avenues within Atlantic City (COP Volume I, Section 4.7; Atlantic Shores 2023). The Monmouth ECC would landfall at the Monmouth Landfall Site, located within the Borough of Sea Girt in Monmouth County, New Jersey, at the NGTC (COP Volume I, Section 4.7; Atlantic Shores 2023).

The proposed Cardiff cable route onshore substation and/or converter station site would be located at a vacant lot on approximately 20 acres (8 hectares) and bordered by Fire Road (County Road 651) and Hingston Avenue in Egg Harbor Township (COP Volume I, Section 4.9.1; Atlantic Shores 2023). The facility is not within a designated floodplain or other flood hazard area nor does the site contain wetland resources. The site is zoned for commercial and industrial uses, and surrounding land uses are characterized by a mixture of urban development and forests.

The proposed Larrabee cable route onshore substation and/or converter station would be located at one of three potential sites in Howell Township, New Jersey. The Lanes Pond Road Site would be approximately 16.3 acres and located at the southeast intersection of Lanes Pond Road and Miller Road. The Randolph Road Site would be approximately 24.7 acres and located east of Lakewood Farmingdale Road and north of Randolph Road. The Brook Road Site would be located west of Brook Road and south of Randolph Road, and is expected to be prepared and developed as part of the State of New Jersey's SAA to support multiple offshore wind generation projects that the state will procure in the future (State of New Jersey 2023). If Atlantic Shores does not receive the award to utilize the Brook Road Site, Atlantic Shores would utilize either the Lanes Pond Road or the Randolph Road Site.

Considering no long-term change in land use is required to use the proposed Cardiff and Larrabee onshore substation and/or converter station sites, BOEM expects that construction, O&M, and decommissioning of the Cardiff and Larrabee cable route onshore substations and/or converter stations, and the Cardiff and Larrabee POIs would have minor impacts on existing land use at the site and negligible impacts on surrounding land uses.

Because onshore export cable and interconnection cable would be buried and utilize existing ROWs and previously disturbed areas to the extent practicable (LAN-03, Appendix G, Table G-1; COP Volume II, Section 7.5; Atlantic Shores 2023), BOEM expects that construction, O&M, and possible decommissioning of onshore export cable and interconnection cables would have no long-term effects on land use or coastal infrastructure related to the presence of structures.

Traffic: Cable installation within the roadway can result in temporary traffic impacts such as lane closures, shifted traffic patterns, or closed roadways with temporary detours. The Cardiff onshore Interconnection Cable Route is expected to be approximately 12.4 to 22.6 miles (20 to 36.4 kilometers) in length, and the Larrabee Onshore Interconnection Cable Route is expected to be approximately 9.8 to 23 miles (15.8 to 37 kilometers) (Atlantic Shores 2023). BMPs and traffic plans would be developed and coordinated with local and state agencies, and the Project would adhere to a construction schedule that avoids major tourism seasons (such as from May to September) (LAN-08, Appendix G, Table G-1; COP

Volume II, Section 7.3.2.4; Atlantic Shores 2023). Traffic impacts would be limited to the immediate construction area. Roadways would be returned to preconstruction conditions, and changes to the existing land use would not result (COP Volume I, Section 4.8.3; Atlantic Shores 2023). Atlantic Shores proposes to designate signage, police details, lane closures, and detours to minimize potential impacts (COP Volume I, Section 4.8.3; Atlantic Shores 2023).

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* as part of the Proposed Action, an O&M facility would be constructed in Atlantic City, New Jersey, on a site previously used for vessel docking or other port activities. Construction of the O&M facility would involve a new building and associated parking structure, repairs to the existing docks, and installation of a new bulkhead and new dock facilities. Installation of a new bulkhead and maintenance dredging in coordination with Atlantic City's dredging of the adjacent basins would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead and dredging activities are considered to be a connected action and are evaluated in this section.

The connected action would affect land use and coastal infrastructure in the geographic analysis area through the port utilization IPF.

Port utilization: The connected action would facilitate in activating a retired marine terminal into an O&M facility to support the offshore wind industry, thereby resulting in an increase in port utilization. Impacts from port utilization associated with the connected action are expected to be localized and short term.

Implementation of the connected action would provide long-term, moderate beneficial impacts on port utilization from greater economic activity and increased employment in Atlantic City, New Jersey, for an O&M facility, as well as through increased demand for vessel maintenance services, vessel berthing, loading and unloading, warehousing, capital investment for improvements, and other business activity related to offshore wind.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities, and the connected action.

Accidental releases: The Proposed Action would contribute a noticeable increment to the cumulative potential for accidental releases from ongoing and planned activities, including offshore wind projects. The increased risk of (and thus the potential impacts from) accidental releases of fuel, fluids, or hazardous materials in the geographic analysis area would result in localized, long-term, negligible to minor impacts on land use and coastal infrastructure.

Land disturbance: The Proposed Action would contribute a noticeable increment to the cumulative land disturbance impacts on land use and coastal infrastructure, which are anticipated to be localized and short term and minor.

Lighting: The Proposed Action would contribute a noticeable increment to the cumulative lighting impacts, which would introduce additional sources of nighttime lighting to the geographic analysis area and would result in localized, long-term, negligible to minor impacts on land use and coastal infrastructure.

Noise: Construction of planned offshore wind projects within the geographic analysis area would be required to comply with the same or similar noise regulations as the Proposed Action, and noise levels are anticipated to be similar to noise levels from other ongoing activities. The incremental impacts contributed by the Proposed Action to the cumulative noise impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind are anticipated to be localized, short term, and minor.

Port utilization: The Proposed Action would contribute a noticeable increment to the cumulative port utilization impacts from ongoing and planned activities, including the connected action, which would have moderate beneficial impacts on land use and coastal infrastructure due to increased port utilization and resulting economic activity.

Presence of structures: The Proposed Action would contribute a noticeable increment to cumulative presence of structures impacts on land use and coastal infrastructure, which are anticipated to be minor. Assuming that new substations for offshore wind projects would be in locations designated for industrial or utility uses, and underground cable conduits would primarily be co-located with roads or other utilities, operation of substations and cable conduits would not affect the established and planned land uses for a local area.

Traffic: The incremental impacts contributed by the Proposed Action to cumulative traffic impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind are anticipated to be localized and short term and minor.

Conclusions

Impacts of Alternative B – Proposed Action. In summary, BOEM anticipates that impacts on land use and coastal infrastructure from the Proposed Action alone would range from **negligible** to **minor** with **minor beneficial** impacts. The Proposed Action would have minor beneficial impacts resulting from port utilization by supporting designated uses and infrastructure improvements in Atlantic City, New Jersey; negligible impacts resulting from land disturbance during onshore installation of the cable route and substation; and negligible to minor impacts resulting from accidental spills. Noise and traffic from onshore construction would have localized, short-term, minor impacts on land use and coastal infrastructure due to traffic and noise impacts being similar to ongoing activities.

BOEM expects that the connected action alone would have **moderate beneficial** impacts on land use and coastal infrastructure due to port utilization.

Cumulative Impacts of Alternative B – Proposed Action. The incremental impacts contributed by the Proposed Action to the cumulative impacts on land use and coastal infrastructure would range from negligible to minor adverse and negligible to moderate beneficial impacts. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities would result in **minor** adverse impacts and **moderate beneficial** impacts on land use and coastal infrastructure in the geographic analysis area. The main drivers for this impact rating are the moderate beneficial impacts of port utilization, minor impacts on the viewshed due to the presence of offshore structures, and minor impacts of land disturbance, based upon the return of disturbance to preconstruction conditions. The Proposed Action would contribute to the overall impact rating primarily through short-term impacts from onshore landfall, cable, and substation modifications, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

3.6.5.6 Impacts of Alternatives C, D, E, and F on Land Use and Coastal Infrastructure

Impacts of Alternatives C, D, E, and F. Impacts on land use and coastal infrastructure under Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would be the same as those described for the Proposed Action because these alternatives would differ only with respect to the WTG number and layout (Alternatives C, D, and E); OSS number (Alternative C); or the WTG, OSS, and met tower foundation structures (Alternative F); and would not affect construction of onshore Project components or utilization of ports. Therefore, the impacts resulting from individual IPFs associated with onshore construction and installation, O&M, and decommissioning under Alternatives D, E, and F on land use and coastal infrastructure would be the same as those of the Proposed Action and are expected to be minor adverse related to the IPFs for accidental releases, lighting, and land disturbance; minor to moderate adverse related to the presence of structures; and minor beneficial related to port utilization.

Cumulative Impacts of Alternatives C, D, E, and F. The incremental impacts contributed by Alternatives C, D, E, and F to the impacts on land use and coastal infrastructure from ongoing and planned activities, including offshore wind, would be the same as those of the Proposed Action.

Conclusions

Impacts of Alternatives C, D, E, and F. Impacts of Alternatives C, D, E, and F are expected to be **minor** adverse related to the IPFs for accidental releases, lighting, noise, and traffic; **negligible** to **minor** adverse related to the presence of structures and land disturbance; and **minor beneficial** related to port utilization.

Cumulative Impacts of Alternatives C, D, E, and F. Impacts from ongoing and planned activities in combination with each of these action alternatives are expected to be **minor** adverse impacts and

moderate beneficial impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change among alternatives.

3.6.5.7 Proposed Mitigation Measures

No measures to mitigate impacts on land use and coastal infrastructure have been proposed for analysis.

3.6.5.8 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F from accidental releases, lighting, port utilization, presence of structures, and land disturbance would be similar to those of the Proposed Action, ranging from **minor** adverse related to the IPFs for accidental releases, lighting, noise, and traffic; **negligible** to **minor** adverse related to presence of structures and land disturbance; and **minor beneficial** for impacts related to port utilization.

By installing up to 17 or 31 fewer offshore structures, Alternative C and Alternative D, respectively, would reduce the impact on lighting, presence of structures, and land disturbance. By altering the number of WTGs (Alternatives C, D, and E), or the foundation structure (Alternative F), construction of onshore Project components or utilization of ports would not be affected.

3.6.6 Navigation and Vessel Traffic

This section discusses navigation and vessel traffic characteristics and potential impacts on waterways and water from the proposed Project, alternatives, and ongoing and planned activities in the navigation and vessel traffic geographic analysis area. The navigation and vessel traffic geographic analysis area, described in the NSRA (COP Volume II, Appendix II-S; Atlantic Shores 2023) as the WTA, and shown on Figure 3.6.6-1, is located within Lease Area OCS-A 0499 and includes coastal and marine waters within a 10-mile (16.1-kilometer) buffer of the Offshore Project area and adjacent Lease Areas OCS-A 0498 (Ocean Wind 1), OCS-A 0532 (Ocean Wind 2), and OCS-A 0549 (Atlantic Shores North), as well as waterways leading to ports in New Jersey, Virginia, and Texas that may be used by the Project. This study area as defined by the NSRA was used for analysis in this Draft EIS. These areas encompass locations where BOEM anticipates direct and indirect impacts associated with Project construction and installation, O&M, and decommissioning.

The Atlantic Shores South Project includes two wind energy facilities (Project 1 and Project 2), one in the western section and one in the eastern section of the Lease Area and includes two offshore ECCs within federal and New Jersey state waters. Information presented in this section draws primarily upon the NSRA[1], which was conducted per the guidelines in USCG Navigation and Vessel Inspection Circular (NVIC 01-19) (USCG 2019) and Commandant Instruction (COMDTINST) 16003.2B (USCG 2019).

[1] The NSRA analyzed vessel traffic that navigated within or near the WTA (Figure 3.6.6-1) based on 3 years of AIS data (2017–2019). The analysis included studies of vessel traffic patterns, density, and numbers as well as anticipated changes in traffic from the Atlantic Shores South Project.

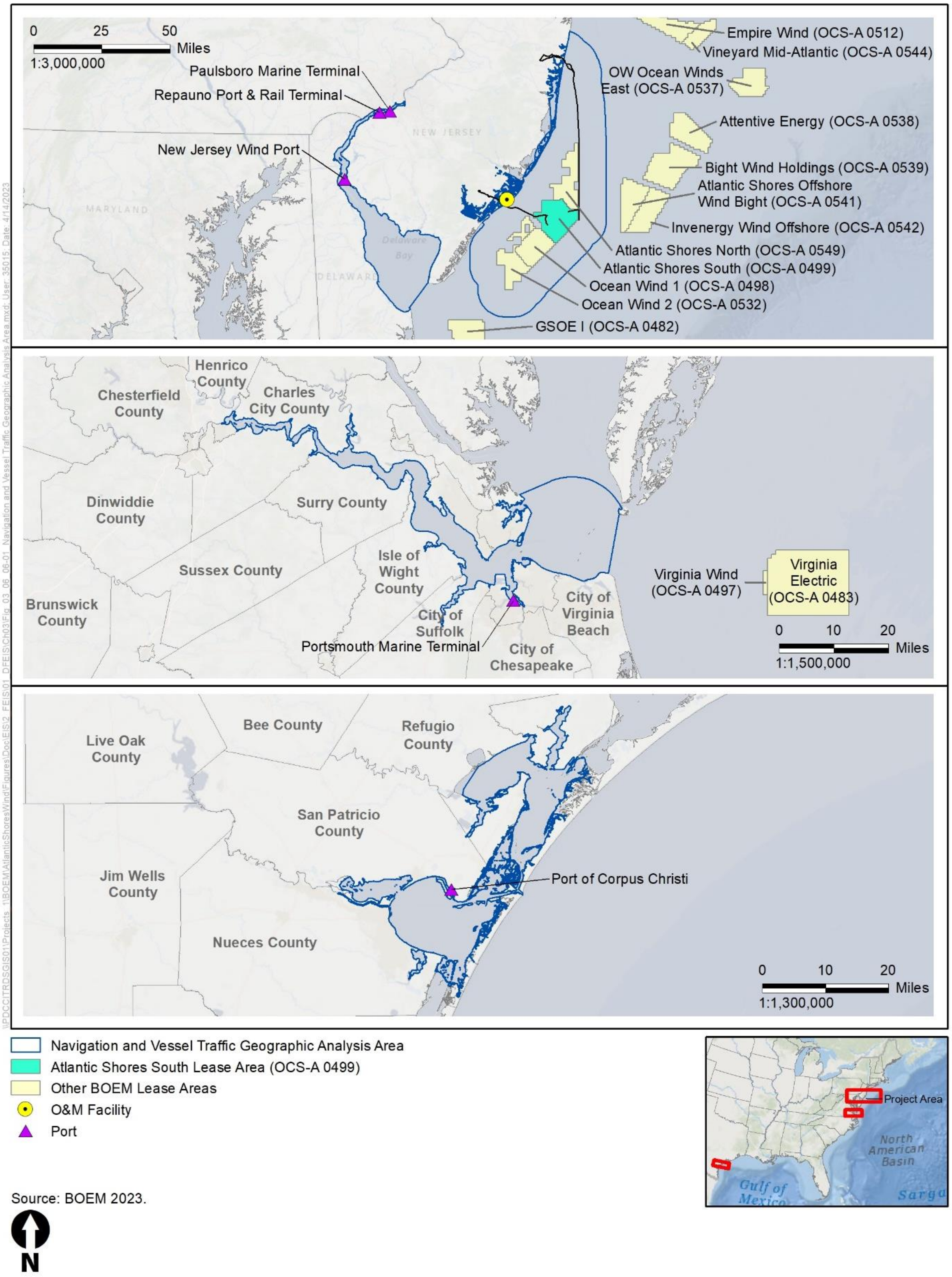


Figure 3.6.6-1. Navigation and vessel traffic geographic analysis area

3.6.6.1 Description of the Affected Environment and Future Baseline Conditions

Regional Setting

Marine transportation in the region is diverse and sourced from many ports and private harbors. Commercial vessel traffic in the region includes research, tug/barge, tankers (such as those used for liquefied petroleum gas (LPG), cargo, cruise ships, smaller passenger vessels, and commercial fishing vessels. Recreational vessel traffic includes private motorboats and sailboats. The Northeast Regional Planning Body (2016) anticipates that major vessel traffic routes will be relatively stable in the region for the foreseeable future, but that coastal developments and market demands that are unknown at this time could affect them. One new regional maritime highway project received funding from the Maritime Administration: a new barge service (Davisville/Brooklyn/Newark Container-on-Barge Service) is proposed to run twice each week in state waters between Newark, New Jersey, and Brooklyn, New York (Appendix D, *Ongoing and Planned Activities Scenario*, Section D.2.9).

The Atlantic Shores South Project would be located approximately 8.7 miles (14 kilometers) from the New Jersey shoreline under a Commercial Lease for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0499). The nearest major port to the Project area is the NJ Wind Port which is in the Delaware Bay, New Jersey, approximately 58 miles (93 kilometers) southeast of the Project area.

An assessment of shipping fairways along the Atlantic Coast, the Atlantic Coast Port Access Route Study (ACPARS) (USCG 2016) has advanced in the rulemaking process into Advanced Notice of Proposed Rulemaking (ANPRM) (USCG 2022), seeking to formally establish the proposed shipping safety fairways along the Atlantic Coastline. There may be updates as the USCG rulemaking process advances. There are two fairways in the vicinity of the Lease Area: the St. Lucie to New York Fairway to the east of the Lease Area, which is outside the WTA and will not affect the WTA layout; and the Cape Charles to Montauk Point Fairway to the west of the Lease Area, which is indicated as a Tug-Tow Extension Lane intended for use primarily by tug-barge tows and does show occasional overlap with the western edge of the Lease Area.

As part of supplementing and updating ACPARS, there are several regional ongoing PARS, which also consider port approaches and international approaches and departures connecting to the ANPRM-identified shipping safety fairways. On September 9, 2022, USCG released a Consolidated Port Approaches Port Access Route Studies (PARS). This report summarizes the findings of four regional PARS: the Northern New York Bight; Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware; Approaches to the Chesapeake Bay, Virginia; and the Seacoast of North Carolina Including Approaches to the Cape Fear River and Beaufort Inlet, North Carolina. The final report for this study (COP Volume II, Appendix II-S, Section 3.2.3; Atlantic Shores 2023), *Seacoast of New Jersey Including Offshore Approaches to Delaware Bay, Delaware*, included two recommendations relevant to the Lease Area: a modification of the proposed Cape Charles to Montauk Point Fairway such that it does not interfere with the offshore wind lease areas, and support for the proposed establishment of a deep-draft fairway to the east of the Lease Area.

Traffic patterns, density, and statistics were developed from 3 years of AIS data (2017–2019) supplemented with NOAA's VMS data (COP Volume II, Appendix II-S; Atlantic Shores 2023). A summary of the data indicates that traffic is highest in the months between May and September, with June and July having the highest traffic each year. The vessel traffic varies by year, with 2019 having the highest number of vessel tracks and 2017 the lowest. The majority of the traffic traveled in a north-northeast and south-southwest heading.

Project Area

Vessel Traffic

The NSRA used AIS vessel traffic data, VMS data for fishing vessels, USCG maritime incident data, NOAA nautical charts, and other publicly available data. AIS is only required on vessels with a length of 65 feet (19.8 meters) or longer, although some smaller recreational and fishing vessels may choose to carry it. As many commercial fishing vessels are less than 65 feet (19.8 meters) in length, the NSRA supplemented the AIS data with VMS data. However, as VMS data covers only regulated fisheries under the Magnussen Stevens Fisheries Conservation Management Act, commercial fishing vessels in the combined VMS and AIS are likely to be somewhat underreported (COP Volume II, Appendix II-S, Section 6.2; Atlantic Shores 2023). "Other" vessels consist of 113 unique commercial vessels not covered by other categories, including dredgers, cable-laying, and survey vessels (COP Volume II, Appendix II-S, Section 6.3; Atlantic Shores 2023). The vessel transits within the WTA are summarized in NSRA Table 6.2, with "unique vessels" being those identified by name and Maritime Mobile Service Identity (MMSI), and "unique tracks" identified by the time and distance intervals between data points. Figure 3.6.6-2 illustrates vessel traffic in the vicinity of the Lease Area.

Table 3.6.6-1. Vessel types within the WTA based on 2017–2019 AIS data

	Unique Vessels		Unique Tracks	
	Number	Percentage	Number	Percentage
Dry Cargo Vessels	780	27	3,169	26
Tankers	186	6	302	2
Passenger Vessels	84	6	304	2
Tug-barge Vessels	177	6	861	7
Military Vessels*	0	0	0	0
Recreational Vessels	998	34	1,713	14
Fishing Vessels	329	11	5,101	41
Other Vessels	113	4	489	4
Unspecified AIS Type	218	9	489	4
Total (2017–2019)	**2,915**	**100**	**12,315**	**100**
Annual Average Vessel Tracks			**4,105**	

Source: COP Volume II, Appendix II-S, Table 6.2; Atlantic Shores 2023.
*No military vessels had transits through the WTA.

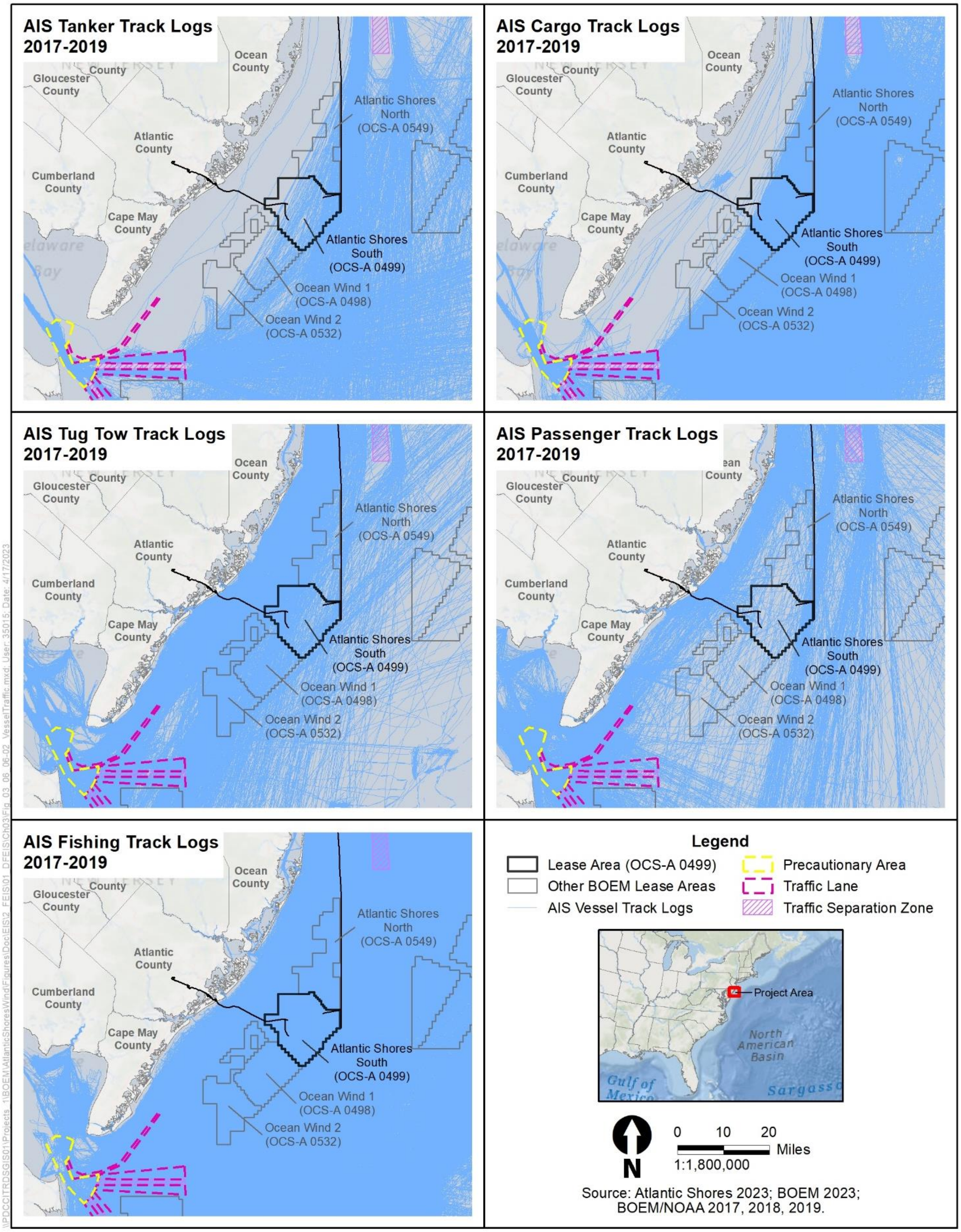


Figure 3.6.6-2. Vessel traffic in the vicinity of the Lease Area

Aids to Navigation

There are Private Aids to Navigation (PATONs), Federal Aids to Navigation (ATONs), and radar transponders located in the vicinity of the WTA but not within the WTA. They consist of lights, sound horns, buoys, and onshore lighthouses and are intended to serve as visual references to support safe maritime navigation. Near the WTA, there are several buoys, with the closest buoy being a PATON located approximately 1 nautical mile south of the southeast corner of the WTA. Other ATONs are located inshore of the WTA. ATONs are developed, established, operated, and maintained or regulated by the USCG to assist mariners in determining their position, identifying safe courses, and warning of dangers and obstructions.

There are several federal aids to navigation near shore of the Monmouth ECC, and two private aids outside but near to the Monmouth ECC. There are no federal or private aids to navigation within or near the Atlantic ECC (Figure 3.6.6-3).

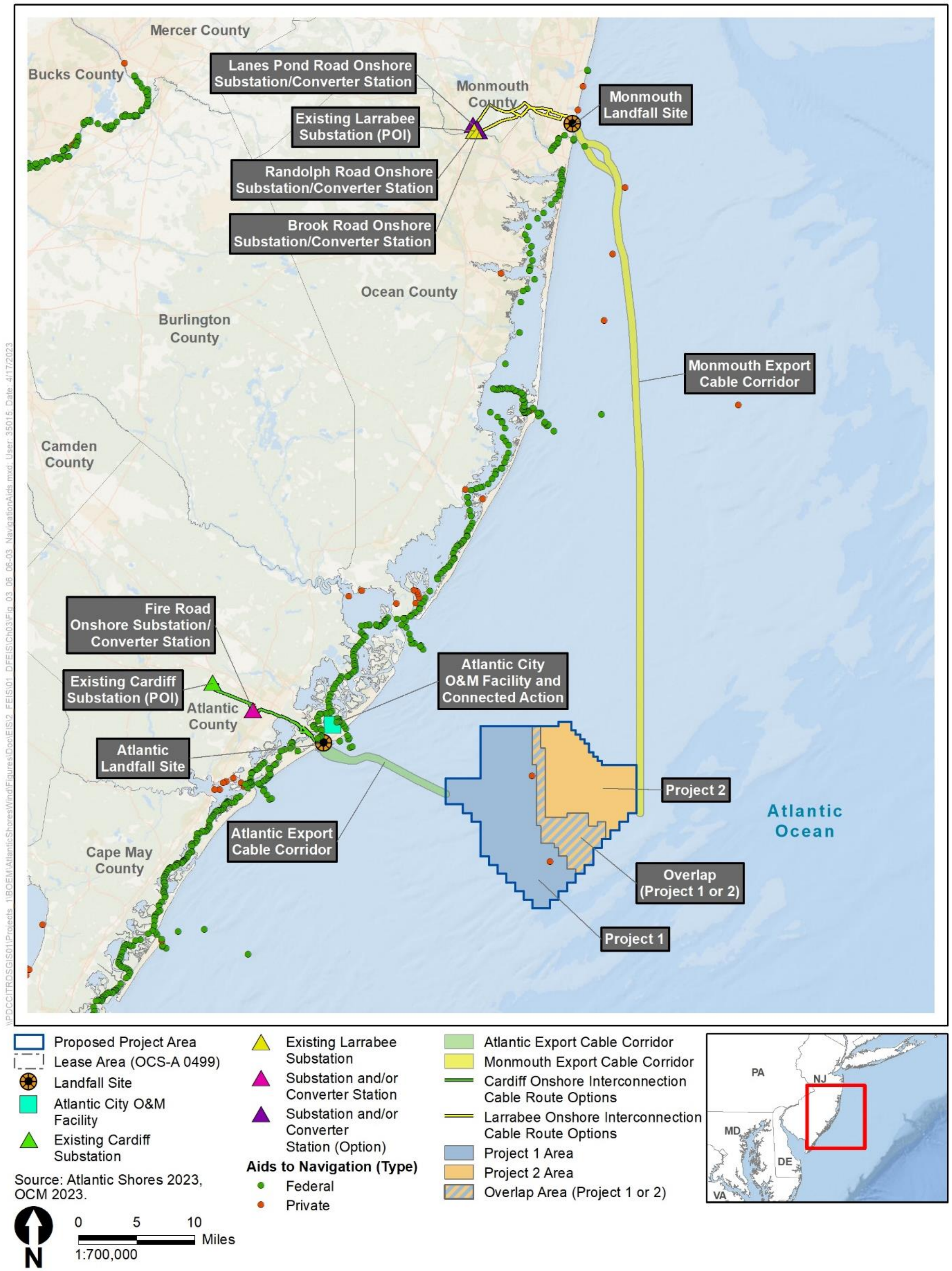
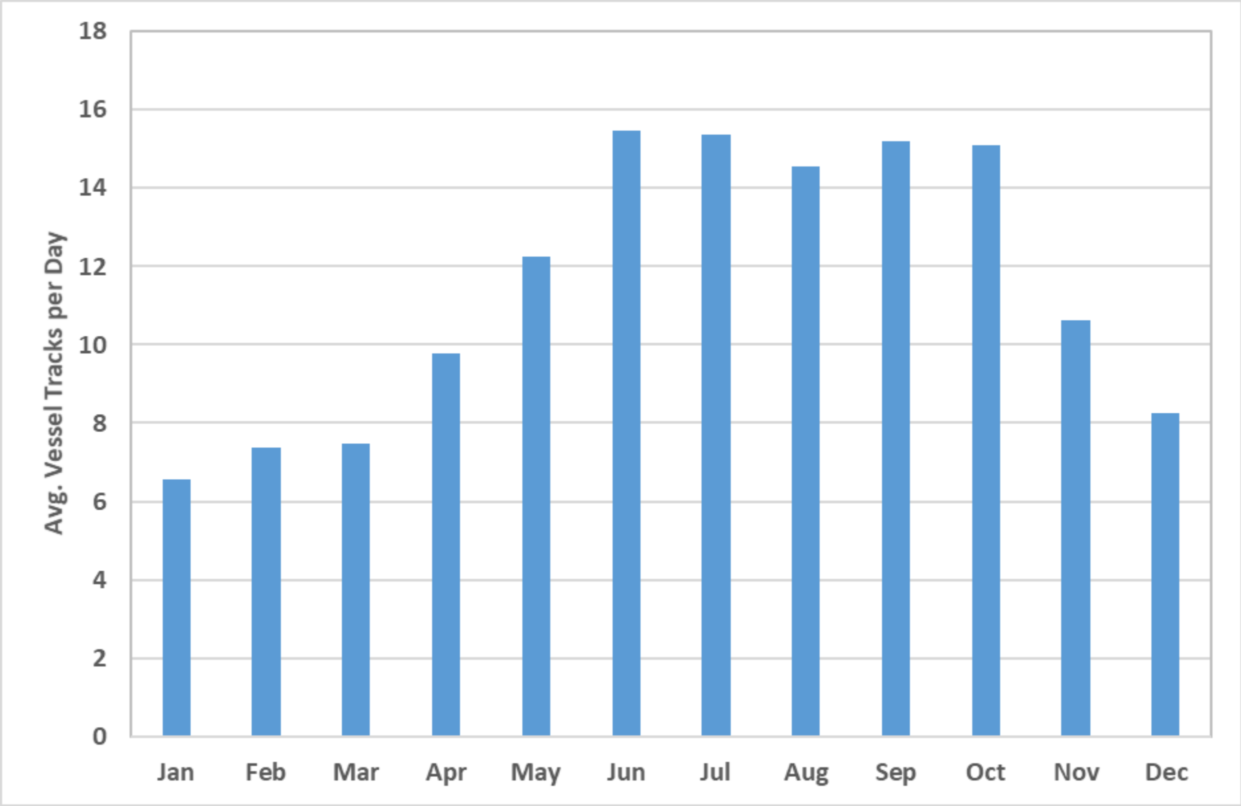


Figure 3.6.6-3. Aids to Navigation in the vicinity of the Lease Area

Ports, Harbors, and Navigation Channels

The closest ports to the Project area and the Cable Landing Locations are the NJ Wind Port, the Paulsboro Marine Terminal, and the Port of Wilmington DE within the Delaware Bay and River, Delaware basin. These are ports of call for large commercial deep-draft ships and tug/barge units as well as smaller commercial and non-commercial shallower-draft vessels. Most of the traffic in the vicinity of the Project area consists of transits of fishing and pleasure vessels to or from three major New Jersey commercial fishing ports: Long Beach-Barnegat, Atlantic City, and Cape May-Wildwood. North of the Project area is the outer portion of the approach to New York Harbor, Ambrose Channel, and the AIS data shows a large distribution of deep-draft ships within this passage. Larger commercial vessels—including passenger, dry cargo, and tanker vessels—made an average of 1,258 transits through the WTA in a 3-year period. Deep-draft traffic within the WTA is predominately along a north-northeast to south-southwest course and density within the WTA increases towards the east with very little traffic in the western section of the WTA (COP Volume II, Appendix II-S, Section 6.9; Atlantic Shores 2023).

USACE is responsible for documenting vessel and trip information of major American ports. The NSRA considers commercial cargo vessels, military vessels, towing, fishing, and recreation vessels (COP Volume II, Section 7.6.1.2; Atlantic Shores 2023). As shown in Figure 3.6.6-4, during the study period (2017–2019), an average of 11.5 unique vessels per day passed through the WTA; however, the traffic is seasonal and recorded vessel traffic through the WTA averaged 15.5 vessels per day in June of each year of the study. Vessel traffic is highest in the months between May and September, with June and July having the highest vessel traffic each year. The most frequently recorded unique vessel type transiting within the Project area were dry cargo vessels at 27 percent, with fishing vessels next at 11 percent. It should be noted that there was a higher percentage (41 percent) of fishing vessel “unique tracks,” indicating that an individual fishing vessel transited the WTA more than once.



Source: COP Volume II, Appendix II-S, Figure 6.2; Atlantic Shores 2023.

Figure 3.6.6-4. Summary of average vessel tracks per day through the WTA (2017–2019)

Atlantic Shores has identified five port facilities in New Jersey, Virginia, and Texas that may be used for major construction staging activities for the Atlantic Shores South Project. These are the New Jersey Wind Port, Paulsboro Marine Terminal, and Repauno Port and Rail Terminal in New Jersey, Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas.

Construction ports will be utilized for the following functions:

- Crew transfers;
- Component fabrication and assembly;
- Receiving and offloading shipments of Project components;
- Storing Project components;
- Preparing Project components for installation;
- Loading Project components onto installation vessels or other suitable vessels for delivery to the Offshore Project area for installation; and
- Preparing vessels to tow floating components to the WTA.

All port facilities being considered to support Project construction are located within industrial waterfront areas with existing marine industrial infrastructure or where such infrastructure is proposed for development within the required timeframe. Atlantic Shores will not implement any port improvements itself. Any port development would occur independent of the Project, including any permitting or approvals that the port facility owner/lessor may need to obtain for port improvements.

The NSRA analyzed vessel incidents using data gathered from the USCG for a period of 14 years (2004–2018). This information is discussed in Section 3.6.7, *Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)*. In summary, SAR incidents occurred during all seasons, half during daylight hours and half during nighttime, and varied between disabled vessels, medical issues, and other incidents, but there were no recorded allisions, collisions, or groundings in the WTA (COP Volume II, Appendix II-S, Section 10.1; Atlantic Shores 2023).

3.6.6.2 Impact Level Definitions for Navigation and Vessel Traffic

This Draft EIS uses a four-level classification scheme to characterize potential impacts of alternatives, including the Proposed Action, as shown in Table 3.6.6-2. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions. There are no beneficial impacts on navigation and vessel traffic.

Table 3.6.6-2. Impact level definitions for navigation and vessel traffic

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Impacts would be small, localized, and temporary. Normal or routine functions associated with vessel navigation would not be disrupted.
Moderate	Adverse	Impacts would be unavoidable. Vessel traffic would have to adjust somewhat to account for disruptions due to impacts of the Project.
Major	Adverse	Vessel traffic would experience unavoidable disruptions to a degree beyond what is normally acceptable, including potential loss of vessels and life.

3.6.6.3 Impacts of Alternative A – No Action on Navigation and Vessel Traffic

When analyzing the impacts of the No Action Alternative on navigation and vessel traffic, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for navigation and vessel traffic. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix D.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for navigation and vessel traffic described in Section 3.6.6.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore and offshore wind activities. See Appendix D, Table D.A1-13 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for navigation and vessel traffic. There are no ongoing offshore wind activities within the geographic analysis area for navigation and vessel traffic.

Ongoing non-offshore activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic are generally associated with marine transportation, military use, NMFS activities and scientific research, and fisheries use and management. Impacts from these activities increase vessel traffic in the area, adding to congestion in waterways and increasing the potential for maritime accidents. Impacts associated with global climate change have the potential to require modifications to existing port infrastructure and aids to navigation, with the former adding to port congestion and limited berths during construction activities.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect navigation and vessel traffic in the geographic analysis area include dredging and port improvement projects, and installation of new structures on the OCS (see Appendix D, Section D.2 for a description of planned activities). These activities may result in a moderate increase in port maintenance activities, port upgrades to accommodate larger deep-draft vessels, and temporary increases in vessel traffic for offshore cable emplacement and maintenance. Planned offshore wind projects include Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North. In addition, USCG is planning to establish shipping safety fairways or other vessel-routing measures along the Atlantic Coast of the United States as referenced in Section 3.6.1. The purpose of the fairways is to protect maritime commerce and safe navigation amidst the non-offshore wind activities described in this section. See Table D.A1-13 for a summary of non-offshore wind activities and the associated IPFs for navigation and vessel traffic. BOEM expects offshore wind development activities to affect navigation and vessel traffic through the following primary IPFs.

Anchoring: Offshore wind developers are expected to coordinate with the maritime community and USCG to avoid laying export cables through any traditional or designated lightering/anchorage areas, meaning that any risk of impacts for deep-draft vessels would come from anchoring in an emergency scenario. Generally, larger vessels accidently dropping anchor on top of an export cable (buried or otherwise protected) to prevent drifting in the event of vessel power failure would result in damage to the export cable, damage to the vessel anchor or anchor chain, and risks associated with an anchor contacting an electrified cable.

Smaller commercial or recreational vessels anchoring in the offshore wind lease areas may have issues with anchors failing to hold near foundations and any scour protection. Given the small size of the geographic analysis area compared to the remaining area of open ocean around and near the Project area, as well as the low likelihood that any anchoring risk would occur in an emergency scenario, it is unlikely that offshore wind activities would affect vessel-anchoring activities. The overall traffic density within the WTA was found to be relatively low, with two or more vessels present in the WTA for only 15.6 percent of the time on average (COP Volume II, Appendix II-S, Section 13.1; Atlantic Shores 2023).

Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of moderate increase commensurate with any increase in tankers visiting ports. Deep-draft visits to major ports are expected to increase as well, increasing the potential for an emergency need to anchor, and thereby creating navigational hazards for other vessels. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.

Cumulative impacts on navigation and vessel traffic from anchoring would likely be minor because impacts would be small, short term, and localized, and navigation and vessel traffic would be expected to fully recover following the disturbance.

Cable emplacement and maintenance: Based on the assumptions in Appendix D, Table D.A2-1, the 98 WTGs for the Ocean Wind 1 Project would require a maximum of 194 miles (312 kilometers) of export cable, plus a maximum of 190 miles (306 kilometers) of interarray cables; Ocean Wind 2 would require a maximum of 200 miles (322 kilometers) of export cable plus a maximum of 173 miles (278 kilometers) of interarray cables for the addition of 111 WTGs; Atlantic Shores North's 157 WTGs would require a maximum of 331 miles (533 kilometers) of export cable plus a maximum of 528 miles (850 kilometers) of interarray cable (Appendix D, Table D.A2-1).

Emplacement and maintenance of cables for these offshore wind projects would generate vessel traffic and would specifically add slower-moving vessel traffic above cable routes. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes during installation and maintenance activities. BOEM anticipates that there would likely be simultaneous cable-laying activities from multiple projects based on the estimated construction timeline (Appendix D, Table D-3). While simultaneous cable-laying activities may disrupt vessel traffic over a larger area than if activities occurred sequentially, the total time of disruption would be less than if each project were to conduct cable-laying activities sequentially. The cumulative impacts of this IPF on vessel traffic and navigation under the No Action Alternative would be minor because impacts would be short term, localized, and most disruptive during peak construction activity of the offshore wind projects in the geographic analysis area in 2026 (Appendix D, Table D.A2-1).

Port utilization: As described in Section D.2 of Appendix D, offshore wind development would support planned expansions and modifications at ports in the geographic analysis area for navigation and vessel traffic, including Paulsboro Marine Terminal, New Jersey, New Jersey Wind Port in New Jersey, and Portsmouth Marine Terminal in Virginia. Simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity and resources and could concentrate vessel traffic in port areas. Such concentrated activities could lead to increased risk of allision, collision, and vessel delay.

Major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The Marine Commerce Terminal (MCT) is being upgraded by the Port of New Bedford specifically to support the construction of offshore wind facilities, and the New Jersey Wind Port is being developed as a marshaling and manufacturing site for offshore wind projects (COP Volume I, Table 4.10-2; Atlantic Shores 2023). As explained in Appendix D, Section D.2.6, *Dredging and Port Improvement Projects,* the New Jersey Wind Port would be sited on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County. The development plan includes dredging the Delaware River Channel, and construction commenced in September 2021 with a targeted completion date of late 2023 (New Jersey Wind Port 2021; Salem County 2021). The Delaware River Channel dredging project provides deepening of the existing Delaware River Federal Navigation Channel, bend widening, partial deepening of the Marcus Hook anchorage, and relocation and addition of aids to navigation. The deeper channel will allow for more efficient transportation of containerized, dry and liquid bulk, break bulk, roll-on/roll-off, and project cargoes to and from Delaware River ports (USACE 2021). The channel project will improve port access to the New Jersey Wind Port, Paulsboro Marine Terminal, and Repauno Port and Rail Terminal. Expansion of port facilities can introduce large, modern port infrastructure into the viewsheds of nearby historic properties, impacting their setting and historic significance.

A channel deepening project at the Port of Virginia is currently underway with USACE and a private contractor engaged in dredging approximately 1.1 million cubic yards (0.84 cubic meters) of sediment from the federal channel in Norfolk Harbor and Newport News, Virginia (USACE 2019). The project is anticipated to be completed in 2024, resulting in a channel depth of over 50 feet (15 meters) in the harbor, which will allow it to accommodate two ultra-large container vessels simultaneously (The Port of Virginia 2021).

In 2018, two NJDOT projects, High Bar Harbor channel and Barnegat Light Stake channel, both near Barnegat Inlet in Ocean and Long Beach Townships, New Jersey, underwent dredging of approximately 39,150 cubic yards (29,932 cubic meters) and 3,230 cubic yards (2,469 cubic meters), respectively, to maintain the depths of these channels. Maintenance dredging for both projects is authorized until December 2025 and is expected to occur before the permits expire (USACE 2015a, 2015b). Barnegat Light is the primary commercial seaport on Long Beach Island and is the homeport to approximately 36 commercial vessels. Barnegat Light's two commercial docks are home to several scallop vessels, longliners, and a fleet of smaller inshore gillnetters (New Jersey Department of Agriculture 2020).

USACE has received numerous permit applications for private dock, boat lift, and bulkhead repairs in Barnegat Bay, New Jersey (USACE 2022).

Under the No Action Alternative, three offshore wind projects in the analysis area—Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North—would generate vessel traffic during construction (Appendix D, Table D-3). Ocean Wind 1 is estimated to be under construction between 2024 and 2025, and Ocean Wind 2 and Atlantic Shores North are estimated to be under construction between 2026 and 2030. During peak construction activity for the Ocean Wind 2 and Atlantic Shores North projects, impacts on port utilization would be moderate, short term, continuous, and localized to the ports and their maritime approaches.

Ports would need to perform maintenance and upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Impacts would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.

Future activities with the potential to result in port expansion impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Port expansion would continue at current levels, which reflect efforts to capture business associated with the offshore wind industry (irrespective of specific projects).

The increase in port utilization due to this vessel activity would vary across ports and would depend on the specific port or ports supporting each offshore wind project. It is unlikely that all projects would use the same ports; therefore, the total increase in vessel traffic would be distributed across multiple ports in the region. Port utilization in the geographic analysis area would occur primarily during construction. As discussed under the *Impacts of Alternative A – No Action,* section, offshore wind construction activities may result in competition for scarce berthing space and port services, potentially causing short- to medium-term adverse impacts on commercial shipping. During peak activity, impacts on port utilization would be moderate, short term, and continuous at the ports and their maritime approaches.

After offshore wind projects are constructed, related port utilization would decrease. During operations, project-related port utilization would have minor, long-term, intermittent, localized impacts on overall vessel traffic and navigation. Port utilization would increase again during decommissioning at the end of the operating period of each project, which BOEM anticipates being approximately 34 years, with magnitudes and impacts similar to those described for construction.

Presence of structures: Under the No Action Alternative, approximately 377 foundations (Appendix D, Table D-3) would be constructed in the geographic analysis area. Structures in this area would pose navigational hazards to vessels transiting within and around areas leased for offshore wind projects. Offshore wind projects would increase navigational complexity and ocean space use conflicts, including the presence of WTG and OSS structures in areas where no such structures currently exist, potential compression of vessel traffic both outside and within offshore wind lease areas, and potential difficulty seeing other vessels due to a cluttered view field.

Another potential impact of offshore wind structures is interference with marine vessel radars. The BOEM-sponsored National Academies study *Wind Turbine Generator Impacts to Marine Vessel Radar* (2022), which assessed the impact of WTGs located on the OCS on marine vessel radar, concluded that impacts of wind turbines on marine vessel radar are situation-dependent, and that there are active and passive means to ameliorate any interference. USCG noted in its final *Areas Offshore of Massachusetts and Rhode Island Port Access Route Study* (USCG 2020a) that various factors play a role in potential marine radar interference by offshore wind infrastructure, stating that “the potential for interference with marine radar is site specific and depends on many factors including, but not limited to, turbine size, array layouts, number of turbines, construction material(s), and the vessel types." In the event of radar interference, other navigational tools are available to ship captains.

The fish aggregation and reef effects of offshore wind structures would also provide new opportunities for recreational fishing. The additional recreational vessel activity focused on aggregation and reef effects would incrementally increase vessel congestion and the risk of allision, collision, and spills near WTGs and OSSs. If marine mammals choose to avoid WTGs and OSSs, this could potentially increase the risk of cetacean interaction with vessels, marginally increasing the likelihood of a vessel strike outside the offshore wind lease areas. Fishing near artificial reefs is not expected to change meaningfully over the next 34 years. Overall, the impacts of this IPF on navigation and vessel traffic would be moderate, long term (as long as structures remain), regional (throughout the entire geographic analysis area for navigation and vessel traffic), and constant (COP Volume II, Section 7.4.4; Atlantic Shores 2023).

Traffic: Offshore wind projects would generate vessel traffic during construction, operation, and decommissioning within the navigation and vessel traffic geographic analysis area. Other vessel traffic in the region (e.g., from commercial fishing, for-hire and individual recreational use, shipping activities, military uses) would overlap with offshore wind-related vessel activity in the open ocean and near ports supporting the offshore wind projects. BOEM anticipates that the total increase in vessel traffic would be distributed across multiple ports in the region.

As shown in Appendix D, Table D-3, the increase in vessel traffic and navigation risk due to offshore wind projects in the Project area would increase beginning in 2024 through 2030 when up to 377 foundations associated with offshore wind projects other than the Proposed Action (Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North) would be under construction. During this construction period for Ocean Wind 1, a maximum of 18 vessels could be operating simultaneously in the geographic analysis area at any given time (Ocean Wind COP Volume I, Chapter 6, Table 6.1.2-3; Ocean Wind 2022). The presence of offshore wind project vessels would add to the overall Atlantic Coast vessel traffic levels as each offshore WTAs are developed, leading to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels, injuries to crews, engagement of USCG SAR, and vessel fuel spills. Increased offshore wind-related vessel traffic during construction would have moderate, short-term, localized impacts on overall (wind and non-wind) vessel traffic and navigation.

After offshore wind projects are constructed, related vessel activity at the construction ports would decrease in the O&M period, but total vessel traffic including to and from the O&M facility would increase in the O&M period. Vessel activity related to the operation of offshore wind facilities would consist of scheduled inspection and maintenance activities with corrective maintenance as needed. During operations, project-related vessel traffic would have long-term, intermittent, localized impacts on overall vessel traffic and navigation. Vessel activity would increase again during decommissioning at the end of the assumed 30-year operating period of each project, with magnitudes and impacts similar to those described for construction. As stated under the *Presence of Structures* IPF, absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 30 years. Even with increased port visits by deep-draft vessels, this is still a relatively small adjustment when considering the whole of mid-Atlantic vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.

Conclusions

Impacts of Alternative A – No Action. BOEM expects ongoing activities, including other offshore wind activities, to have continuing short- and long-term impacts on navigation and vessel traffic, primarily through the presence of structures, port utilization, and vessel traffic. BOEM anticipates that the navigation and vessel traffic impacts as a result of ongoing activities, especially port utilization and vessel traffic, would be **moderate**.

Cumulative Impacts of Alternative A – No Action. Under the No Action Alternative, existing environmental trends and activities would continue, and navigation and vessel traffic would continue to be affected by natural and human-caused IPFs. Planned activities other than offshore wind include port expansion, cable emplacement and maintenance, and SAR operations. BOEM anticipates that the impacts of planned activities other than offshore wind would be minor because, while impacts would be measurable, they would not disrupt navigation and vessel traffic**.** BOEM expects the combination of ongoing and planned activities other than offshore wind to result in moderate impacts on navigation and vessel traffic.

Other offshore wind projects would increase vessel activity, which could lead to congestion at affected ports, the possible need for port upgrades beyond those currently envisioned, and an increased likelihood of collisions and allisions, with resultant increased risk of accidental releases. In addition, the offshore wind projects other than the Proposed Action would lead to the construction of up to 366 WTGs and up to 8 OSSs (including 98 WTGs for Ocean Wind 1, 111 WTGs for Ocean Wind 2, and 157 WTGs for Atlantic Shores North) in areas where no such structures currently exist, also increasing the risk for collisions, allisions, and resultant accidental releases and threats to human health and safety. BOEM anticipates that the overall impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in overall **moderate** adverse impacts due to the presence of structures, port utilization, and vessel traffic.

3.6.6.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections that follow. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on navigation and vessel traffic characteristics:

- The Project layout includes the number, type, and placement of the WTGs, OSSs, and met tower, including the location, width, and orientation of the WTA rows and columns;
- The number of and types of vessels utilized for construction and installation;

- The offshore electric cable corridor routes/locations;
- Time of year and duration of offshore construction;
- Ports utilized to support construction and installation;
- The number of and types of vessels utilized for O&M support; and
- Ports selected to support O&M.

Variability of the proposed Project design within the PDE that could affect navigation and vessel traffic includes the number of vessels that would be used during construction; the ports used to support Project construction, installation, and decommissioning; the exact placement and number of WTGs; and the construction sequence, as shown in Table 2-2 in Chapter 2, *Alternatives*. Variances in these factors could affect vessel traffic and navigation choices. This section has assessed the maximum-case scenario, so variances from this scenario should lead to similar or reduced impacts.

3.6.6.5 Impacts of Alternative B – Proposed Action on Navigation and Vessel Traffic

Impacts from the Proposed Action alone would include increased vessel traffic in and near the Project area and on the approach to ports used by the Proposed Action, as well as obstructions to navigation caused by Proposed Action activity. During construction, the potential IPFs to marine transportation and navigation may include short-term increase in Project-related construction vessel traffic, short-term presence of partially installed structures, and short-term safety zone implementation. Atlantic Shores would implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project construction. COP Volume I, Table 4.10-1 (Atlantic Shores 2023) summarizes the Project-related vessel traffic (representative numbers and types of vessels) anticipated during Proposed Action construction.

Anticipated changes in vessel traffic from the Project were estimated to include:

- Project-related vessel traffic related to construction and installation, O&M, and decommissioning activities;
- Additional non-Project traffic that might be generated by the presence of the Project, for example, pleasure vessel trips for sight-seeing or recreational fishing; and
- The modification of usual traffic routes for larger commercial cargo ships, tankers and military vessels due to the presence of WTGs, OSSs, and met tower.

Impacts on navigation and vessel traffic would also include changes to navigational patterns and to the effectiveness of marine radar and other navigation tools. This could result in delays within or approaching ports, increased navigational complexity, detours to offshore travel or port approaches, or increased risk of incidents such as collision and allision, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The Proposed Action's impacts on recreation and tourism and commercial fisheries and for-hire recreational fishing are addressed in Sections 3.6.8 and 3.6.1, respectively.

The NSRA marine risk analysis modeled the frequency of non-Project vessel accidents that could result from installation of the Proposed Action WTGs, OSSs, and met tower. The future case assessments for marine accidents account for Project- and location-specific environmental, traffic, and operational parameters. Detailed information about the risk analysis is included in the NSRA (COP Volume II, Appendix II-S, Section 8.3.2; Atlantic Shores 2023). The risk analysis calculated the frequency of hazards due to the following navigation hazards (COP Volume II, Appendix II-S, Section 8.3.2; Atlantic Shores 2023):

- Vessel grounding
- Vessel collisions
    - Head-on
    - Overtaking
    - Crossing
- Vessel to structure allision risk
    - Powered vessel
    - Drifting vessel
    - Results of the NSRA risk modeling are described in the *Traffic* IPF below.

Anchoring: There are no designated anchoring areas in the proximity of the WTA and ECCs. There are two fairways in the vicinity of the Lease Area: the St. Lucie to New York fairway to the east of the Lease Area, which is outside the WTA and will not affect the WTA layout, and the Cape Charles to Montauk Point Fairway to the west of the Lease Area, which is indicated as a Tug-Tow Extension Lane intended for use primarily by tug-barge tows.

It is not expected that anchorage areas will have an impact on the Project (COP Volume II, Section 7.6.1.1; Atlantic Shores 2023). There will be no restrictions on anchoring within the Lease Area, it is considered unlikely that commercial vessels would seek to do so once the Offshore Project components were installed, and as such the existing activity is likely to be displaced. Based on the NSRA study data, the level of activity which may be displaced is low and there is established anchoring space inshore of the Lease Area.

The presence of the Offshore Project components may create an underwater snapping or contact risk to vessel anchoring in close proximity, such as:

- A vessel drops anchor over a subsea cable in an emergency;

- The deployed anchor of a vessel fails to imbed causing the anchor to drag over a subsea cable;
- A departing vessel neglects to raise anchor and drags it over a subsea cable; or
- The anchor is negligently or accidently deployed over a subsea cable.

Given the small size of the Offshore Project area compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario, impacts on navigation and vessel traffic are anticipated to short term and minor.

Cable emplacement and maintenance: The Proposed Action would require the installation of offshore export cables and interarray cables. The presence of slow-moving (or stationary) installation or maintenance vessels would increase the risk of collisions and spills. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes, or would need to avoid installation or maintenance areas entirely during installation and maintenance activities. Atlantic Shores intends to bury offshore cables to a target depth of 5 to 6.6 feet (1.5 to 2 meters) to avoid interference with existing marine uses (e.g., some anchoring and commercial fishing) and protect the cable (GEO-07; Appendix G, Table G-1). BOEM expects that all Project features will be appropriately charted on navigation charts. The presence of installation or maintenance vessels would have minor localized, short-term, intermittent impacts on navigation and vessel traffic.

Port utilization: Atlantic Shores has identified five port facilities in New Jersey, Virginia, and Texas that may be used during construction (Table 3.6.3-3). The construction and installation, O&M, and decommissioning activities associated with the Project may result in restricted access at local ports. The Proposed Action would generate trips by support vessels, such as crew transports vessels, hotel vessels, tugs, and miscellaneous vessels (see Table 3.6.6-3). Project vessels are not anticipated to cause access issues in these areas, with the potential exception of larger vessels such as jack-up barges when in transit to/from the Lease Area. The onshore O&M facility is anticipated to be based in Atlantic City's Inlet Marina and any Project vessel activity would be taking a similar route to/from the Lease Area. Project traffic would decrease during the operation phase, and no significant impact is anticipated. The presence of these vessels could cause delays for non-Proposed Action vessels and could cause some fishing or recreational vessel operators to change routes or use an alternative port. During construction and installation, the Proposed Action's impacts on vessel traffic due to port utilization would be moderate and short term. During O&M, impacts would be minor, long term, and intermittent. Impacts would increase to moderate for decommissioning, comparable to construction and installation impacts.

Table 3.6.6-3. Estimated vessel trips for each port for O&M and construction

Port	# Round Trips During Construction (total)	# Round Trips During Operations (per year)
Atlantic City (O&M Facility)	315	1,825
New Jersey Wind Port	1,250	32
Paulsboro Marine Terminal	120	2
Repauno Port & Rail Terminal	20	1
Portsmouth Marine Terminal	20	1
Port of Corpus Christi	20	0
TOTAL	**1,745**	**1,861**

Note: These are the maximum estimates and could change based on selected foundation technology, selected contractors, and other factors.

Presence of structures: The Proposed Action would include up to 200 WTGs (inclusive of the 31 WTGs in the Overlap Area), up to 1 met tower, and up to 10 small OSSs, or up to 5 medium OSSs, or up to 4 large OSSs, operating for up to 30 years, within the WTA where no such structures currently exist. Presently there are no approved routing measures within the proposed Project area that would be altered by the presence of structures (COP Volume II, Appendix II-S; Atlantic Shores 2023).Vessels that exceed a height of 72.2 feet (22 meters) would be at risk of alliding with WTG blades at mean high water would need to navigate around the Project area or navigate with caution through the area to avoid the WTGs.

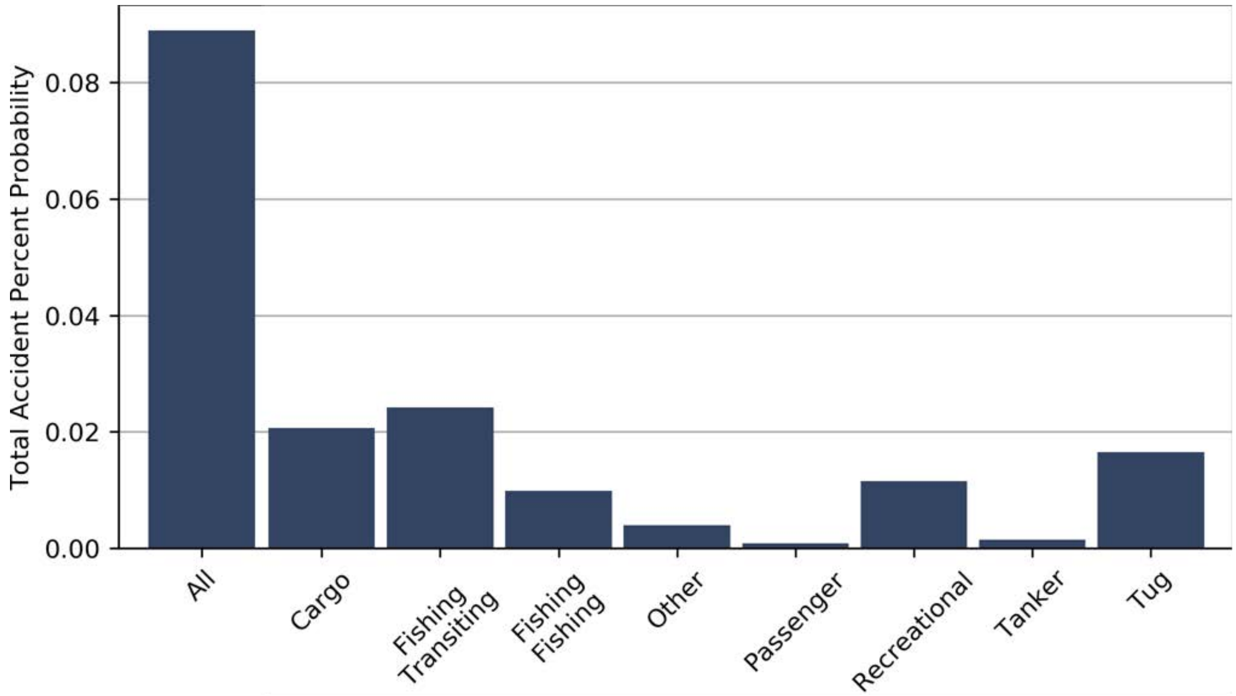
Structures associated with the Proposed Action would increase the risk of allision as well as i the risk of collision between vessels navigating through the WTG areas, due to added navigational complexity. WTGs could also interfere with use of marine radars (although other navigation tools are available to ship captains). An aerial SAR risk assessment with associated mitigation measures was prepared in coordination with USCG, BOEM, and other relevant stakeholders (see COP Volume II, Appendix II-T4; Atlantic Shores 2023). All construction and installation vessels and equipment will display the required navigation lighting and day shapes and make use of AIS as required by the USCG (NAV-02; Appendix G, Table G-1). The increased risk of allisions and collisions could, in turn, increase the risk of spills (refer to Section 3.4.2, *Water Quality*, for a discussion of the likelihood of spills). Nearly all vessels that travel through the WTA where no structures currently exist would need to navigate with greater caution under the Proposed Action to avoid WTGs, OSSs and the met tower; however, there would be no restrictions on use or navigation in the Project area. All structures will be appropriately lit, marked, and charted with a requirement that each structure receives a valid PATON from USCG. Many vessels that currently navigate that area would continue to be able to navigate through the Project area between the WTGs and OSSs. The proposed WTG and OSS layout has been developed in consideration of commercial fishing patterns and in close coordination with the surf clam/quahog dredging fleet. The layout is designed to facilitate the transit of vessels through the WTA based on a review of existing traffic patterns (NAV-03; Appendix G, Table G-1). To facilitate safe navigation, all offshore structures will include appropriate marine navigation lighting and marking in accordance with USCG and BOEM guidance. Atlantic Shores will continue to work with USCG and BOEM to determine the appropriate marine lighting and marking schemes for the proposed offshore facilities (NAV-04; Appendix G, Table G-1).While some non-Project vessel traffic may navigate through the Project area, many vessels may choose not to pass through the area during construction (due to the presence of construction-related activities and the emergence of fixed structures), during the life of the Project (due to the presence of fixed structures), and during decommissioning. The NSRA modeled the frequency of marine accidents under the Proposed Action assuming there would be a rerouting of common vessel traffic routes around the Project area for the larger commercial traffic utilizing the proposed shipping safety fairways in the Consolidated PARS (COP Volume II, Appendix II-S, Section 8.3.3.3; Atlantic Shores 2023; USCG 2022). The NSRA assumed other vessel types, including fishing, pleasure, and other vessels, would not reroute around the WTA.

Operation of the WTGs associated with the Proposed Action would likely affect marine radar on vessels near or within the Project area. As noted in the BOEM-sponsored National Academies (2022) study referred to previously, the potential impacts on marine radar are variable, with the most likely effect being signal degradation. Proximity to the WTGs is the primary factor that determines the degree of radar signal degradation. Due primarily to the quality of radars and the proficiency of professionally licensed crew, radar operations on commercial ships are not anticipated to be affected. Smaller vessels operating in the vicinity of the Project may experience radar cluttering and shadowing (COP Volume II, Appendix II-S, Section 9.7; Atlantic Shores 2023) While radar is one of several navigational tools available to vessel captains, including navigational charts, global positioning system, and navigation lights mounted on the WTGs radar is the main tool used to help locate other nearby vessels that are not otherwise visible. The navigational complexity of transiting through the Project area, including the potential effects of WTGs and OSSs on marine radars, would increase risk of collision with other vessels (including non-Project vessels and Proposed Action vessels), and the risk of vessel allisions with the Project structures. Furthermore, the presence of the WTGs, OSSs, and met tower could complicate offshore SAR operations or surveillance missions within the Project area and lead to abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, major impacts on navigation and vessel traffic. Impacts on SAR missions are discussed further under Section 3.6.7.

Traffic: Construction of the Proposed Action would generate approximately 51 vessels operating in the Project area or over the offshore export cable route at any given time (COP Volume II, Section 7.6.2.1; Atlantic Shores 2023). Various vessel types (scour protection, installation, cable-laying, support, transport/feeder, and crew vessels) would be deployed throughout the Offshore Project area during the construction and installation phase. Estimated vessel trips for each port for construction and O&M of the Project are shown in Table 3.6.6-3. The presence of these vessels would increase the risk of allision, collision, and spills (refer to Section 3.4.2 for a discussion of the likelihood of spill). The vessels would typically be transiting to the Offshore Project area from staging and support areas throughout the New Jersey and other port areas. However, construction activities within the Offshore Project area would be compatible with existing marine transportation uses and would not represent a substantial increase in existing vessel traffic in the region (a maximum of 51 construction vessels plus up to 15 non–construction-related vessels depending on the season). Project-related vessel traffic would not interfere with existing marine and navigation traffic patterns as shown in COP Volume II, Appendix II-S (Atlantic Shores 2023). Project-related vessel traffic would follow existing transit routes to the extent practicable. During offshore export cable route construction, non-Project vessels that may travel a more restricted (narrow) lane could potentially experience greater delays waiting for cable-laying vessels to pass.

Proposed Action vessel traffic in ports could result in vessel traffic congestion, limited maneuvering space in navigation channels, and delays in ports and could also increase the risk of collision, allision, and resultant spills, in or near ports. Atlantic Shores routed around existing ATONs where practical in the planning of this project, but there were some areas where existing obstructions (such as artificial reefs, sand borrow areas, and other constraints) did not allow for avoidance. In these cases, Atlantic Shores surveyed around the aid and is investigating whether there is enough clearance to route cables around the anchors. Atlantic Shores will not know whether any ATONs within the surveyed corridors will require repositioning until final cable routing is completed. Cable burial near ATONs must be deconflicted with USCG prior to installation (GEO-22, Appendix G, Table G-1). Any relocation of USCG-maintained ATON would incrementally increase impacts on vessel navigation/ USCG activities. Non-Project vessels transiting between the Proposed Action ports and the Project area would be able to avoid Proposed Action vessels, components, and any safety zones (where USCG is authorized and elects to establish such zones) through routine adjustments to navigation. Although fishing vessels may experience increased transit times in some situations, these situations would be spatially and temporarily limited. An increase in avoidance measures could lead to over-avoiding and alliding with fixed structures or non-moving vessels. The Proposed Action's construction and installation vessel traffic would have localized, short-term, continuous impacts on overall navigation and vessel traffic in opens waters and near ports.

As shown in Figure 3.6.6-5 and Tables 3.6.6-4 and 3.6.6-5, the NSRA risk modeling suggests that under the Proposed Action, the overall total frequency of all operations phase accident scenarios for all vessel classes was calculated to be 0.10 to 0.11 accidents per year (10 percent to 11 percent annual probability), a slight increase from pre-construction. The primary risks for collision under existing conditions occur between the cargo, tug tows, transiting fishing, and recreational vessels. It is anticipated that this traffic will reroute to bypass the Project to the east, as noted in the 2016 ACPARS/ANPRM (USCG 2020c).



Source: COP Volume II, Appendix II-S, Figure 8.9; Atlantic Shores 2023.

Figure 3.6.6-5. Estimated pre-construction inter-class accident annual frequencies

Table 3.6.6-4. Estimated operational phase inter-class accident annual frequencies

Vessel Class	Collisions	Allisions	Total
Cargo	0.021 (0.021)	--	0.021 (0.021)
Fishing – Fishing	0.011 (0.011)	0.00013 (0.((40 zeros))41)	0.011 (0.011)
Fishing – Transiting	0.023 (0.023)	0.0015 (0.0048)	0.025 (0.028)
Passenger	0.00092 (0.00092)	--	0.00092 (0.00092)
Recreational	0.012 (0.012)	0.00038 (0.00038)	0.013 (0.013)
Tanker	0.0015 (0.0015)	--	0.0053 (0.0053)
Tug-Tow	0.018 (0.018)	--	0.018 (0.018)
Other	0.0048 (0.0048)	--	0.0048 (0.0048)
O&M	0.0069 (0.0069)	0.00080 (0.0025)	0.0077 (0.0093)
All	**0.10 (0.10)**	**0.0028 (0.0089)**	**0.10 (0.11)**

Source: COP Volume II, Appendix II-S, Table 8.11; Atlantic Shores 2023.
Note that the source table in the COP utilizes scientific notation, which has been converted to facilitate correlation between the data.
Note that results for both the 39.4-foot (12.0-meter) and 98.4-foot (30.0-meter) foundation widths are presented. The 39.4-foot (12.0-meter) foundation width is associated with the monopile, mono-bucket, suction bucket tetrahedron base, gravity-pad tetrahedron base, and GBS WTG foundation types. The 98.4-foot (30.0-meter) foundation width is associated with the piled jacket and suction bucket jacket WTG foundation types; the results for these foundation types are presented in parentheses.

Table 3.6.6-5. Estimated operational phase inter-class accident average recurrence intervals (years)

Vessel Class	Collisions (years)	Allisions (years)	Total Average Recurrence Interval (years)
Cargo	47 (47)	--	47 (47)
Fishing – Fishing	89 (89)	7,775 (2461)	88 (85)
Fishing – Transiting	43 (43)	665 (208)	40 (35)
Passenger	1,084 (1084)	--	1084 (1084)
Recreational	82 (82)	2,604 (803)	79 (74)
Tanker	679 (679)	--	679 (679)
Tug-Tow	56 (56)	--	56 (56)
Other	209 (209)	--	209 (209)
O&M	145 (145)	1,256 (403)	129 (106)
All	**10 (10)**	**356 (112)**	**10 (9)**

Source: COP Volume II, Appendix II-S, Table 8.12; Atlantic Shores 2023.
Note that results for both the 394-foot (12.0-meter) and 98.4-foot (30.0-meter) foundation widths are presented. The 39.4-foot (12.0-meter) foundation width is associated with the monopile, mono-bucket, suction bucket tetrahedron base, gravity-pad tetrahedron base, and GBS WTG foundation types. The 98.4-foot (30.0-meter) foundation width is associated with the piled jacket and suction bucket jacket WTG foundation types; the results for these foundation types are presented in parentheses.

Vessel traffic generated by the Proposed Action could restrict maneuvering room and cause delays accessing the port. Vessel traffic within the Lease Area is expected to increase once the WTGs and OSSs are in place, and the O&M phase of the Proposed Action would result in the same types of vessel traffic and navigation impacts as those described during construction. To assist with mitigation of these risks, an emergency response plan (ERP) will be developed to specify coordination, shutdown, and rescue procedures. The ERP will be reviewed and updated at least annually between Atlantic Shores and USCG (NAV-010; Appendix G, Table G-1). Updated asset and operational awareness bulletins will be regularly distributed showing the development area, depicted on local nautical charts, with a description of the assets in the area, the activities taking place, timelines, and relevant contact information. Atlantic Shores will also publish announcements and share updates with print and online industry publications and local news outlets (NAV-11; Appendix G, Table G-1). A "For Mariners" project webpage (www.atlanticshoreswind.com/mariners/) has been developed that contains the latest news and events, real-time Project buoy data display and Project vessel tracking chart, Project vessel schedules, and Fisheries Liaison Officer and Fishing Industry Representative contact information (NAV-12; Appendix G, Table G-1). Specific methods for communicating with offshore fishermen while they are at sea are being established, including a 24-hour phone line to address any real-time operational conflicts and/or safety issues (NAV-13; Appendix G, Table G-1). A Marine Coordinator will be employed to monitor daily vessel movements, implement communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project area. The Marine Coordinator will be responsible for coordinating with USCG for any required Notices to Mariners (NAV-14; Appendix G, Table G-1). Activities related to the operation of the Proposed Action would be minor, localized, short term, and infrequent relative to the life of the Project.

Impacts of the Connected Action

As described in Chapter 2, as part of the Proposed Action, an O&M facility would be constructed in Atlantic City, New Jersey, on a site previously used for vessel docking or other port activities. Construction of the O&M facility would involve construction of a new building and associated parking structure, repairs to the existing docks, and installation of new dock facilities. Installation of a new bulkhead and maintenance dredging in coordination with Atlantic City's dredging of the adjacent basins would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead installation and dredging activities are considered to be a connected action and are evaluated in this section.

The connected action would affect navigation and vessel traffic in the geographic analysis area through the following IPFs:

Port utilization: During the bulkhead installation and dredging activities, there could be delays to other vessels trying to enter or leave the port. Activities related to the connected action of the Proposed Action would be minor, localized, short term, and infrequent relative to the life of the Project.

Traffic: During the bulkhead installation and dredging activities, vessel traffic could experience delays transiting to and from the port. Activities related to the connected action of the Proposed Action would be minor, localized, short term, and infrequent relative to the life of the Project.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities including offshore wind activities, and the connected action.

Anchoring: The Proposed Action would contribute a small increment to the cumulative anchoring impacts, which would be short term and minor due to the small size of the offshore wind lease areas in the geographic analysis area compared to the remaining area of open ocean around and near the Project area, as well as the low likelihood that any anchoring risk would occur in an emergency scenario.

Cable emplacement and maintenance: The Proposed Action would contribute a small increment to the cumulative cable emplacement and maintenance impacts, which would be localized, intermittent, and minor. Cable installation and maintenance for other offshore wind activities would generate comparable types of impacts to those of the Proposed Action for each offshore export cable route and interarray and interconnector cable system. As shown in Table D.A2-1 in Appendix D, offshore export cable and interarray/interconnector cables for three other offshore wind projects (Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North) could be operating simultaneously while the Proposed Action is under construction. Simultaneous construction of interarray and interconnector cables for adjacent projects could have a combined effect, although it is assumed that installation vessels would only be present above a portion of a project's interarray/interconnector system at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export cable and interarray/interconnector installation activities for other offshore wind projects.

Port utilization: Other offshore wind projects would generate comparable types and volumes of vessel traffic in ports and would require similar types of port facilities as the Proposed Action. The Proposed Action would commence offshore construction in 2025, after construction of Ocean Wind 1, another potential offshore wind project in the geographic analysis area, has begun, and continue through 2027. Offshore construction of the two other potential offshore wind projects in the geographic analysis area, Ocean Wind 2 and Atlantic Shores North, would commence in 2026 and continue through 2030. Therefore, the increase in port utilization due to other offshore wind project vessel activity would be limited during construction and installation of the Proposed Action. The adjacent Ocean Wind 1 project anticipates utilizing the Port of Atlantic City, Paulsboro Marine Terminal, New Jersey Wind Port, and the Port of Elizabeth, New Jersey; Port of Norfolk, Virginia; and Port of Charleston, South Carolina. The Proposed Action would primarily use ports in the local New Jersey area, including the Paulsboro Marine Terminal, New Jersey Wind Port, and Repauno Port and Rail Terminal, in addition to the Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas. This should allow the total increase in vessel traffic to be distributed across multiple ports in the region; however, there could be delays for vessels using those ports if two or more projects are under construction at the same time and accessing the same ports. Accordingly, cumulative port utilization impacts on navigation and vessel traffic would be continuous and moderate.

Presence of structures: The Proposed Action would contribute a noticeable increment to the cumulative impacts from the presence of structures. Structures from other offshore wind activities would generate comparable types of impacts as under the Proposed Action across the entire geographic analysis area. Up to 200 WTGs, up to 10 (small) OSSs, and 1 met tower would be constructed under the Proposed Action. The presence of up to 585 structures from all offshore wind projects in the geographic analysis area including the Proposed Action (211 structures) and other offshore wind projects (374 structures) would further increase the navigational complexity in the region, resulting in an increased risk of collisions and allisions, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The presence of neighboring offshore wind projects could also affect demand for resources associated with USCG SAR operations by changing vessel traffic patterns and densities.

Unique structure orientation patterns are planned within the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects and the Proposed Action to accommodate different traffic patterns within each lease area. The BOEM lease agreements for Atlantic Shores South and Ocean Wind 1 do not require setbacks from adjoining borders, so the Proposed Action WTG layout does not include a setback from the adjacent Ocean Wind 1 lease area. However, when adjacent offshore wind projects share borders, USCG recommends a common WTG spacing and layout across the projects to provide consistent straight-line orientation through the adjoining areas. A common WTG spacing and layout facilitates predictable navigation patterns, navigational safety, consistent and continuous marking and lighting, SAR, and other uses such as commercial fishing. In the absence of a common spacing and orientation between adjacent wind projects, USCG recommends setbacks from the shared border to create a separation between projects. The space between projects should be greater than the WTG spacing within either WTA to provide a clear visual reference to easily distinguish separate projects (USCG 2021). A change in orientation or spacing without this separation would increase risk for surface and aerial navigation through the WTAs and could make it more difficult for SAR aircraft to perform operations in the geographic analysis area, leading to a less optimized search pattern and a lower probability of success. This could lead to increased possibility for loss of life due to maritime incidents. SAR is further addressed in Section 3.6.7. The lack of a shared WTG layout or setback from the shared boundary between the Ocean Wind 1 and Atlantic Shores South projects would increase navigational complexity in the geographic analysis area and have a moderate to major impact on navigation depending on the final layout and proximity of WTGs in the adjoining lease areas.

Traffic: The other offshore wind projects in the geographic analysis area (Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North) would generate amounts of vessel traffic comparable to that of the Proposed Action. While construction of the Proposed Action is expected to be completed in 2027 (Chapter 2) an overlap in construction is expected in 2026–2027 with Ocean Wind 2 and Atlantic Shores North, causing vessel traffic impacts to increase. Following construction, Ocean Wind 1, Ocean Wind 2, and the Atlantic Shores offshore wind projects would be operating simultaneously and could generate up to 22 vessel trips to support O&M activities at any given time (COP Volume I, Section 5.6; Atlantic Shores 2023). Traffic from these projects could be spread among multiple ports within and outside the geographic analysis area for navigation and vessel traffic, thus potentially moderating the effect of offshore wind-related vessel traffic at any single location. The contribution of the Proposed Action to cumulative vessel traffic impacts would be localized, short term, and intermittent.

Conclusions

Impacts of Alternative B – Proposed Action. In summary, construction and installation, O&M, and decommissioning of the Proposed Action would have adverse impacts on navigation and vessel traffic. The impacts of the Proposed Action alone on navigation and vessel traffic would be **moderate**. Impacts on non-Project vessels would include changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions within the WTA, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels would choose to avoid the WTA altogether, leading to some potential funneling of vessel traffic along the Project area borders. In addition, the increase in potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users in the geographic analysis area.

BOEM expects that the connected action alone would have **minor** impacts on navigation and vessel traffic due to port utilization and traffic.

Cumulative Impacts of the Proposed Action. The incremental impacts contributed by the Proposed Action to the cumulative impacts on navigation and vessel traffic would range from noticeable to appreciable. The main IPF from which impacts are contributed is the presence of structures, which increases the risk of collision/allision and navigational complexity, particularly when adjoining offshore wind projects do not share a common WTG layout or spacing and do not include a separation between adjoining lease areas. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with impacts from ongoing and planned activities, including offshore wind would be **moderate** to **major**, due primarily to the increased possibility for marine accidents, which could produce significant disruptions for ocean users in the geographic analysis area.

3.6.6.6 Impacts of Alternatives C, D, and F on Navigation and Vessel Traffic

Impacts of Alternatives C, D, and F. Impacts of Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) would be similar to those of the Proposed Action for navigation and vessel traffic except for the impact of the presence of structures. The construction of Alternative C could install fewer WTGs (up to 29 fewer WTGs) and associated OSS (1 fewer OSS) and interarray cables, which would slightly reduce the construction impact footprint and installation period. The removal of these WTGs and OSS would result in a minor reduction of impacts on navigation and vessel traffic compared to the Proposed Action, with fewer structures to consider.

Impacts of Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) would be similar to those of the Proposed Action for navigation and vessel traffic except for the impact of the presence of structures. Alternative D would alter the layout and number of WTGs to reduce impacts. Alternative D could result in a reduced impact to navigation and vessel traffic, but the overall impact would be minor.

Impacts of Alternative F (Foundation Structures) would be the same as those of the Proposed Action for navigation and vessel traffic. The construction of Alternative F would either use monopile and piled jacket, suction bucket, or gravity-based foundations. The foundation type has little to no impact on navigation and traffic.

Cumulative Impacts of Alternatives C, D, and F. The incremental impacts contributed by Alternatives C, D, and F to the cumulative impacts on navigation and vessel traffic would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternatives C, D, and F. The same grid pattern as the Proposed Action would remain intact; therefore, the impacts on navigation and vessel traffic from Alternative C would be similar to the impacts from the Proposed Action, which would be **moderate.** The impacts on navigation and vessel traffic from Alternative D would be similar to or slightly less than the **moderate** impacts from the Proposed Action, based on the new layout, as well as the number and location of WTGs removed. The impacts on navigation and vessel traffic from Alternative F would be similar to the **moderate** impacts from the Proposed Action as the WTG grid would remain the same. Modeling indicated an increase of one additional accident the overall total frequency of all operations phase accident scenarios for all vessel classes was calculated to be 0.10 to 0.11 accidents per year (10 percent to 11 percent annual probability) (Table 3.6.6-4) depending on the type of foundation ultimately used; however, it does not change the outcome of the risk assessment as the risk for the highest number of accidents remains negligible (COP Volume II, Appendix II-S; Atlantic Shores 2023).

3.6.6.7 Cumulative Impacts of Alternatives C, D, and F.

The incremental impacts contributed by Alternatives C, D, and F to the cumulative impacts on navigation and vessel traffic would be similar to those described under the Proposed Action.

3.6.6.8 Impacts of Alternative E on Navigation and Vessel Traffic

Impacts of Alternative E. Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) was developed to address concerns raised in public scoping comments regarding the different layouts between the Ocean Wind 1 and Atlantic Shores South projects and the need for a setback for each of the two projects in the adjacent lease areas (refer to Section 2.1.3). USCG recommends that, when multiple lease areas share borders, there is a common WTG spacing and layout throughout all adjoining wind projects; additionally, in the absence of the common spacing and orientation between adjacent wind projects, a setback from the shared border is recommended (USCG 2021). Alternative E encompasses wind turbine layout modifications that would result in a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Ocean Wind 1 Lease Area (OCS-A 0498) and the Atlantic Shores South Lease Area (OCS-A 0499).

Alternative E would accomplish the setback with the exclusion or micrositing of up to 5 WTG positions.

The proposed setback (0.81 to 1.08 nautical miles [1,500 to 2,000 meters]) would be an improvement to vessel navigation and SAR considerations over no separation between lease areas, particularly as there is a lack of common WTG spacing and layout throughout. The separation would provide a clear visual reference for each project to mariners within the area and to USCG aviators on SAR missions so that the operators can adjust their course as needed. It also provides the sea and air space required to conduct that course adjustment. Overall, Alternative E would have slightly reduced impacts on navigation and vessel traffic compared to the Proposed Action.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the cumulative impacts on navigation and vessel traffic would be slightly reduced from those described under the Proposed Action

Conclusions

Impacts of Alternative E. Alternative E would reduce the impacts on navigation and vessel traffic compared to the Proposed Action from minor to moderate to **negligible** to **minor** due to the presence of structures, port utilization, and vessel traffic.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E on navigation and vessel traffic to the cumulative impacts on navigation and vessel traffic would be appreciable. The incremental impacts would be less than those described under the Proposed Action due to WTG layout modifications to address navigational safety concerns as recommended by USCG.

BOEM anticipates the cumulative impacts of Alternative E to be **minor** to **moderate,** primarily due to the presence of structures, which increases the likelihood of allisions and complicates SAR activities.

3.6.6.9 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed in Table 3.6.6-6 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.6.6-6. Proposed mitigation measures – navigation and vessel traffic

Mitigation Measure	Description	Effect
Export cable spacing	When possible, the cable spacing should be minimized.	This will reduce potential impacts to ocean users.
Cable Maintenance Plan	In conjunction with cable monitoring, develop and implement a Cable Maintenance Plan that requires prompt remedial burial of exposed and shallow-buried cable segments, review to address repeat exposures, and a process for identifying when cable burial depths reach unacceptable risk levels.	This will allow for timely response to any issues related to the cables and reduce the risk to vessels navigating the ECC from any cable issues.
Incident reporting	Provide written notification of incidents (e.g., gear interactions, anchor strikes, vessel allisions, property damage less than $25,000) that fall below or are simply not captured by the regulatory thresholds outlined in 30 CFR §§ 285.832 and 285.833. Summaries could be provided to BOEM/BSEE and USACE during construction, operations, and decommissioning.	This will increase awareness of the frequency and circumstances surrounding these incidents and assess whether any actions are needed to address them in a timely manner, to reduce risk of recurrence.
Expand Fisheries Communication Plan	Expand Fisheries Communication Plan to include outreach and communication with all mariners, including the commercial shipping industry and recreational users. Communication and outreach should cover all project phases from pre-construction to decommissioning.	This will facilitate coordination with all mariners, including the commercial shipping industry, commercial and for-hire fishing industries, and other recreational users, and allow for a reduction of vessel traffic in the area and a commensurate reduction of risk of allision or collision with other vessels or structures.

3.6.6.10 Comparison of Alternatives

Construction of Alternatives C, D, and F would have the same **moderate** impacts on navigation and vessel traffic as described under the Proposed Action. Alternative E could reduce the impact to a degree by creating a setback between the Atlantic Shores South and Ocean Wind 1 projects, leading to **negligible** to **minor** impacts on navigation and vessel traffic.

3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

This section discusses potential impacts on other uses not addressed in other portions of this Draft EIS, including marine minerals, military use, aviation, and scientific research and surveys that would result from the proposed Atlantic Shores South Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis areas for these topics are described below and shown in Figure 3.6.7-1.

- Marine minerals: Areas within 0.31 mile (0.5 kilometer) of the ECCs and WTA that could affect marine minerals extraction (Figure 3.6.7-1).
- Aviation and air traffic, military and national security, and radar systems: Areas within 10 miles (16.1 kilometers) of the ECCs and WTA and the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North Lease Areas, as well as Atlantic City International Airport, Ocean City Municipal Airport, Woodbine Municipal Airport, Cape May County Airport, and Warren Grove Range Airport (Figure 3.6.7-1).
- Cables and pipelines: Areas within 1 mile (1.6 kilometers) of the ECCs and WTA that could affect future siting or operation of cables and pipelines (Figure 3.6.7-1).
- Scientific research and surveys: Same analysis area as finfish, invertebrates, and EFH (Figure 3.5.5-1).

These areas encompass locations where BOEM anticipates direct and indirect impacts associated with the Project's construction, O&M, and conceptual decommissioning.

3.6.7.1 Description of the Affected Environment and Future Baseline Conditions

Marine Minerals Extraction

BOEM's Marine Mineral Program manages non-energy minerals (primarily sand and gravel) on the OCS and leases access to these resources to target shoreline erosion, beach renourishment, and restoration projects. At this time, there are no active or requested BOEM leases in the geographic analysis area. The closest previous lease in BOEM's Marine Minerals Program is known as the D2 borrow area, offshore New Jersey near Harvey Cedars, Surf City, Long Beach Township, Ship Bottom, and Beach Haven (Lease Area OCS-A-0505; executed July 1, 2014), which was approved through September 30, 2018, for the use of up to 10,000,000 cubic yards of material. Periodic nourishment for this project has been authorized in a 7-year cycle, with an estimated final nourishment year of 2055 (Cresitello 2020).

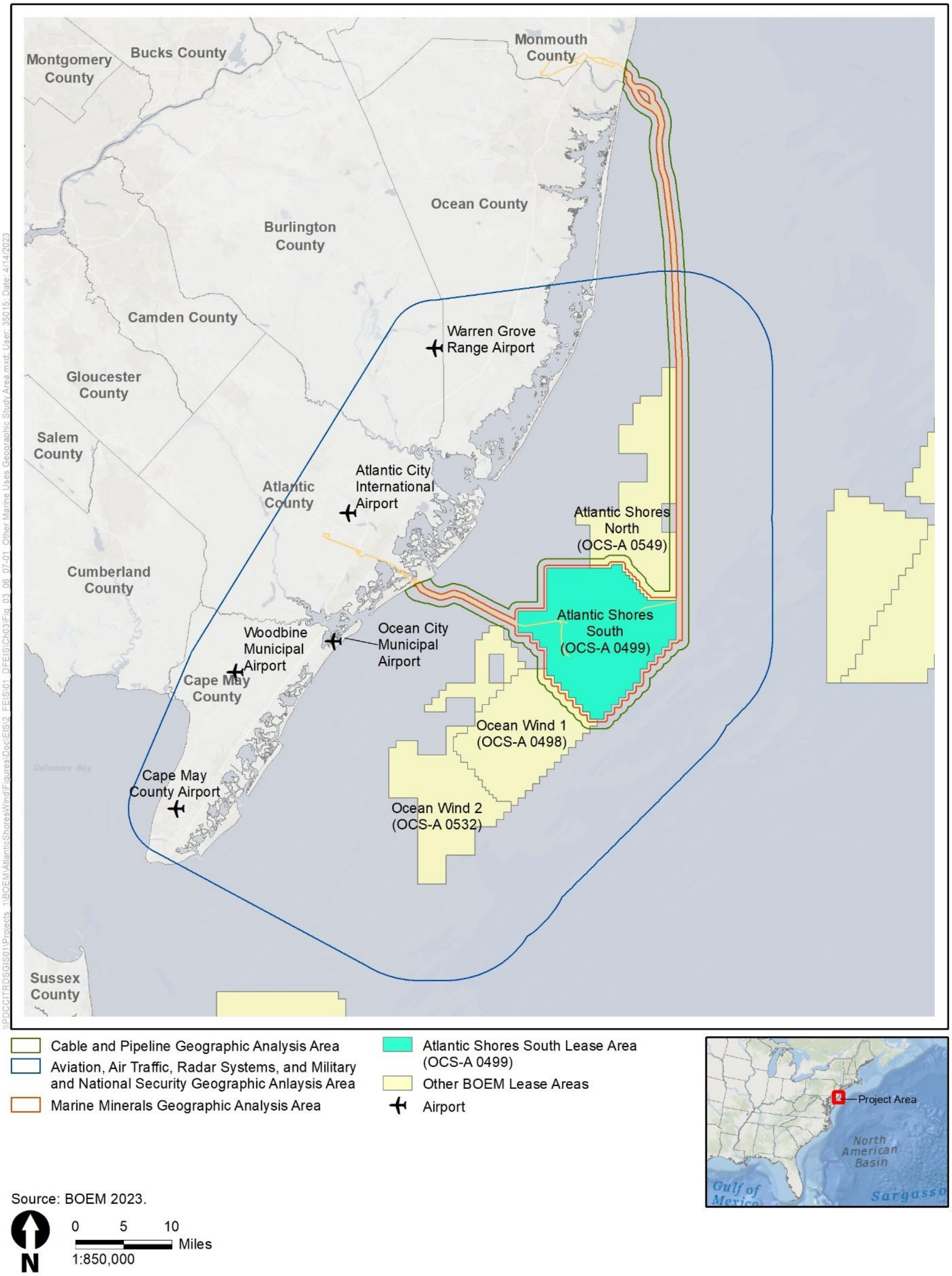


Figure 3.6.7-1. Other uses geographic analysis area

Offshore sand and gravel are important resources managed by federal and state agencies and used for coastal protection and restoration, beach nourishment, and habitat reconstruction purposes. Within or adjacent to the Offshore Project area, BOEM, USACE, NJDEP, and New Jersey Geological and Water Survey (NJGWS) coordinate the management of areas of potential and confirmed sand resources for these coastal management and restoration activities. Beach nourishment projects are common along the sandy coast of New Jersey with several active and proposed projects documented for the beaches of Atlantic City, adjacent to the Atlantic ECC, and in Sea Girt, adjacent to the Monmouth ECC (NOAA 2020).

Military and National Security Use

Of the United States Armed Forces with installations and operations in the vicinity of the Project, the U.S. Navy and USCG (Department of Homeland Security [DHS]) has the most significant presence in and around the Offshore Project area as shown in Figure 3.6.7-2. There is a designated U.S. Navy at-sea area referred to as an Operating Area (OPAREA) located off the coast of New Jersey. The Atlantic City OPAREA extends from Seaside Heights to Sea Isle City and encompasses a majority of the Offshore Project area. This range complex is used for U.S. Atlantic Fleet training and testing exercises and supports training and testing by other services, primarily the U.S. Air Force. The Aegis Combat Systems Center conducts operations in this area. It is controlled by the Fleet Area Control and Surveillance Facility Virginia Capes, Naval Air Station, Oceana. The Atlantic City special use airspace (SUA), within the OPAREA, is used for surface-to-air gunnery exercises and is, therefore, designated as a Warning Area for nonparticipating pilots (COP Volume II, Section 7.7.2; Atlantic Shores 2023).

Within the Offshore Project area, there is the potential to encounter munitions and explosives of concern (MEC) that are the result of military testing and training. MEC is inclusive of UXO and discarded military munitions or constituents that could pose an explosive hazard. Two site-specific studies were commissioned by Atlantic Shores to gain a more detailed understanding of the potential for MEC in the Offshore Project area: the MEC Hazard Assessment and the MEC Risk Assessment with Risk Mitigation Strategy (COP Volume II, Appendix II-A4; Atlantic Shores 2023). The studies determined that the Offshore Project area is within low hazard zones (Zones 2 and 3) for MEC. The reports determined that the likelihood of encountering buried items that constitute a notable safety risk to be below the industry standard of As Low as Reasonably Practicable (ALARP). Furthermore, the studies recommended that Atlantic Shores avoid the use of high-resolution magnetometry surveys to detect buried items.

The NSRA analyzed vessel incidents using data gathered from the USCG for a period of 14 years (2004–2018). A total of 24 SAR missions were found to have occurred within the confines of the study area, which is defined as 2 nautical miles (3.7 kilometers) beyond the lease boundary and is based on an assumed maximum 2-hour response time for the USCG. These incidents occurred during all seasons, half during daylight hours and half during nighttime, and varied between disabled vessels, medical issues, and other incidents, but there were no recorded allisions, collisions, or groundings in the WTA (COP Volume II, Appendix II-S, Section 10.1; Atlantic Shores 2023).

Military activities are anticipated to continue to use onshore and offshore areas in the vicinity of the Project area into the future and may involve routine and non-routine activities.

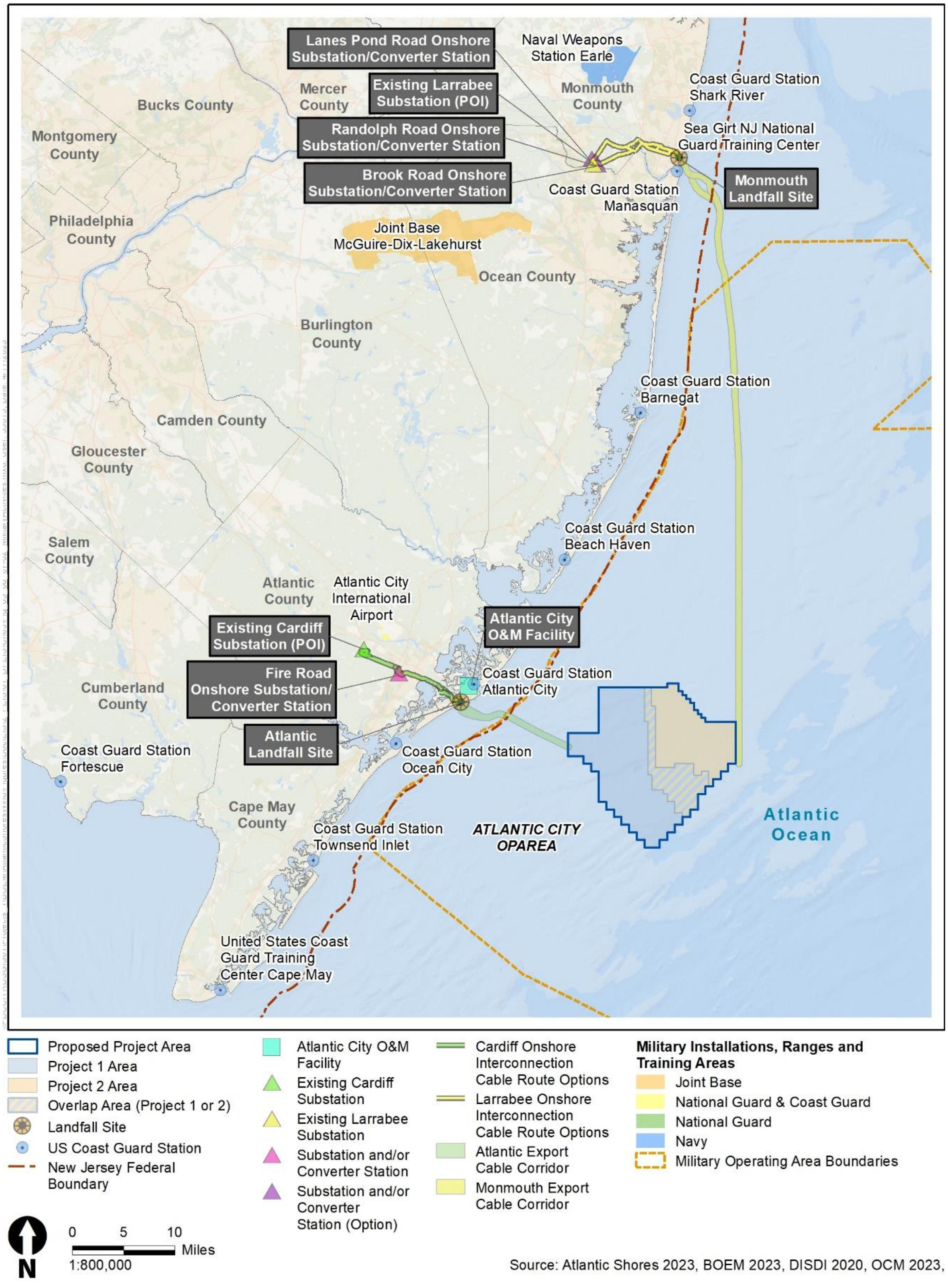


Figure 3.6.7-2. Military activities in the vicinity of the Offshore and Onshore Project areas

Aviation and Air Traffic

Multiple public and private-use airports serve the region surrounding the Project area, including Atlantic City International Airport, Ocean City Municipal Airport, Woodbine Municipal Airport, Warren Grove Range Airport, and Cape May County Airport. The New Jersey and Delaware Air National Guard and the U.S. Navy use portions of the WTA for flight training. A list of public, private, and military airports within proximity to the WTA can be found in COP Volume II, Table 7.8-1 (Atlantic Shores 2023). In addition to the designated military airspace within the Offshore Project area, USCG will conduct flights over the water to support SAR missions using both vessel and helicopter assets (COP Volume II, Section 7.8.2; Atlantic Shores 2023).

Air traffic is expected to continue at current levels in and around the WTA.

Cables and Pipelines

The onshore export cable corridors for Cardiff and Larrabee are within developed areas of New Jersey that overlap multiple utilities including cables and pipelines.

There are approximately 20 publicly known telegraph and fiber optic cables (active and out of service) offshore within the geographic analysis area (Figure 3.6.7-3).

During the Initial Cable Burial Risk Assessment (CBRA) for the Monmouth ECC, it was found that, within the Monmouth ECC, there are five expected crossings of active cables, seven crossings of inactive cables, and two crossings of cable where the status is unconfirmed or unknown (COP Volume II, Appendix II-A5b, Section 6.2.1.4; Atlantic Shores 2023). Cables within the Monmouth ECC include:

- GlobeNet Segment 5, a high-capacity subsea cable system from Bermuda to New Jersey, active
- GlobeNet Segment 1, a high-capacity subsea cable system from Florida to New Jersey, active
- Transatlantic Telecommunications Cables (TAT-3 [inactive], TAT-14 [inactive], TAT-7 [inactive], TAT-8 [inactive], TAT-11 [inactive], and TAT-9 [inactive])
- Apollo South, an optical submarine communications cable system, active
- TGNA, a submarine telecommunications cable system, active
- Possible telephone cable, status unknown
- Unknown cable, status unknown

During the Initial CBRA for the Atlantic ECC, it was found that, within the Atlantic ECC, there were no identified cable crossings. There was a potential linear object interpreted from the geophysical survey; however, the interpreted object does not correspond to a charted cable. This linear feature is interpreted most likely to be a dropped pipe related to dredging operations (COP Volume II, Appendix II-A5a, Executive Summary; Atlantic Shores 2023). The Initial CBRAs only surveyed existing cables within the Atlantic and Monmouth ECCs.

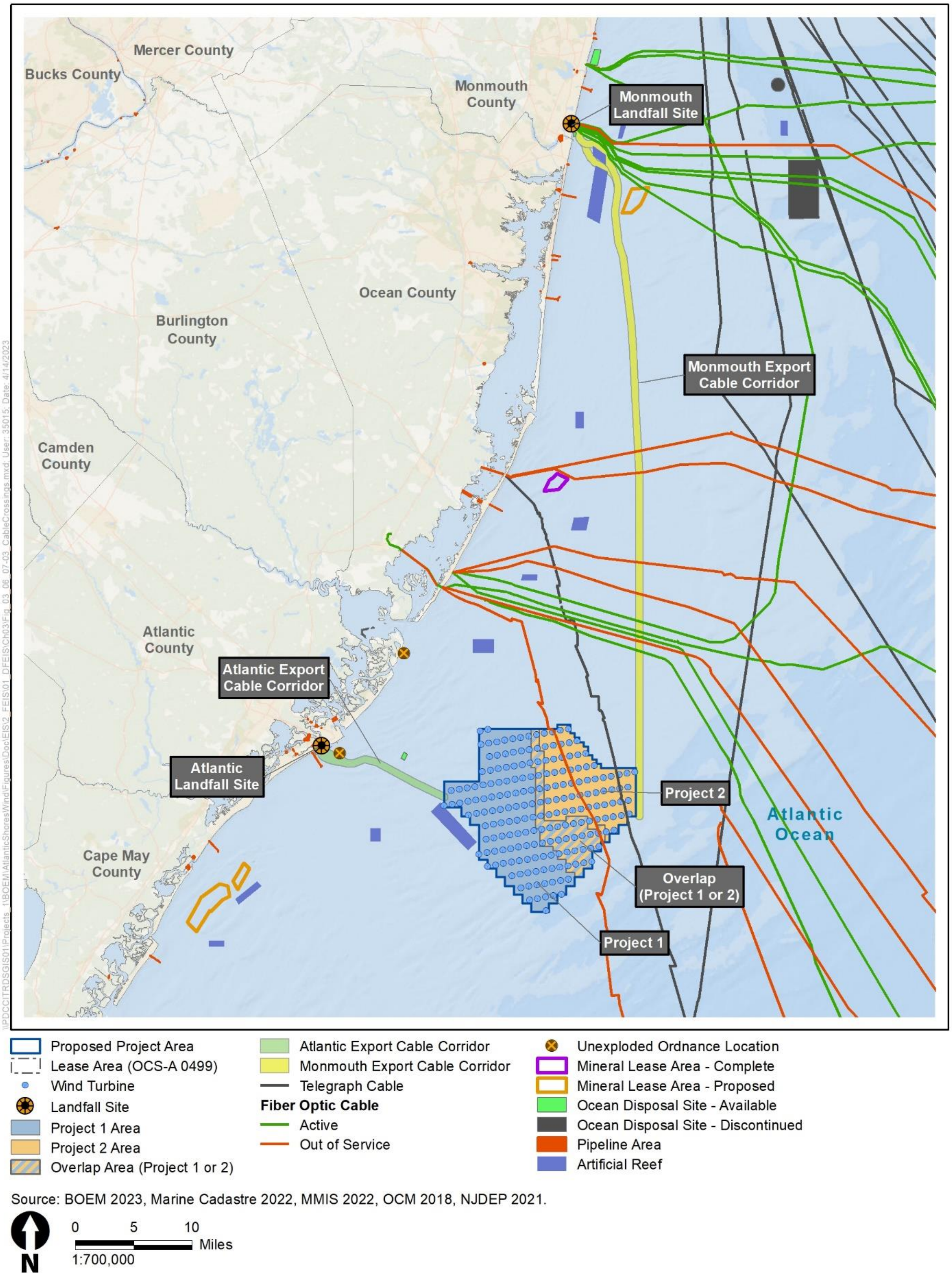


Figure 3.6.7-3. Atlantic Shores South cable crossings

BOEM has not identified any additional publicly noticed plans for planned submarine cables or pipelines in the geographic analysis area.

Radar Systems

Commercial air traffic control, national defense, and weather radar systems currently operate in the region. Radar facilities that overlap with the Offshore Project area include those that support air traffic control, military surveillance, high frequency (HF) coastal radars, and weather monitoring.

The FAA uses the following radar sites for air traffic control at multiple facilities, including the New York TRACON and the Philadelphia TRACON:

- Newark Airport Surveillance Radar model 9 (ASR-9)
- New York ASR-9
- Philadelphia ASR-9
- Naval Air Station (NAS) Willow Grove ASR-11

The NOAA Integrated Ocean Observing System (IOOS) utilizes the following HF radars (which are operated by Rutgers University) as part of its Surface Currents Program, with the exception of Assateague Island HF, which is operated by Old Dominion University (COP Volume II, Appendix II-T2; Atlantic Shores 2023). The HF data collected in the IOOS is also utilized by the USCG for their Search and Rescue Optimal Planning System (SAROPS) software (IOOS 2012).

- Bradley Beach HF radar
- Brant Beach HF radar
- Brigantine Long Range HF radar
- Brigantine Medium Range HF radar
- Cape May Point HF radar
- Hempstead HF radar
- Loveladies HF radar
- Moriches HF radar
- North Wildwood HF radar
- Sandy Hook HF radar
- Sea Bright HF radar
- Seaside Park HF radar
- Strathmere HF radar
- Wildwood HF radar
- Assateague Island HF radar

Existing radar systems will continue to provide weather, navigational, and national security support to the region. The number of radars and their coverage areas are anticipated to remain at current levels for the foreseeable future.

Scientific Research and Surveys

Research in the geographic analysis area includes oceanographic, biological, geophysical, and archaeological surveys focused on the OCS and nearshore environments, and resources that may be affected by offshore wind development. Federal and state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing offshore research in the WTA and surrounding waters.

Off the coast of New Jersey, agency-sponsored research and survey efforts are conducted by the NEFSC, NJDEP, and the Northeast Area Monitoring and Assessment Program (NEAMAP) led by the Virginia Institute of Marine Sciences. The following in-water studies have historically traversed the Offshore Project area: NEFSC multi-species bottom trawls, NJDEP trawls, NEFSC clam surveys, and NEAMAP trawl surveys. Gear used for these surveys include four-seam bottom and otter trawls, with the exception of NEFSC clam surveys, which used a hydraulic dredge (COP Volume II, Section 7.7.6; Atlantic Shores 2023). Additionally, NEFSC conducts an annual Integrated Sea Scallop and HabCam Research Survey, a sea scallop stock assessment and habitat characterization tool, and an ecosystem monitoring program, a more than 40-year shelf monitoring program within the mid-Atlantic region, both of which overlap with the Lease Area.

In addition to in-water surveys, aerial surveys to measure the abundance of marine mammals and sea turtles are conducted from Maine to the Florida Keys as part of the Atlantic Marine Assessment Program for Protected Species (AMAPPS) by NOAA. NOAA conducts these surveys within the Offshore Project area utilizing aircraft that fly 600 feet (183 meters) above the water surface at 110 knots (200 kilometers per hour) (NEFSC 2020).

3.6.7.2 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

This Draft EIS uses a four-level classification scheme to characterize potential impacts of the Proposed Action, as shown in Table 3.6.7-1. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions. There are no beneficial impacts on other uses.

Table 3.6.7-1. Impact level definitions for other uses

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Impacts on the affected activity would be avoided, and impacts would not disrupt the normal or routine functions of the affected activity. Once the Project is decommissioned, the affected activity would return to a condition with no measurable effects.
Moderate	Adverse	Impacts on the affected activity would be unavoidable. The affected activity would have to adjust to account for disruptions due to impacts of the Project, or, once the Project is decommissioned, the affected activity could return to a condition with no measurable effects if proper remedial action is taken.

Impact Level	Impact Type	Definition
Major	Adverse	The affected activity would experience unavoidable disruptions to a degree beyond what is normally acceptable, and, once the Project is decommissioned, the affected activity could retain measurable effects indefinitely, even if remedial action is taken.

3.6.7.3 Impacts of Alternative A – No Action on Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

When analyzing the impacts of the No Action Alternative on other uses, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for other uses. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys described in Section 3.6.7.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. See Appendix D, Tables D.A1-14 through D.A1-19 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for military and national security use, aviation and air traffic, cables and pipelines, marine minerals, radar systems, and scientific research and surveys, respectively.

There are no ongoing offshore wind activities within the geographic analysis area for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, or radar systems. Within the geographic analysis area for scientific research and surveys, the following offshore wind activities are ongoing: the BIWF offshore Rhode Island, the CVOW Pilot offshore Virginia, Vineyard Wind 1 offshore Massachusetts, and South Fork Wind Farm offshore Rhode Island.

Ongoing activities within the geographic analysis area that would contribute to impacts on other uses would generally be associated with offshore developments and climate change. Impacts on the marine environment associated with ongoing offshore wind activity have the potential to affect ongoing research and surveys within the geographic analysis area.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

No offshore developments, such as the installation of new structures on the OCS outside of planned offshore wind projects, were identified within the geographic analysis area (see Section D1 in Appendix

D for a description of ongoing and planned activities). Impacts on the marine environment associated with climate change and commercial fishing have the potential to affect ongoing research and surveys within the geographic analysis area. See Appendix D, Tables D.A-14 through D.A-19 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for other uses.

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on other uses during construction, O&M, and decommissioning of the projects. Other planned offshore wind activities in the geographic analysis area for other uses are limited to the construction and installation, O&M, and decommissioning of Ocean Wind 1 in Lease Area OCS-A 0498, Ocean Wind 2 in Lease Area OCS-A 0532, and Atlantic Shores North in Lease Area OCS-A 0549.

BOEM expects planned offshore wind development to affect other uses through the following IPFs.

Marine Mineral Extraction

Presence of structures: The demand for sand and gravel resources is expected to grow with increasing trends in coastal erosion, storm events, and sea level rise. Within the geographic analysis area, there are no mineral leases.[1] There are, however, two open ocean dredged material disposal sites: Cold Spring Inlet and Absecon Inlet (Ocean Disposal Database 2022). In addition, within the geographic analysis area, there are two sand resource areas in federal waters (Shoal 236 and F2) and three in state waters (Shoal 235, Area G, and BI-J) (BOEM 2022). Offshore wind project infrastructure, including WTGs and transmission cables, could prevent future marine mineral extraction activities where the Project footprint overlaps with the extraction area. Marine mineral extraction typically occurs within 8 miles of the shoreline, limiting adverse impacts on the offshore export cable routes. Additionally, it may be possible for other offshore wind projects to avoid existing and prospective borrow areas through consultation with the BOEM Marine Minerals Program, USACE, and relevant state agencies before an offshore wind cable route is approved. The adverse impacts on sand and marine mineral extraction of offshore wind activities are anticipated to be minor.

Military and National Security Uses

The offshore wind lease area geographic boundaries were developed through coordination with stakeholders to address concerns surrounding overlapping military and security uses. BOEM continues to coordinate with stakeholders to minimize these concerns, as needed.

Presence of structures: Existing stationary facilities along the coastline are limited to dock facilities and other structures. Installation of up 377 foundations (see Table D.A2-2, Appendix D) as part of other offshore wind projects in the geographic analysis area would affect military and national security operations, including USCG SAR operations, primarily through increased risk of allision with foundations and other stationary structures. Generally, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations or other non-typical activities.

[1] BOEM Marine Mineral Lease Areas: https://www.boem.gov/marine-minerals/requests-and-active-leases.

Smaller-draft vessels moving within or near the wind installation have a higher risk of allision with offshore wind structures. Wind energy facility structures would be lighted according to USCG and BOEM requirements at sea level to decrease allision risk. Allision risk would be further mitigated through coordination with stakeholders on WTG layouts to allow for safe navigation through the offshore wind lease areas in the geographic analysis area.

The construction of offshore wind projects in the geographic analysis area would incrementally change navigational patterns and would increase navigational complexity for vessels and military aircraft operating in the region around the wind energy projects. The structures associated with offshore wind energy may necessitate route changes to navigate around the offshore wind lease areas and vessels associated with the construction of a project. Military and national security aircraft operations would be affected by the presence of tall equipment necessary for offshore wind facility construction, such as stationary lift vessels and cranes, which would increase navigational complexity in the area. Additionally, military and security operations would be affected during the construction and operation periods of offshore wind activities. It is assumed, however, that all offshore wind energy projects would coordinate with relevant agencies during the COP development process to identify and minimize conflicts with military and national security operations. Refer to Section 3.6.6, *Navigation and Vessel Traffic*, for additional discussion of navigation impacts in the offshore wind lease areas.

Once the WTGs are operational, the artificial reef effect created by the offshore structures could attract commercial and recreational fishing vessels farther offshore than currently, possibly leading to use conflicts with military and national security vessels and to an increased demand for USCG SAR operations.

Navigational hazards would be eliminated as structures are removed during decommissioning. Due to anticipated coordination with agencies the overall impacts on military and national security uses from offshore wind energy activities are anticipated to be minor to moderate**.**

Traffic: Impacts on military and national security operations from vessel traffic related to the construction and operation of offshore wind activities on the OCS are expected to be short term and localized. Vessel traffic is expected to increase during construction. While construction periods of various offshore wind energy projects are expected to be staggered, there would be an overlap in construction between the three offshore wind projects in the geographic analysis area (Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North) in 2026–2027, which would result in a cumulative impact on traffic volumes. Military and national security vessels may experience congestion and delays in ports due to the increase in offshore wind facility vessels.

Aviation and Air Traffic

Presence of structures: Other offshore wind development could add up to 377 foundations to the offshore environment in the nearby OCS (Appendix D, Table D.A2-2). WTGs could have a maximum blade tip height of 1,049 feet (320 meters) MLLW. As these structures are built, aircraft navigational patterns and complexity would incrementally increase in the region around the offshore wind lease areas, along transit routes between ports and construction sites, and locally around ports. These changes could compress lower-altitude aviation activity into more limited airspace in these areas, leading to airspace conflicts or congestion and increasing collision risks for low-flying aircraft. After all foreseeable offshore wind energy projects are built, there would still be open airspace available over the open ocean. Navigational hazards and collision risks in transit routes would be reduced as construction is completed and would be gradually eliminated during decommissioning as offshore WTGs are removed.

All stationary structures would have aviation and navigational marking and lighting in accordance with FAA, USCG, and BOEM requirements and guidelines to minimize and mitigate impacts on air traffic (AVI-09). BOEM assumes that offshore wind projects would coordinate with aviation interests through the planning, construction, operations, and conceptual decommissioning processes to avoid or minimize impacts on aviation activities and air traffic. For this reason, the adverse impacts on aviation and airports are anticipated to be minor.

Cables and Pipelines

Presence of structures: There are at least 14 cables, including both active and inactive fiber optic and telephone cables within the geographic analysis area. One mapped pipeline area of unknown origin is present onshore along the Cardiff Onshore Interconnection Cable Route. Structures within and near the geographic analysis area that pose potential allision hazards include buoys that are used to mark inlet approaches, channels, and shoals; meteorological buoys associated with offshore wind lease areas; and shoreline developments such as docks, ports, and other commercial, industrial, and residential structures. Installed WTGs and OSSs, and the stationary lift vessels used during construction of offshore wind energy project infrastructure, may pose allision/collision risks and navigational hazards to vessels conducting maintenance activities on these existing cables and pipelines. Risk to cable maintenance vessels during construction and operations of nearby offshore wind projects would be limited due to the infrequent submarine cable maintenance required at any single location along existing cable routes. Allision risks would be mitigated by navigational hazard markings per FAA, USCG, and BOEM requirements and guidelines. Risk of allision by cable maintenance vessels would decrease to zero after project decommissioning as structures are removed.

Up to 1,616 miles (2,601 kilometers) of submarine cables are expected to be installed for the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects (Appendix D, Table D.A2-1). The installation of WTGs and OSSs could preclude future submarine cable placement within the foundation footprint, which would cause future cables to route around these areas. However, the presence of existing submarine cables would not prohibit the placement of additional cables and pipelines. Following standard industry procedures, cables and pipelines can be crossed without adverse impact. Impacts on submarine cables would be eliminated during decommissioning of offshore wind farms when foundations are removed and if the export and interarray cables associated with those projects are removed. Minor adverse impacts on existing cables and pipelines due to anticipated offshore wind projects are expected.

As for buried structures, the presence of MECs which include UXO and discarded military munitions or constituents, the Offshore Project area is within the low hazard zones. The likelihood of encountering buried items that constitute a notable safety risk within the low hazard zones is deemed to be below the ALARP threshold.

Radar Systems

Presence of structures: WTGs that are near to or in the direct line of sight or over the horizon coverage area of land-based radar systems can interfere with the radar signal, causing shadows or clutter in the received signal. Construction of other wind energy projects would add up to 366 WTGs with a maximum blade tip height of up to 1,049 feet (320 meters) MLLW in the geographic analysis area. The presence of these wind energy structures could lead to localized, long-term, moderate impacts on radar systems. Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars. Most offshore wind structures would be sited at such a distance from existing and proposed land-based radar systems to minimize interference to most radar systems, but some impacts are anticipated.

BOEM assumes that project proponents would conduct an independent radar analysis and coordinate with the federal agency that manages the radar system (e.g., FAA, DoD, NOAA) to identify potential impacts and any mitigation measures specific to aeronautical, military, and weather radar systems. BOEM would continue to coordinate with the Military Aviation and Installation Assurance Siting Clearinghouse to review each proposed offshore wind project on a project-by-project basis and would attempt to resolve project concerns identified through such consultation related to military and national security radar systems with COP approval conditions. Refer to Section 3.6.6 for discussion of impacts on marine vessel radar.

Scientific Research and Surveys

Presence of structures: Construction of other wind energy projects between 2024 and 2030 in the geographic analysis area would add up to 377 WTGs, OSSs and met towers (Appendix D, Table D3), associated cable systems, and associated vessel activity that would present additional navigational obstructions for sea- and air-based scientific studies. Collectively, these developments would prevent NOAA from continuing scientific research surveys or protected species surveys under current vessel capacities, would affect monitoring protocols in the geographic analysis area, could conflict with state and nearshore surveys, and may reduce opportunities for other NOAA scientific research studies in the area. This Draft EIS incorporates by reference the detailed summary of potential impacts on NOAA's scientific research provided in the Vineyard Wind 1 Final EIS in Section 3.12.2.5, *Scientific Research and Surveys* (BOEM 2021). In summary, offshore wind facilities actuate impacts on scientific surveys and advice by preclusion of NOAA survey vessels and aircraft from sampling in survey strata; impacts on the random-stratified statistical design that is the basis for assessments, advice, and analyses; alteration of benthic and pelagic habitats and airspace in and around the wind energy development, which would require new designs and methods to sample new habitats; and reduced sampling productivity through navigation impacts of wind energy infrastructure on aerial and vessel surveys. NOAA has determined that survey activities within offshore wind facilities are outside of safety and operational limits. Survey vessels would be required to navigate around offshore wind projects to access survey locations, leading to a decrease in survey precision and operational efficiency. The height of turbines would affect aerial survey design and protocols, requiring flight altitudes and transects to change. Scientific survey and protected species survey operations would therefore be reduced or eliminated as offshore wind facilities are constructed. If stock or population changes, biomass estimates, or other environmental parameters differ within the offshore wind lease areas but cannot be observed as part of surveys, resulting survey indices could be biased and unsuitable for monitoring stock status. Offshore wind facilities will disrupt survey sampling statistical designs, such as random-stratified sampling. Impacts on the statistical design of regionwide surveys violate the assumptions of probabilistic sampling methods. Development of new survey technologies, changes in survey methodologies, and required calibrations could help to mitigate losses in accuracy and precision of current practices caused by the impacts of wind development on survey strata.

Other offshore wind projects could also require implementation of mitigation and monitoring measures identified in records of decision. NOAA Fisheries and BOEM have drafted a Federal Survey Mitigation Implementation Strategy for the Northeast U.S. Region (Hare et al. 2022) describing impacts on fishery participants and on the conservation and recovery of protected species. Identification and analysis of specific measures are speculative at this time; however, these measures could further affect NOAA's ongoing scientific research surveys or protected species surveys because of increased vessel activity or in-water structures from these other projects. BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies as a result of offshore wind farms.

Overall, reasonably foreseeable offshore wind energy projects in the area would have major effects on NOAA's scientific research and protected species surveys, potentially leading to impacts on fishery participants and communities; as well as potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.

Conclusions

Impacts of Alternative A – No Action. Ongoing activities in the geographic analysis area would likely result in **minor** impacts for marine mineral extraction due to proximity to open ocean dredged material disposal sites and sand resource areas within the geographic area. The impacts on military and national security uses, aviation and air traffic, cables and pipelines, and radar systems would be **negligible** due to the other existing activities in the geographic analysis area. Currently, offshore structures in the geographic analysis area are limited to meteorological buoys associated with planned offshore wind activities. Military and national security use, aviation and air traffic, vessel traffic, commercial fishing, and scientific research and surveys are expected to continue in the geographic analysis area. Impacts of ongoing activities on scientific research and surveys are anticipated to be **moderate** due to the impacts from ongoing offshore wind activities.

Cumulative Impacts of Alternative A – No Action. In addition to ongoing activities, BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in moderate adverse impacts. Planned activities expected to occur in the geographic analysis area include increasing vessel traffic; continued residential, commercial, and industrial development onshore and along the shoreline; and continued development of FAA-regulated structures such as cell towers and onshore wind turbines. BOEM anticipates that any issues with aviation routes or radar systems would be resolved through coordination with DoD, FAA, and/or NOAA, as well as through implementation of aviation and navigational marking and lighting of structures according to FAA, USCG, and BOEM requirements and guidelines. There are no planned offshore activities anticipated to affect marine mineral extraction or cable and pipeline infrastructure.

BOEM anticipates that offshore wind activities in the geographic analysis area would result in noticeable impacts. The presence of stationary structures associated with ongoing and planned offshore wind energy projects could prevent or impede continued NOAA scientific research surveys using current vessel capacities and monitoring protocols or reduce opportunities for other NOAA scientific research studies in the area. Coordinators of large-vessel survey operations or operations deploying mobile survey gear have determined that activities within offshore wind facilities would not be within current safety and operational limits. In addition, changes in required flight altitudes due to the proposed WTG height would affect aerial survey design and protocols.

BOEM anticipates that the cumulative impact of the No Action Alternative in the geographic analysis area would result in **negligible** to **minor** impacts for marine mineral extraction, aviation and air traffic, and cables and pipelines; **minor** impacts for radar systems due to WTG interference; **minor** impacts for military and national security uses except for USCG SAR operations, which would have **major** impacts; and **major** impacts for scientific research and surveys.

3.6.7.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on other uses:

- The number, size, location, and spacing of WTGs; and
- Timing of offshore construction and installation activities.

Variability of the proposed Project design exists as outlined in Appendix C. Below is a summary of potential variances in impacts:

- WTG size and location: larger turbines closer to shore could increase visual impacts and the removal or relocation of turbines to avoid impacts on marine habitats and reefs.
- WTG spacing: Removal of groups of WTGs to allow for a setback between lease areas could allow for movement of commercial and military vessels.
- Timing of construction: Construction could affect submarine or surface military vessel activity during typical operations and training exercises.

Atlantic Shores has committed to ensuring that the Project offshore infrastructure has been sited and designed to avoid or minimize impacts on sand resource areas, cables/pipelines, and known MECs to the maximum extent practicable (OTH-02; Appendix G, Table G-1). Additionally, initial mitigation for the Project includes desktop assessments of military activities, sand resources, other offshore energy, and cables and pipelines conducted to characterize marine uses and military activities (OTH-01; Appendix G, Table G-1). For construction consideration stormwater outfalls and water intake structures were identified through publicly available sources and during constructability studies, stakeholder consultation, and preconstruction surveys.

3.6.7.5 Impacts of Alternative B – Proposed Action on Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

Marine Mineral Extraction

Presence of structures: While there are two open ocean disposal sites in the vicinity of the Project within the geographic analysis area for marine mineral extraction, they have not been used in recent years (Ocean Disposal Database 2022). The Absecon Inlet, west of Atlantic City, was last used in 1978 and the Cold Springs Inlet, southwest of Cape May, was last used in 2016. As shown on Figure 3.6.7-4 there are two unverified[2] sand resource areas that fall within the route of the Monmouth ECC: Shoal 236 (within federal waters) and Shoal 235 (within state waters), and one potential[3] resource area F2 (within federal waters). There are two potential sand resource areas along the Atlantic ECC: BI-J and Area G (within state waters) (BOEM 2022). Offshore wind project infrastructure, including WTGs and transmission cables, has the potential to prevent future marine mineral extraction activities where the footprint of the structures and cable corridors overlaps with the extraction area.

[2] Resource areas hypothesized to exist on the basis of indirect evidence (seismic profiles, bathymetry, or side scan sonar). Inferred sediment types, unit thickness, and lateral extents have not been confirmed through direct sampling methods.
[3] Resource areas whose existence has been verified through sufficient geotechnical and geophysical data. Thickness and lateral extent has not been fully determined. All areas have some combination of geotechnical and geophysical datasets (vibracore, bathymetry, sidescan, and seismic).

The need for federal sand resources is expected to increase over time due to increased storm activity, coastal erosion, and sea level rise. These offshore sand resources are used to protect coastal infrastructure and economic viability of the localities in need. The Projects' ECCs that were surveyed in 2020 were routed to avoid most federal- and state-designated sand resource and sand borrow sites in the vicinity of the Offshore Project area. However, because small segments of both ECCs crossed designated sand borrow areas, Atlantic Shores actively coordinated with BOEM, NJDEP, and USACE to reroute small portions of the ECCs in 2021, to avoid mapped sand resource areas, including leased sand borrow sites (COP Volume II, Section 2.1.1.2.2; Atlantic Shores 2023).

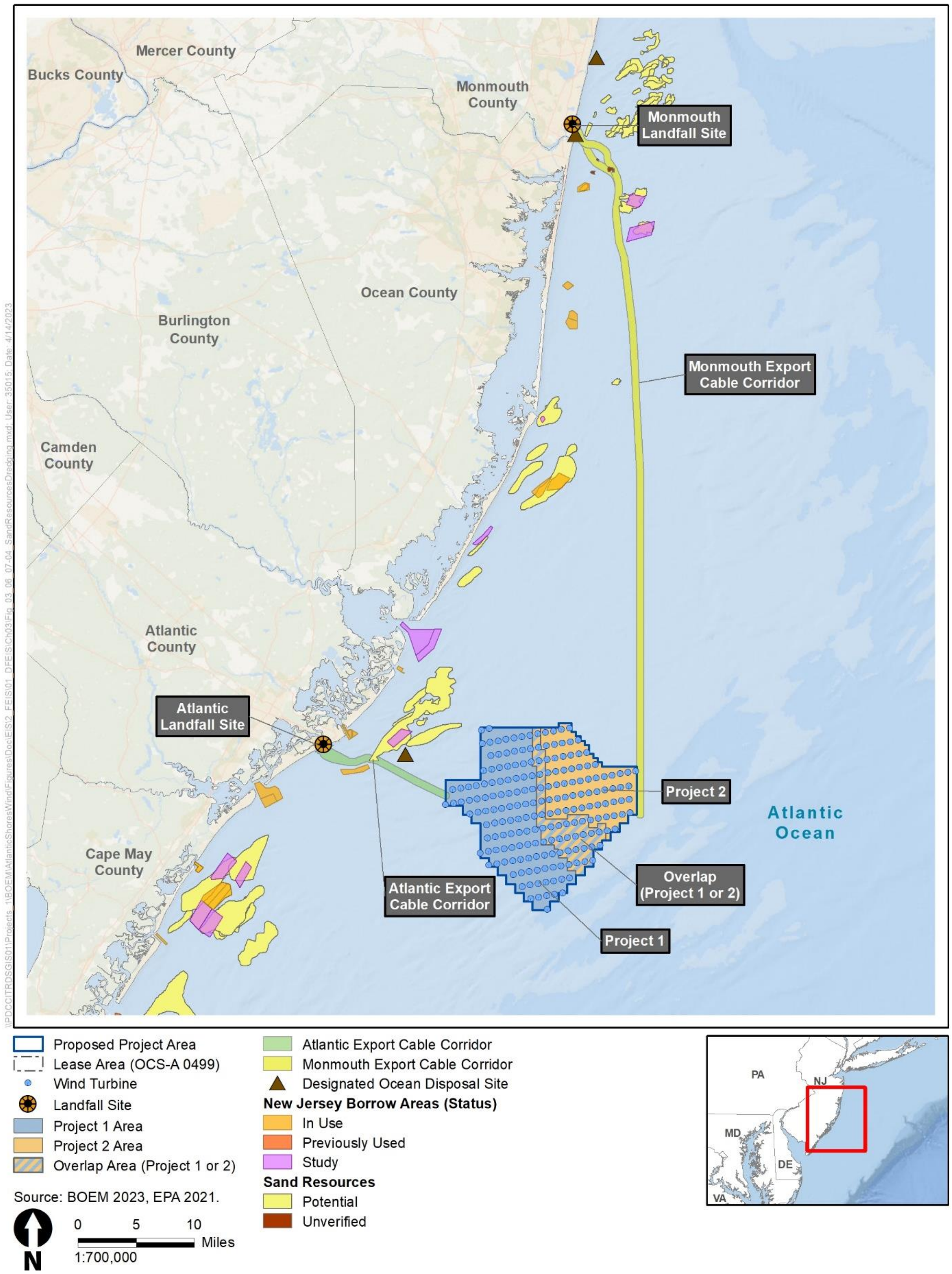


Figure 3.6.7-4. Atlantic Shores South sand resource and sand burrow areas

Military and National Security Uses

Presence of structures: The addition of up to 200 WTGs, one permanent met tower and up to 10 OSSs would increase the risk of allisions for military and national security vessels during Project operations, particularly in bad weather or low visibility. The presence of structures could also change navigational patterns and add to the navigational complexity for military vessels and aircraft operating in the Project area during construction and operation of the Proposed Action. Project structures would be marked as a navigational hazard per FAA, BOEM, and USCG regulations and guidelines, and WTGs, OSSs, and the met tower would be visible on military and national security vessel and aircraft radar, minimizing the potential for allision and increased navigational complexity. Additional navigational complexity would increase the risk of collision and allisions for military and national security vessels or aircraft within the Project area.

If any anthropogenic hazard cannot be avoided during the installations, the agreed reporting protocol must be followed. Once Atlantic Shores has established the full situation, USCG will be informed of the item. They will then consult with the relevant military organizations to determine if the item presents a direct risk to infrastructure or personnel (COP Volume II, Appendix II-A4; Atlantic Shores 2023).

An Obstruction Evaluation/Airspace Analysis (OE/AA) report was completed to characterize the existing airspace surrounding the WTA and support the preliminary assessment of the WTGs potential effects on airspace (COP Volume II, Appendix II-T1; Atlantic Shores 2023). Potential impacts on military and national security operations from the permanent placement of structures within the water column and above the sea surface within the WTA are expected to be long term and localized.

The Military Aviation and Installation Assurance Siting Clearinghouse coordinated a review of the COP within the DoD. The Department of the Navy, in coordination with BOEM, is developing language for a provision as terms of COP approval. The provision would be for distributed fiber optic sensing technology that could be used as part of the wind energy project or associated transmission cables that would mitigate potential impacts on the Department of the Navy's operations in the area (Sample 2021). Atlantic Shores would continue to coordinate with DoD through the Military Aviation and Installation Assurance Siting Clearinghouse, as well as FAA and USCG (AVI-09; Appendix G, Table G-1).

USCG SAR activities could be hindered within the WTA due to navigational complexity and safety concerns of operating among WTGs. Changing navigational patterns could also concentrate vessels within and around the outsides of the Project area, potentially causing space use conflicts in these locations or reducing the efficiency of SAR operations, resulting in moderate, adverse impacts on SAR operations. USCG may need to adjust its SAR planning and search patterns to accommodate the WTG layout, leading to a less-optimized search pattern and a lower probability of success. This could lead to increased loss of life due to maritime incidents.

ATONs, as discussed in Section 3.6.6, are developed, established, operated, and maintained or regulated by USCG to assist mariners in determining their position, identifying safe courses, and warning of dangers and obstructions. In the planning of routes for cables, Atlantic Shores avoided existing ATONs where possible while also considering the locations of other obstructions such as artificial reefs and sand borrow areas. Atlantic Shores will not know whether any ATONs within the surveyed cable corridors will require repositioning until the final cable routing is complete. Cable burial near ATONs must be deconflicted with USCG prior to installation (GEO-22; Appendix G, Table G-1). Any relocation of USCG-maintained ATON would incrementally increase impacts on vessel navigation/USCG activities such as SAR.

Construction of the Proposed Action would add up to 200 WTGs, one permanent met tower, and up to 10 OSSs that could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing, which would attract additional recreational vessels in addition to existing vessel traffic in the area. The presence of additional recreational vessels would add to the space use conflict and collision risks for military and national security vessels.

Traffic: Increased vessel traffic in the Project area during construction, operations, and decommissioning could result in an increased risk of vessel collisions with military and national security vessels, cause military and national security vessels to change routes, and result in congestion and delays in ports. Impacts would be greatest during construction when vessel traffic is greatest and would be reduced during operations. Vessel traffic and navigation impacts are summarized in Section 3.6.6. All structures would be marked and lighted in accordance with FAA, BOEM, and USCG guidelines.

Aviation and Air Traffic

Presence of structures: The Proposed Action would install up to 200 WTGs with maximum blade tip heights of up to 1,049 feet (320 meters) above MLLW in the WTA, and up to 10 OSSs. The addition of these structures would increase navigational complexity and change aircraft navigational patterns around the WTGs.

As the WTGs defined by the maximum PDE for the Atlantic Shores South Project will exceed 200 feet (61 meters), each WTG located within 12nautical miles (22 kilometers) of the coastline would require review by the FAA in accordance with 14 CFR Part 77.9. Of the up to 200 WTGs in the WTA, up to 43 would require filing with the FAA (U.S. Territorial Airspace), including up to 41 within Project 1 and up to 2 within Project 2 (each including the Overlap Area) (COP Volume II, Section 7.8.2; Atlantic Shores 2023).

Atlantic Shores conducted an Air Traffic Flow Analysis (COP Volume II, Appendix II-T3; Atlantic Shores 2023) to ascertain if there is evidence of historic flights within FAA managed airspace to determine the potential to modify FAA operational procedures or adjust airspace or other mitigation requirements through formal filing and review under Federal Regulations, FAA Orders, and Flight Information Publications. The findings in the Air Traffic Flow Analysis indicate that turbines at 1,049 feet (320 meters) MLLW and below would not affect a significant volume of operations; and it is possible that the FAA would not object to increasing the affected altitudes of the various procedures and radar control facility charts to accommodate turbines. These mitigation options are available and are subject to FAA approval (COP Volume II, Section 7.8.2; Atlantic Shores 2023). Site-specific studies for the Proposed Action also included an Obstruction Evaluation and Airspace Analysis (COP Volume II, Appendix II-T1; Atlantic Shores 2023) and Navigational and Radar Screening Study (COP Volume II,

Appendix II-T2; Atlantic Shores 2023). These studies assessed height constraints overlying each turbine in the Project area and the results of a radar and navigational aid screening study, respectively.

WTGs and OSSs would comply with lighting and marking regulations and be marked per FAA, BOEM, and USCG regulations and guidelines to minimize and mitigate impacts on air traffic. Due to their size, WTGs and OSSs would also be visible on aircraft radars. Navigational hazards and collision risks in transit routes would be reduced as construction is completed and would be gradually eliminated during decommissioning as offshore WTGs are removed. Adverse impacts on air traffic are anticipated to be localized, long term, and minor.

Aviation could be affected by the use of vessels and equipment (e.g., cranes) during construction, operations and maintenance, and decommissioning of offshore structures. The effects would result from the potential that tall structures could interfere with air traffic or radar transmission, or both, within the WTA. If vessels or cranes required to support construction, O&M, or decommissioning exceed 14 CFR Part 77.9 Notice Criteria and JO 7400.2N Instrument Approach Areas, Atlantic Shores would file a notice with the FAA for evaluation prior to the start of construction (COP Volume II, Section 7.8.5; Atlantic Shores 2023).

Atlantic Shores has also committed to implementing a comprehensive set of measures to avoid, minimize, or mitigate effects on SAR and improve search efforts overall. The measures include, but are not limited to, installing a direction finder system, high-resolution infrared cameras, and weather monitoring devices; employing a Marine Coordinator to liaise with the USCG; and developing an Emergency Response Plan (ERP) (OTH-06, AVI-04 – AVI-08; Appendix G, Table G-1). Additionally, Atlantic Shores prepared a comprehensive risk assessment of aerial SAR (COP Volume II, Appendix II-T4; Atlantic Shores 2023) in coordination with USCG, BOEM, and other relevant stakeholders, to further evaluate effects of the Project on USCG SAR missions and identify additional risk mitigation strategies. As a result, all construction and installation vessels and equipment will display the required navigation lighting and day shapes and make use of AIS as required by USCG.

The Projects are not expected to preclude helicopter use in the WTA. The USCG (2020) Massachusetts and Rhode Island Port Access Route Study (MARIPARS) undertook a detailed assessment of the effect of WTG spacing on aerial SAR and identified that a 1-nautical mile (1.9-kilometer) corridor spacing was sufficient for safe use.

Cables and Pipelines

Presence of structures: The ECCs would cross existing marine infrastructure, including submarine cables and pipelines. The Monmouth ECC could encounter up to 15 crossings, while the Atlantic ECC could have up to four crossings. These maximum numbers of crossings assume that other offshore wind energy cables may be installed prior to the start of Project construction. It is also estimated that up to 10 interarray cable crossings and up to 2 interlink cable crossings may be required (COP Volume I, Section 4.5.8; Atlantic Shores 2023). Atlantic Shores is currently coordinating with cable owners regarding crossing methods or setbacks (OTH-03; Appendix G, Table G-1). The presence of planned offshore wind energy structures could preclude future submarine cable placement within any given development footprint, requiring future cables to route around these areas. However, the placement and presence of the Proposed Action's offshore export cables would not prohibit the placement of additional cables and pipelines because these could be crossed following standard industry protection techniques. Impacts on submarine cables and pipelines would be eliminated during decommissioning of the Project as the export and interarray cables are removed.

Before the installation of Offshore Project cables, the area around each cable crossing would be cleared of any marine debris and all existing structures identified. Depending on the status of the existing cable and its location, such as burial depth and substrate characteristics, cable protection may be placed between the existing cable and the Project overlying cable. However, if sufficient vertical distance exists, such protection may be avoided. Once the final CBRA is complete, the target burial depth would be determined. The presence of an existing cable likely would prevent the Project cable from being buried to its target burial depth of 5 to 6.6 feet (1.5 to 2 meters). In this case, cable protection may be required at the crossing location to cover the new cable (OTH-03; Appendix G, Table G-1). Following installation of the new cables, a visual survey of cable crossing would be conducted to ensure proper placement has occurred (COP Volume II, Section 2.1.1.2.4; Atlantic Shores 2023). Atlantic Shores will work with NOAA to ensure the location of the cables are included on navigational charts for mariner awareness and are monitored. This will ensure that any cables left in place after the decommissioning of the Project can be accurately located.

One pipeline within the Great and Turtle Gut Thoroughfares is present onshore along the Cardiff Onshore Interconnection Cable Route. Atlantic Shores would cross the waterbodies in this area via trenchless technologies such as HDD, jack-and-bore, and/or jack piping to avoid this identified pipeline. The NOAA nautical charts show no evidence that either ECC route would require a submarine pipeline crossing (COP Volume II, Section 7.7.5; Atlantic Shores 2023).

Project structures, including WTGs, OSSs, the permanent met tower, and the stationary lift vessels used during Project construction and installation, may pose allision risks and navigational hazards to vessels conducting maintenance activities on existing submarine telecommunication cables. However, FAA, USCG, and BOEM regulations and guidelines for navigational hazard marking as well as the relative infrequency of maintenance activities would minimize the risk of allision. Risk of vessel collision between cable maintenance vessels and vessels associated with the Project would be limited to the construction and installation phase and during planned maintenance activities in the operational phase.

Atlantic Shores is currently coordinating with cable owners regarding crossing methods or setbacks. Impacts during Project operations would be infrequent and limited to times when work at the cable crossings would be required. Impacts would decrease to zero after decommissioning if cables are removed. Cables can be protected through the use of either rock placement, concrete mattresses, rock bags, grout-filled bags, or half-shell pipes.

The ECCs have a low possibility of coming in contact with MECs during installation. Within the Offshore Project area, the likelihood of encountering buried items that constitute a notable safety risk within the low hazard zones of Zone 2 and Zone 3, is deemed to be below the ALARP threshold. Given the results of the MEC hazard assessments define the Offshore Project area as a low hazard zone for MEC, Atlantic Shores does not plan to conduct a site survey specifically for MEC (COP Volume II, Section 2.1.1.2.4; Atlantic Shores 2023). Atlantic Shores will avoid the use of high-resolution magnetometry surveys, as the survey would be disproportionate to the risk within the Offshore Project area (OTH-07; Appendix G, Table G-1).

Prior to the installation of the onshore export cables, temporary cofferdams are expected to be installed. The locations of the crossings would be verified during route constructability studies conducted by Atlantic Shores prior to the implementation of the proposed Project activities. It is not anticipated that the infrastructure of the cables would interfere with land uses or coastal infrastructure. Any necessary repairs on the interconnection cables would be accessed through manholes, and repairs would be completed within the installed transmission infrastructure.

The WTA and ECCs would be open to marine navigation, and no permanent restrictions to commercial or recreational fishing, and anchoring are proposed during the O&M phase of the Projects. Limited restrictions may occur during some maintenance activities, where temporary safety zones may be established around maintenance vessels and activities (COP Volume II, Section 7.3.3.2; Atlantic Shores 2023). In relation to dredging around the cables, they would not be buried to a sufficient depth to allow for this activity above the cables. The exception is for existing marked channels that are actively dredged where cables are buried sufficiently deep to avoid any interference to planned dredge depths. Atlantic Shores would coordinate with NOAA to ensure the cables are included on navigational charts for mariner awareness.

Radar Systems

Presence of structures: Air traffic control, national defense, weather, and oceanographic radar within the line of sight of the offshore infrastructure associated with the Proposed Action may be affected by the O&M phase of the Project. The WTA overlaps with radar facilities that support air traffic control, military surveillance, and weather monitoring. WTGs may affect radar by causing unwanted radar returns (i.e., clutter) resulting in a partial loss of target detection or false targets within and in proximity to the WTA. Other radar effects could include a loss of ocean surface current data and wave measurements, and a partial loss of weather detection and false weather indications. Atlantic Shores is committed to continue working to further evaluate potential effects on these radar facilities in coordination with the FAA, DoD, DHS, NOAA, and NWS and identify potential mitigating measures, if required (COP Volume II, Section 7.8.6; Atlantic Shores 2023).

To support the understanding of radar facilities operating in the Offshore Project area, Atlantic Shores conducted an initial analysis for Long Range Radar (LRR) and Next Generation Weather Radar (NEXRAD) using the DoD Preliminary Screening Tool (PST) on the FAA Obstruction Evaluation/Airport Airspace Analysis website. This analysis provides a cursory indication of whether wind turbines may be within line of sight of one or more radar sites, and likely to affect radar performance. The PST LRR analysis accounts for air route and airport surveillance radar associated with the FAA, DoD, and DHS. The PST NEXRAD analysis accounts for DoD, FAA, and NOAA Weather Surveillance Radar. The preliminary results indicate that Project 1 would overlap with LRR but neither Project 1 nor Project 2 would influence NEXRAD Radar (COP Volume II, Section 7.8.3; Atlantic Shores 2023). Atlantic Shores is committed to continue working to further evaluate potential effects on these radar facilities in coordination with the FAA, DoD, DHS, and NOAA.

Studies have been conducted to evaluate concerns that the WTGs may affect some shipborne radar systems, potentially creating false targets on the radar display or causing vessels navigating within the WTA to become “hidden” on radar systems due to shadowing created by the WTGs. The effectiveness of radar systems and any effects from WTGs would vary from vessel to vessel based on several factors, including radar equipment type, settings, and installation (including location of placement on the vessel). The potential effects of WTGs may be reduced through adjustment of the radar gain control (COP Volume II, Section 7.6.2.3; Atlantic Shores 2023). The Proposed Action would be within the line of sight of and would affect the following radar systems: Newark ASR-9, New York ASR-9, Philadelphia ASR-9, and NAS Willow Grove ASR-11. Once the WTG dimensions have been established, coordination would occur with NWS to conduct a required analysis by the Radar Operations Center on potential data contamination for the NEXRAD WSR-88D and the FAA TDWR (AVI-11; Appendix G, Table G-1). Atlantic Shores expects that radar operator training and dissemination of information regarding proper installation and adjustment of equipment would avoid or minimize effects on radar systems. Additionally, Atlantic Shores plans to use an AIS to mark the presence of WTGs, which would further limit potential effects (COP Volume II, Section 7.6.2.3; Atlantic Shores 2023).

Scientific Research and Surveys

Presence of structures: Scientific research and surveys could be affected during the construction and operations of the Proposed Action. Off the coast of New Jersey, agency-sponsored research and survey efforts are conducted by the NEFSC, NJDEP, and the NEAMAP led by the Virginia Institute of Marine Sciences. The following in-water studies have historically traversed the Offshore Project area: NEFSC multi-species bottom trawls, NJDEP trawls, NEFSC clam surveys, and NEAMAP trawl surveys. Gear used for these surveys include four-seam bottom and otter trawls, with the exception of NEFSC clam surveys, which used a hydraulic dredge (COP Volume II, Section 7.7.6; Atlantic Shores 2023).

The *NOAA Fisheries and BOEM Federal Survey Mitigation Strategy – Northeast U.S. Region* was developed to provide guidelines for the growing implementation of offshore wind energy. While both agencies support this expansion of renewable energy, they also focus on protecting biodiversity and promoting ocean co-use. The NOAA Fisheries surveys are essential for sustainably managing the nation’s fisheries, promoting the protection and recovery of marine mammals and endangered and threatened species, and conserving coastal and marine habitats and ecosystems for future generations. The *Federal Survey Strategy* was created with the intent to guide in the development and implementation of a program to mitigate impacts of wind energy development on fisheries surveys over the expected full duration (30+ years) of wind energy development in the Northeast United States (Hare et al. 2022).

The Proposed Action would install up to 200 WTGs with a maximum blade tip height of 1,049 feet (320 meters) above MLLW. In addition to in-water surveys, aerial surveys to measure the abundance of marine mammals and sea turtles are conducted from Maine to the Florida Keys as part of the AMAPPS by NOAA. NOAA NEFSC conducts these surveys within the Offshore Project area utilizing aircraft that fly 600 feet (183 meters) above the water surface at 110 knots (200 kilometers per hour) (Atlantic Shores 2023).

Impacts of the Connected Action

As described in Chapter 2, *Alternatives*, under the connected action, bulkhead repair and/or replacement and maintenance dredging activities would be conducted within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina. Because the proposed activities are onshore and nearshore, no impacts are expected on marine mineral extraction and scientific research and surveys. No impacts from the connected action are anticipated on aviation and air traffic or radar systems because proposed bulkhead repair and/or replacement is occurring within an already developed area and would not result in structures tall enough to conflict with existing uses. Additionally, no impacts from the connected action on existing submarine cables and pipelines are expected because maintenance dredging has historically occurred in this area during the 1950s and 1980s (USACE 2022). Impacts from the connected action are not anticipated on military or national security uses, as this area is not typically used for these activities.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Planned offshore wind activities in the geographic analysis area for other uses include the construction, O&M, and decommissioning of Ocean Wind 1 in Lease Area OCS-A 0498, Ocean Wind 2 in Lease Area OCS-A 0532 and Atlantic Shores North in Lease Area OCS-A 0549.

Marine Mineral Extraction

Presence of structures: The Proposed Action would place structures within the vicinity of sand resource areas and ocean disposal sites, thus resulting in a minor contribution to cumulative impacts on marine mineral extractions. As the need for federal sand resources is expected to increase over time, BOEM anticipates that other offshore wind projects would be designed to avoid existing and proposed mineral extraction areas through consultation with BOEM, USACE, and relevant state and local agencies; therefore, there would be negligible impacts on future mineral extraction activity.

Military and National Security Uses

Presence of structures and traffic: Ongoing and planned activities, including the Proposed Action, would create navigational complexity within the geographic analysis area through the construction and operation of offshore structures. While potential impacts on most military and national security uses are anticipated to be minor, installation of WTGs throughout the geographic analysis area would hinder USCG SAR operations across a larger area, resulting in a major impact on SAR operations, potentially leading to increased loss of life. Additionally, the Proposed Action would contribute a noticeable increment to the cumulative vessel traffic impacts, which are most likely to occur during the construction and decommissioning timeframes. This would result in localized, temporary, and minor impacts on military and national security uses.

Aviation and Air Traffic

Presence of structures: Open airspace around the offshore wind lease areas in the geographic analysis area would still exist after all reasonably foreseeable future offshore wind energy projects are built. BOEM assumes that offshore wind project operators would coordinate with aviation interests throughout the planning, construction, operations, and conceptual decommissioning processes to avoid or minimize impacts on aviation activities and air traffic. The Proposed Action would contribute a noticeable increment to the minor cumulative impacts.

Cables and Pipelines

Presence of structures: The Proposed Action would contribute an undetectable increment to the cumulative impacts from cables and pipelines, which would be localized and long term. However, these impacts would be negligible because they can be avoided by standard protection techniques.

Radar Systems

Presence of structures: Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars. Cumulative impacts of the Proposed Action would be moderate, primarily due to the presence of WTGs and permanent met tower within the line of sight causing interference with radar systems.

Scientific Research and Surveys

Presence of structures: The Proposed Action would contribute a noticeable increment to the cumulative impacts on scientific research and surveys from ongoing and planned activities including planned offshore wind, which would be long term and major, particularly for NEFSC, NEAMAP, and NJDEP surveys that historically take place in the proposed WTA. The entities conducting scientific research and surveys would have to make significant investments to change methodologies to account for areas occupied by offshore energy components, such as WTGs and cable routes, that are no longer able to be sampled.

Conclusions

Impacts of Alternative B – Proposed Action. Under the Proposed Action, up to 200 WTGs with maximum blade tip heights of 1,049 feet (320 meters) above MLLW would be installed, operated, and eventually decommissioned within the Project area. The presence of these structures would introduce navigational complexity and increased vessel traffic in the area that would continue to have short-term to long-term impacts that range from **negligible** to **major** on marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys.

- *Marine Mineral Extraction*: The WTA and offshore export cable routes for the Proposed Action would avoid most of the regional sand borrow, sand resource, and ocean disposal areas. However, there are two unverified sand resource areas that fall within the route of the Monmouth ECC: Shoal 236 (within federal waters) and Shoal 235 (within state waters) and one potential resource area F2 (within federal waters). There are two potential sand resource areas along the Atlantic ECC: BI-J and Area G (within state waters). The crossings would result in **minor** but long-term potential impacts on marine mineral extraction.

- *Military and National Security Uses*: The installation of WTGs in the Project area would result in increased navigational complexity and increased allision risk, creating potential **major** adverse impacts on USCG SAR operations and potential **minor** impacts on all other military and national security uses.

- *Aviation and Air Traffic*: Potential **minor** impacts on low-level flights would occur, primarily due to the installation, operation, and decommissioning of WTGs in the Project area and changes in navigation patterns. Potential impacts on commercial and military flight operations are not anticipated, as WTGs would be constructed under the listed FAA flight level ceiling.

- *Cables and Pipelines*: Potential impacts on cables and pipelines would be **negligible** due to the use of standard protection techniques to avoid impacts.

- *Radar Systems*: Potential **moderate** adverse impacts on radar systems would primarily be caused by the presence of WTGs within the line of sight causing interference with radar systems. Options are available to minimize or mitigate impacts and Atlantic Shores would continue to coordinate with the FAA, DoD, DHS, and NOAA on impacts.

- *Scientific Research and Surveys:* Potential impacts on scientific research and surveys would be **major**, particularly for NEFSC, NJDEP, and NEAMAP. The presence of structures would exclude certain areas within the Project area occupied by Project components (e.g., WTG foundations, cable routes) from potential vessel and aerial sampling, and by affecting survey gear performance, efficiency, and availability.

BOEM expects that the connected action alone would not impact marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys.

Cumulative Impacts of Alternative B – Proposed Action. The incremental impacts contributed by the Proposed Action to the cumulative impacts on other uses would range from undetectable to noticeable. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action would range from **negligible** to **minor** for aviation and air traffic, cables and pipelines, and most military and national security uses; **minor** for marine mineral extraction; **moderate** for radar systems; and **major** for USCG SAR operations and NEFSC, NJDEP, and NEAMAP scientific research and surveys. The presence of structures associated with the Proposed Action and increased risk of allisions are the primary drivers for impacts on other marine uses. Impacts on NEFSC, NJDEP, and NEAMAP scientific research and surveys would qualify as **major** because entities conducting surveys and scientific research would have to make significant investments to change methodologies to account for unsampleable areas, with potential long-term and irreversible impacts on fisheries and protected species research as a whole, as well as on the commercial fisheries community.

3.6.7.6 Impacts of Alternatives C, D, and F on Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

Impacts of Alternatives C, D, and F. The impacts resulting from individual IPFs associated with the construction and installation, O&M, and conceptual decommissioning of the Project under Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), and F (Foundation Structures) would be similar to those described under the Proposed Action.

Construction of Alternatives C and D could install up to 29 and 31 fewer WTGs, respectively. Impacts under Alternatives C and D would be similar to those of the Proposed Action for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and scientific research and surveys. These alternatives could potentially reduce impacts on scientific research and surveys by removing WTGs from areas populated by marine life; however, the structures that would remain throughout the remainder of the WTA could continue to show potential effects. In addition, Alternative D could potentially decrease impacts on radar systems by removing the WTGs closest to shore, which would possibly reduce line-of-sight impacts; however, localized, long-term impacts on radar systems are still anticipated.

Alternative F would involve the use of different foundations but would not affect the number of WTGs or the height of the WTGs. Construction of Alternative F would involve the use of different WTG, OSS, and met tower foundations, which could impact the construction impact footprint and installation period. All other design parameters and potential variability in the design would be the same as under the Proposed Action.

Impacts under Alternative F would be similar to those of the Proposed Action for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and scientific research and surveys. The type of foundations chosen would not affect the number of WTGs that are included in the overall Project, but each foundation would have a different installation duration.

Cumulative Impacts of Alternatives C, D, and F. The incremental impacts contributed by Alternatives C, D, and F to the cumulative impacts from ongoing and planned activities including offshore wind would be similar to the Proposed Action.

Conclusions

Impacts of Alternatives C, D, and F. Implementation of Alternatives C, D, and F would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The overall level of impact would remain similar to that of the Proposed Action, and the impacts of each alternative alone resulting from individual IPFs associated with these alternatives would be

negligible to **minor** for aviation and air traffic, cables and pipelines, and most military and national security uses; **minor** for radar systems and marine mineral extraction; and **major** for USCG SAR operations and NEFSC, NJDEP, and NEAMAP scientific research and surveys.

Cumulative Impacts of Alternatives C, D, and F. The incremental impacts contributed by Alternatives C, D, and F to the cumulative impacts on other uses would range from undetectable to noticeable. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with Alternatives C, D, and F would range from **negligible** to **minor** for aviation and air traffic, cables and pipelines, marine mineral extraction, and most military and national security uses; **moderate** for radar systems; and **major** for USCG SAR operations and scientific research and surveys. These impact ratings are primarily driven by the presence of offshore structures such as WTGs in the offshore wind lease areas.

3.6.7.7 Impacts of Alternative E on Other Uses (Marine Minerals, Military Use, Aviation, and Scientific Research and Surveys)

Impacts of Alternative E. Construction and installation of Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would create a setback from the boundary between the Atlantic Shores South Lease Area and the Ocean Wind 1 Lease Area. All other design parameters and potential variability in the design would be same as under the Proposed Action.

Impacts of Alternative E would be similar to those of the Proposed Action for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and scientific research and surveys. Alternative E could potentially reduce impacts on military and security use by increasing the navigational space between Atlantic Shores South and Ocean Wind 1. The increase in WTG spacing between Atlantic Shores South and Ocean Wind 1—0.81 nautical miles (1,500 meters) to 1.08 nautical miles (2,000 meters—is not expected to increase impacts on military and national security uses, as deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations, and the separation would allow for safe navigation between lease areas. Alternative E could also lead to a reduction in WTGs, which would slightly reduce the construction impact footprint and installation period.

Cumulative Impacts of Alternative E. The impacts contributed by Alternative E to the cumulative impacts from ongoing and planned activities including offshore wind would be similar to the Proposed Action

Conclusions

Impacts of Alternative E. Implementation of Alternative E would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The overall level of impact would remain similar to that of the Proposed Action. The impacts of Alternative E alone resulting from individual IPFs would be **negligible** for cables and pipelines; **minor** for aviation and air traffic, and marine mineral extraction; **minor** for most military and national security uses, **moderate** for USCG SAR operations and radar systems; and **major** for scientific research and surveys.

Cumulative Impacts of Alternative E. The incremental impacts contributed by Alternative E to the cumulative impacts on other uses would range from undetectable to noticeable except for reduced impacts on navigation. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with Alternative E would range from **negligible** to **minor** for aviation and air traffic, cables and pipelines, marine mineral extraction, and most military and national security uses; **moderate** for radar systems; **moderate** for USCG SAR operations and; **major** for scientific research and surveys. These impact ratings are primarily driven by the presence of offshore structures such as WTGs and the possible reduction in the overall number of WTGs in the offshore wind lease areas.

3.6.7.8 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-2 and addressed in Table 3.6.7-2 in more detail. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.6.7-2. Proposed mitigation measures – other uses (marine minerals, military use, aviation, and scientific research and surveys)

Mitigation Measure	Description	Effect
Radar interference	The Lessee must coordinate with the radar operators impacted and the Surface Currents Program of the NOAA IOOS Office to assess if the Project will cause radar interference to the degree that radar performance is no longer within the specific radar systems' operational parameters or fails to meet mission objectives.	While this mitigation measure would reduce impacts on radar systems, it would not reduce the impact rating for the Proposed Action IPF (presence of structures).

3.6.7.9 Comparison of Alternatives

The impacts of Alternatives C, D, and F would be similar to those of the Proposed Action, ranging from negligible to major impacts on other uses (marine minerals, military use, aviation, and scientific research and surveys). Alternatives C, and D, and E would lead to a possible reduction in the number of WTGs, but the quantitative impact change cannot be determined without more definitive information. The overall impacts under Alternative E would be similar to those of the Proposed Action, with the exception of impacts on USCG SAR operations. The setback would be an improvement to vessel navigation and SAR considerations and would lead to reduced impacts when compared to the Proposed Action: from major to moderate. The different foundations of Alternative F require different installation times and would thereby extend the duration of impacts on military use, radar, and aviation.

3.6.8 Recreation and Tourism

This section discusses potential impacts on recreation and tourism resources and activities from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown in Figure 3.6.8-1, includes the 45.1-mile (72.6-kilometer) visual analysis area measured from the borders of the WTA. The geographic analysis area includes Atlantic, Cape May, Monmouth, and Ocean Counties in New Jersey. The geographic analysis area was selected to coincide with the Atlantic Shores South visual analysis area corresponding to the theoretical limits of Project visibility. Section 3.6.3, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the proposed Project area.

3.6.8.1 Description of the Affected Environment and Future Baseline Conditions

Regional Setting

Proposed Project facilities would be within and off the coast of New Jersey. The coastal areas support ocean-based recreation and tourist activities including boating, swimming, surfing, scuba diving, sailing, and paddle sports. As indicated in Section 3.6.3, *Demographics, Employment, and Economics*, recreation and tourism contribute substantially to the economies of New Jersey's coastal counties. Tourism in New Jersey's coastal communities is a multibillion-dollar industry. More than 1.8 million people visited Island Beach, Barnegat Lighthouse, and Cape May Point state parks in 2016, while over 688,000 used the state's marinas (NJDEP 2018a). In 2019, 116 million people visited New Jersey and spent $46.4 billion, making tourism the sixth largest employer in New Jersey (Tourism Economics 2019). Annual tourism in New Jersey's coastal communities is a $16 billion industry (NJDEP 2021a).

Coastal New Jersey has a wide range of visual characteristics, with communities and landscapes ranging from large cities to small towns, suburbs, rural areas, and wildlife preserves. As a result of the proximity of the Atlantic Ocean, as well as the views associated with the shoreline, the New Jersey shore has been extensively developed for water-based recreation and tourism.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. Additionally, the visual qualities of these historic coastal towns, which include marine activities within small-scale harbors, and the ability to view birds and marine life are important community characteristics.

Figure 3.6.8-1. Recreation and tourism geographic analysis area

Project Area

Recreational and tourist-oriented activities are concentrated in the coastal communities in Atlantic, Cape May, Monmouth, and Ocean Counties, which are some of the most densely populated coastal communities in the U.S. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of residents and visitors each year. Although many of the coastal and ocean amenities, such as beaches, that attract visitors to these regions are accessible to the public for free and thus do not directly generate employment, these nonmarket features function as key drivers for recreation and tourism businesses.

Water-oriented recreational activities in the Project area include boating, visiting beaches, hiking, fishing, shellfishing, and bird and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessel use to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding. Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks.

Inland recreational facilities are also popular but bear less of a relationship to possible impacts of the Project. These include inland waters such as ponds and rivers, wildlife sanctuaries, golf courses, athletic facilities, parks, and picnic grounds. Onshore construction may result in short-term and localized traffic, noise, and light around these areas, changing the recreational experience of isolated locations.

Coastal and Offshore Recreation

Recreational boating and fishing activities occur along the coastline, although most fishing activity takes place in lakes, rivers, and bays, rather than in offshore waters. Swimming is also popular along the miles of white sand beaches in New Jersey (COP Volume II, Section 7.3.1; Atlantic Shores 2023). Surfing can occur year-round, with the prime season in the fall. Surfers frequent several towns and cities along the coastline, including Ocean City and Atlantic City (New Jersey Department of State 2021a). Dive sites and fishing grounds, such as artificial reefs and sunken vessels, attract recreational users to the coastline of New Jersey as well.

There is a large and robust recreational fishing industry in New Jersey. The *Fisheries Economics of the United States Report of 2019* estimates that recreational fishing had a $388 million impact on New Jersey's economy in 2019 (NOAA 2022a). Collectively, there were close to 2.0 million recreational angler trips per year (i.e., party boats, rental/private boats, and shore) made in New Jersey from 2015 to 2020 (COP Volume II, Section 7.3.1.1; Atlantic Shores 2023). There are several areas classified as Prime Fishing Areas by NJDEP, which are areas that have a history of supporting a significant local quantity of recreational and commercial fishing activity, that are within the geographic analysis area (Figure 3.6.8-2).

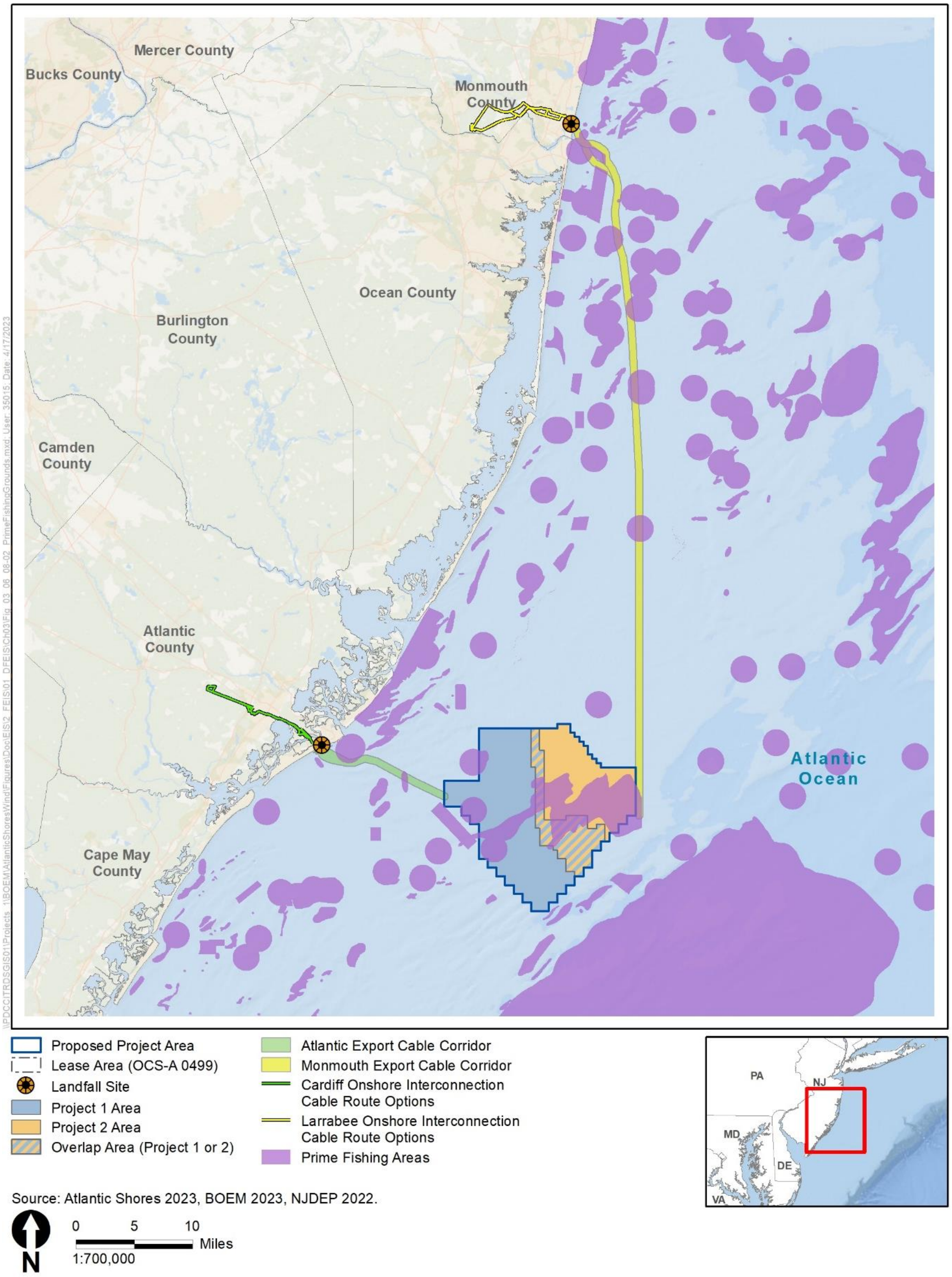


Figure 3.6.8-2. New Jersey prime fishing areas

Recreational fishing takes place all year; however, the number of angler trips is greatest in July and August. There are also annual recreational fishing tournaments held in coastal towns in New Jersey. Common species caught most often include striped bass, summer flounder, bluefish, and black sea bass. Most recreational fishing takes place within 3 miles (4.8 kilometers) of shore, although fishing for Atlantic Highly Migratory Species (HMS) such as federally regulated sharks, blue and white marlin (*Makaira nigricans* and *Tetrapterus albidus*), sailfish (*Istiophorus albicans*), roundscale spearfish (*Tetrapturus georgii*), and swordfish (*Xiphias gladius*) takes place farther offshore. According to NOAA Fisheries One Stop Shop database, recreational anglers off the coast of New Jersey caught 36,002,306 pounds (16,330,358 kilograms) of fish in 2017; 27,819,980 pounds (12,618,920 kilograms) in 2018; 21,344,901 pounds (9,681,876 kilograms) in 2019; 29,425,956 pounds (13,347,378 kilograms) in 2020; and 30,520,854 pounds (13,844,015 kilograms) in 2021 (NOAA n.d.).

NOAA's social indicator mapping (NOAA 2022c) identifies the importance or level of dependence of recreational fishing to coastal communities. Several communities in the geographic analysis area have a high recreational fishing reliance, which measures the presence of recreational fishing in relation to the population size of a community, and high recreational fishing engagement, which measures the presence of recreational fishing through fishing activity estimates. The communities within the geographic analysis area with the highest reliance on recreational fishing are Cape May, Avalon, Point Pleasant Beach, Atlantic Highlands, and Barnegat Light; Atlantic City has a low reliance on recreational fishing. Communities within the geographic analysis area with the highest recreational fishing engagement are Cape May, Avalon, Sea Isle City, Brigantine, Barnegat Light, Berkeley, Belmar, Atlantic Highlands, Point Pleasant Beach, and Ocean City; the rest of the New Jersey coast within the geographic analysis area has low or medium recreational fishing engagement. The communities with the highest recreational fishing reliance and recreational fishing engagement would be most affected by impacts on recreational fishing from offshore wind development.

Recreational crabbing is important to the region and occurs primarily along the bays and creeks on the Jersey Shore, especially in the upper portion of Barnegat Bay, Little Egg Harbor, and the Maurice River estuary, which contribute 65 to 86 percent of the total recreational harvest (NJDEP 2018b). The peak crabbing season occurs from mid-June until early October and is especially good in August.

Atlantic County

Atlantic County lies in the southern peninsula of New Jersey and encompasses approximately 556 square miles (1,440 square kilometers) of land (U.S. Census Bureau 2021c). The county is known for its boardwalk along the beach of Atlantic City, with its nine casinos with restaurants, nightclubs, and game rooms (Atlantic City 2022). The county has nine beaches, which collectively total 14 miles (23 kilometers), and 5.75 miles (9.25 kilometers) of boardwalk (Atlantic County n.d.a, n.d.b). There are several boat launches and marinas in the county, which have small recreational boat rentals. Recreational fishing is permitted on the beaches, outside of guarded areas, and from the jetties. There are also multiple fishing piers available to the public.

Cape May County

Cape May is New Jersey's southernmost county and encompasses 267 square miles (692 square kilometers) of land, receiving millions of visitors annually (Cape May County n.d.a). It is considered one of the premier beach destinations along the mid-Atlantic coast. The Ocean City Boardwalk is more than 2 miles (3 kilometers) long and is lined with shops and amusement park rides. The Wildwood Boardwalk runs from Wildwood into North Wildwood and is home to many amusement attractions (Cape May County n.d.b). Popular activities at the boardwalks include shopping, dining, amusement rides, and walking. The more remote beaches are utilized for sunbathing, swimming, and beachcombing. Surfing, sailing, boating, deep sea fishing, diving, kayaking, and whale watching are also popular offshore activities. Recreational fishing occurs along the back bays and from the surf, piers, and boats along the Jersey Cape (Cape May County n.d.c).

Monmouth County

Monmouth County encompasses 472 square miles (1,223 square kilometers) of land, including 27 miles (44 kilometers) of Atlantic coastline and 26 miles (42 kilometers) of Raritan Bay coastline (County of Monmouth 2021). The county has 17 public beaches that are heavily frequented by tourists during the summer months for swimming, boating, fishing, and scuba diving (Visit Monmouth 2022; County of Monmouth 2020). The county has three public beachfront areas: Seven Presidents Oceanfront Park in Long Branch, Bayshore Waterfront Park in Port Monmouth, and Fisherman's Cove Conservation Area in Manasquan (Monmouth County Park System n.d.a). It is home to 34 marinas, including the Monmouth Cove Marina, and 12 boardwalks, such as the Asbury Park Boardwalk, lined with music venues, food establishments, and shops (County Office.org, Monmouth Marinas 2021). The 1,655-acre (670-hectare) Sandy Hook Peninsula, which is a unit of the Gateway National Recreation Area, is a very popular tourist destination and is frequented by two million tourists every year (National Park Service 2022). It is home to two landmarks, Fort Hancock and the Sandy Hook Lighthouse, and is popular among bird watchers, as it is used by over 300 species of birds (New Jersey Department of State 2022).

Ocean County

Ocean County is in the center of the Jersey Shore region, with approximately 629 square miles (1,792 square kilometers) of land (U.S. Census Bureau 2021d). The county provides an array of recreational beaches, boardwalks, marinas, and wildlife areas. Popular activities include swimming, fishing, and wildlife viewing. The boardwalks are lined with shops, restaurants, and amusement park rides. Popular coastal attractions include lighthouses, the Tuckerton Seaport, Jenkinson's Boardwalk, and annual seafood and music festivals (County of Ocean 2022).

Onshore Recreation

Atlantic County

Most of the Tuckahoe-Corbin City Fish and Wildlife Management Area is within the county and consists of approximately 17,500 acres (7,082 hectares) of tidal marsh, woodlands, fields, and impoundments (NJDEP 2018c). Ten wildlife management areas totaling 55,360 acres (22,403 hectares) also fall within

Atlantic County: Absecon (3,946 acres [1,597 hectares]), Cedar Lake (360 acres [146 hectares]), Great Egg Harbor River (7,552 acres [3,056 hectares]), Hammonton Creek (5,720 acres [2,315 hectares]), Makepeace Lake (11,737 acres [4,750 hectares]), Malibu Beach (257 acres [104 hectares]), Maple Lake (4,789 acres [1,938 hectares]), Pork Island (868 acres [351 hectares]), Port Republic (1,471 acres [595 hectares]), and Tuckahoe (18,660 acres [7,551 hectares]) (NJDEP 2021b).

There were 827 accommodation and food service establishments in the county in 2019. Together, these generated over $1.2 billion in annual payroll. There were 113 arts, entertainment, and recreation establishments in Atlantic County, which bring in approximately $41 million in annual payroll. Approximately 13.4 percent of all housing units in Atlantic County are for seasonal, occupational, or occasional use (U.S. Census Bureau 2021a, 2021b).

Cape May County

There are many parks, state forests, and wildlife management areas in Cape May County. The Cape May National Wildlife Refuge encompasses 11,500 acres (4,654 hectares) of grasslands, saltmarshes, and beachfront (Friends of Cape May National Wildlife Refuge 2022). The Cape May Coastal Wetlands Wildlife Management Area extends along the coast of Cape May County and occupies approximately 17,842 acres (7,220 hectares) (NJDEP 2021b).

There were 917 accommodation and food service establishments in the county in 2019. Together, these generated over $240 million in annual payroll. There were 143 arts, entertainment, and recreation establishments in Cape May County, which brought in approximately $50 million in annual payroll. Approximately 50.9 percent of all housing units in Cape May County are for seasonal, occupational, or occasional use (U.S. Census Bureau 2021a, 2021b).

Monmouth County

There are 30 parks in Monmouth County, many of which have campgrounds, and bays, ponds, creeks, reservoirs, and lakes for fishing. There are 144 miles (232 kilometers) of trails for walkers, runners, cyclists, and equestrians (Monmouth County Park System n.d.b). There are eight wildlife management areas in the county, the largest of which is Assunpink (6,393 acres [2,587 hectares]) (NJDEP 2021b). The county is also home to 21 museums and many local breweries, distilleries, wineries, and golf courses. Popular tourist attractions include the annual Belmar Seafood Festival, jazz festivals, county fairs, and beach movie viewings (County Office, Monmouth Museums 2021; Visit Monmouth 2021).

Ocean County

Ocean County has 27 parks and conservation areas, with over 4,000 acres (1,619 hectares) of preserved land. Popular activities include hiking, biking, kayaking, golfing, and sightseeing (County of Ocean 2021). Sixteen wildlife management areas fall within Ocean County, including Greenwood Forest (32,353 acres [13,093 hectares]), which is partly in Burlington County (NJDEP 2021b).

The Edwin B. Forsythe National Wildlife Refuge consists of more than 47,000 acres (19,020 hectares) of coastal habitats and provides wildlife viewing and nature trails (New Jersey Department of State 2021a).

The Barnegat Lighthouse State Park is located on the northern tip of Long Beach Island and provides panoramic views of Barnegat Inlet as well as trails through maritime forests, birding sites for waterfowl, fishing sites, and nature walks (New Jersey Department of State 2021b).

There were 1,292 accommodation and food service establishments in the county in 2019. Together, these generated over $342 million in annual payroll. There were 272 arts, entertainment, and recreation establishments in Ocean County, which bring in approximately $116 million in annual payroll. Approximately 6.4 percent of all housing units in Ocean County are for seasonal, occupational, or occasional use. (U.S. Census Bureau 2021a; 2021b.)

Visual Resources

As discussed in Section 3.6.9, *Scenic and Visual Resources*, the Project's Lease Area would be in federal waters. At its closest point, the WTA is about 8.7 miles (14 kilometers) from the New Jersey Shoreline (COP Volume I, Section 1.1; Atlantic Shores 2023). The closest key observation point (KOP) is North Brigantine Natural Area in Atlantic County, which is approximately 9 miles (14.5 kilometers) away from the nearest project component, as shown in Table 3.6.8-1 and depicted in Figure 3.6.8-3.

Table 3.6.8-1. Selected key observation points

KOP Identifier	KOP Name	Location	Distance to the Nearest WTG (miles/kilometers)
SPB01	Seaside Park Borough Boardwalk	Seaside Park Borough, Ocean County	39/62.8
LAT01	Edwin B. Forsythe National Wildlife Refuge at the Woodmansee Estate	Lacey Township, Ocean County	32.2/51.8
LBT03	Beach at Long Beach Island Arts Foundation	Long Beach Township, Ocean County	24.9/40.1
BRT01	Bass River State Forest	Bass River Township, Burlington County	18.5/29.8
BHB01	Beach Haven Historic District	Beach Haven Borough, Ocean County	13.5/21.7
LEHT02	Great Bay Boulevard Wildlife Management Area/Rutgers Field Station	Little Egg Harbor Township, Ocean County	11.9/19.2
BC02	North Brigantine Natural Area	Brigantine City, Atlantic County	9/14.5
AC04	Ocean Casino Resort – Sky Garden	Atlantic City, Atlantic County	10.5/16.9
AC02	Jim Whelan Boardwalk Hall (Atlantic City Convention Center National Historic Landmark)	Atlantic City, Atlantic County, New Jersey	11.4/18.3
MC02	Lucy the Margate Elephant National Historic Landmark	Margate City, Atlantic County	14.4/23.2
OC04	Gillian's Wonderland Amusement	Ocean City, Cape May County	17.2/27.7
SIC02	Townsend Inlet Bridge	Sea Isle City, Cape May County	27.4/44.1
LT02	Cape May Point State Park	Lower Township, Cape May County	45/72.4

Source: COP Volume II, Section 5.2.1, Table 5.2.1; Atlantic Shores 2023.

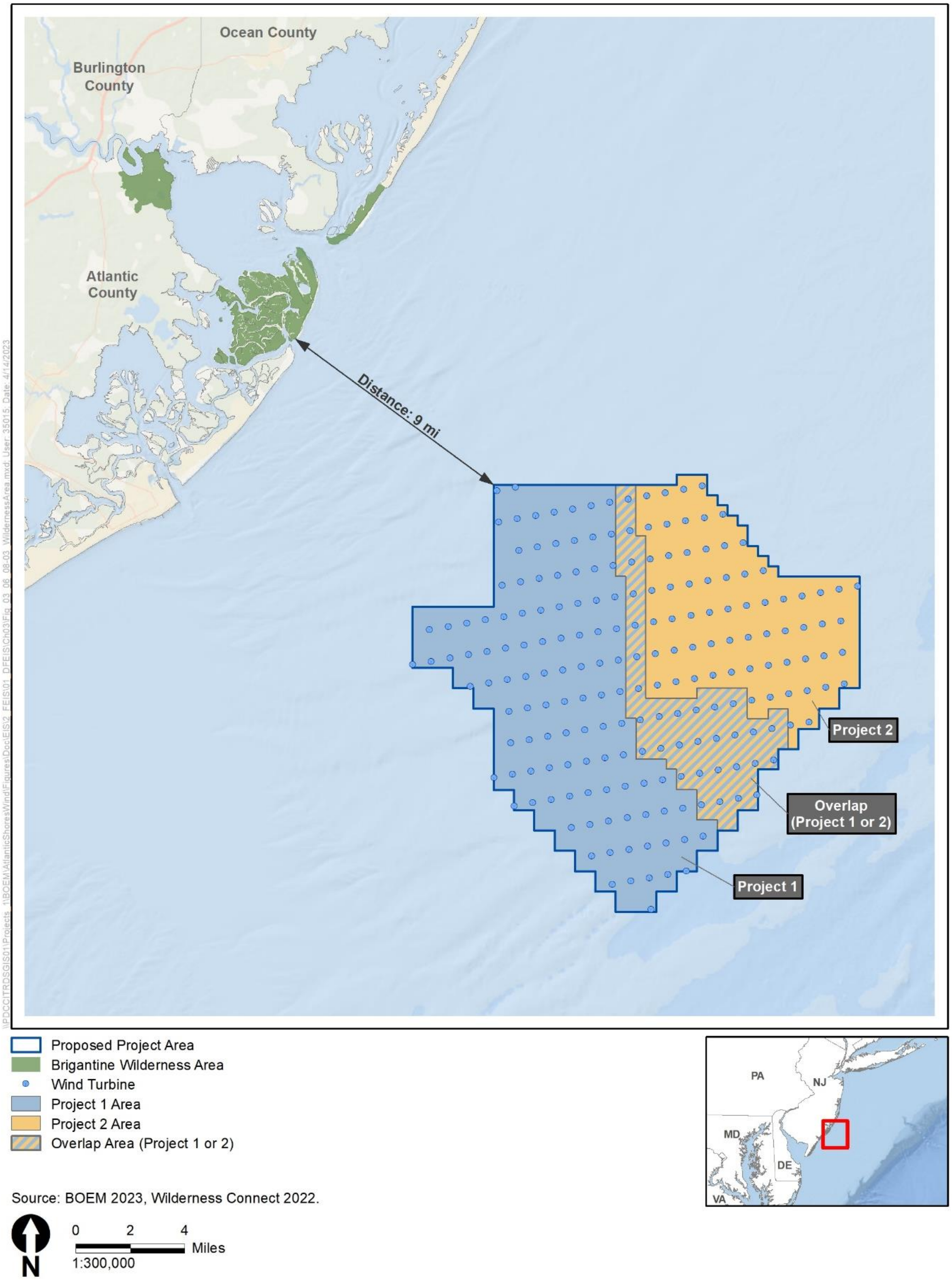


Figure 3.6.8-3. Wind Turbine Area in relation to Brigantine National Wilderness Area

Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and the glare of shorefront developments.

Within the 45.1-mile (72.6-kilometer) radius geographic analysis area, the distance from coastal viewpoints to the nearest Project WTG would vary from slightly more than 9 miles (15 kilometers) to nearly 45 miles (61 kilometers) (COP Volume II, Section 5.2.3; Atlantic Shores 2023). A 2013 study concluded that the predominant focus of visual attention occurs at distances up to 10 miles (16 kilometers); facilities were noticeable to casual observers at distances of almost 18 miles (29 kilometers); and were visible with extended or concentrated viewing at distances beyond 25 miles (40 kilometers) (COP Volume II, Section 5.2.3; Atlantic Shores 2023). Because the proposed Project's WTGs are approximately twice as tall as those described in the study, the WTGs would be noticeable at farther distances during clear conditions.

The landward zone of visual influence occurs within the Background zone (5–15 miles [8–24 kilometers]) or Extended Background zone (beyond 15 miles [24 kilometers]) for viewers along the coast of New Jersey (COP Volume II, Section 5.1.1; Atlantic Shores 2023). Visibility diminishes based on meteorological conditions, such as haze, fog, rain, snow, or a combination thereof. A 2020 Rutgers visibility study found that high visibility conditions occur over a period of less than 23 percent of the daylight hours in a given year (COP Volume II, Section 5.2.3; Atlantic Shores 2023).

3.6.8.2 Impact Level Definitions for Recreation and Tourism

As described in Section 3.3, *Definition of Impact Levels,* this Draft EIS uses a three-level incremental impact and four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. The definitions of potential beneficial and adverse impact levels for recreation and tourism are provided below in Table 3.6.8.2.

Table 3.6.8-2. Impact level definitions for recreation and tourism

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on the recreation section, recreation opportunities, or recreation experiences would be so small as to be unmeasurable.
	Beneficial	No effect or measurable impact.
Minor	Adverse	Impacts would not disrupt the normal functions of the affected activities and communities.
	Beneficial	A small and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to the Project.
	Beneficial	A notable and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.

Impact Level	Impact Type	Definition
Major	Adverse	The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the Project.
	Beneficial	A large local, or notable regional improvement to infrastructure/facilities and community services, or benefit for tourism.

3.6.8.3 Impacts of Alternative A – No Action on Recreation and Tourism

When analyzing the impacts of the No Action Alternative on recreation and tourism, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for recreation and tourism. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for recreation and tourism described in Section 3.6.8.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Recreation and tourism would continue to be affected by ongoing activities, especially ongoing vessel traffic; noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, and offshore cables; and onshore development activities. These activities would contribute to periodic disruptions to recreational and tourism activities but are a typical part of daily life along the New Jersey coastline and would not substantially affect recreational enjoyment in the geographic analysis area. Visitors would continue to pursue activities that rely on the area’s coastal and ocean environment, scenic qualities, natural resources, and establishments that provide services for tourism and recreation. The geographic analysis area has a strong tourism industry and abundant coastal and offshore recreational facilities, many of which are associated with scenic views. See Appendix D, Table D.A1-20 for a summary of potential impacts associated ongoing non-offshore wind activities by IPF for recreation and tourism.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on commercial and for-hire recreational fisheries include:

- Continued O&M of the BIWF-project (5 WTGs) installed in state waters,
- Continued O&M of the CVOW project (2 WTGs) installed in OCS-A 0497, and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517._

These ongoing activities are outside the geographic analysis area that would contribute to impacts on recreation and tourism.

Cumulative Impacts of Alternative A – No Action

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect recreation and tourism include commercial fishing, emplacement of submarine cables and pipelines, dredging and port improvements, marine mineral use, and military use (see Appendix D*,* Section D.2). Like ongoing activities, other planned non-offshore wind activities may result in periodic disruptions to recreation and tourism activities along the coast. However, visitors are expected to be able to continue to pursue activities that rely on other coastal and ocean environments, scenic qualities, natural resources, and establishments that provide services to recreation and tourism.

Offshore wind projects in the geographic analysis area are planned within Lease Areas OCS-A 0498 (Ocean Wind 1), OCS-A 0532 (Ocean Wind 2), OCS-A 0549 (Atlantic Shores North), OCS-A 0538 (Attentive Energy), OCS-A 0539 (Bight Wind Holdings), OCS-A 0541 (Atlantic Shores Offshore Wind Bight), OCS-A 0542 (Invenergy Wind), and OCS-A 0482 (GSOE I). These projects are estimated to collectively install up to 897 WTGs, 20 OSSs or met towers, and 1,725 miles (2,776 kilometers) of submarine export cable, and 1,510 miles (2,430 kilometers) of interarray cable in the geographic analysis area between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2).

BOEM expects planned offshore wind activities to affect recreation and tourism through the following primary IPFs.

Anchoring: Anchoring could potentially affect recreational boating in the geographic analysis area both through the presence of an increased number of anchored vessels during offshore wind construction, O&M, and decommissioning and through the creation of offshore areas with cable or scour protection where anchors of smaller recreational vessels may fail to hold.

Development of planned offshore wind projects between 2023 and 2030 would increase the number of vessels anchored offshore. The greatest volume of anchored vessels would occur in offshore work areas during construction and installation. Vessel anchoring would also occur during O&M but at a reduced frequency. Planned offshore wind projects would add an estimated 1,085 acres (439 hectares) of scour protection for foundations and 990 acres (401 hectares) of hard cable protection to the geographic analysis area (Appendix D, Table D.A2-2), which could create resistance to anchoring for recreational boats.

Anchored vessels for construction and installation, O&M, and decommissioning of planned offshore wind projects would have localized, intermittent, long-term impacts on recreational boating. The addition of scour and cable protection would have localized, long-term impacts on anchoring for recreational boats. BOEM expects that recreational boaters could navigate around anchored vessels and adjust the locations for dropping anchor to avoid cable and scour protection with only brief inconvenience, and impacts would be minor.

Cable emplacement and maintenance: Under the No Action Alternative, an estimated 1,725 miles (2,776 kilometers) of submarine export cable and 1,510 miles (2,430 kilometers) of interarray cable would be installed in the geographic analysis area between 2023 and 2030 for planned offshore wind projects (Appendix D, Table D.A2-1). Recreational uses would be temporarily displaced from work zones during cable installation. Cable installation could also have short-term impacts on fish and invertebrates of interest for recreational fishing, due to trenching and associated underwater noise and turbidity near the work zone. The degree of temporal and geographic overlap of each cable is unknown, although cables for some projects could be installed simultaneously. Displacement of recreational activities due to cable emplacement would be short term and limited to the construction safety zones established for safe performance of the work. Displacement of recreational uses for cable maintenance during the O&M phase of each project would be short term and intermittent over the life of the project.

Land disturbance: Planned offshore wind development would require installation of landfalls, onshore export cable and interconnection cable, and onshore substations or converter stations and POIs, which could result in localized, short-term disturbance to recreational activity or tourism-based businesses near construction sites. BOEM expects these impacts would be localized and short term during construction, O&M, and decommissioning. The exact extent of impacts would depend on the locations of onshore infrastructure for planned offshore wind projects; however, the No Action Alternative would generally have localized, short-term, and minor impacts.

Lighting: Planned offshore wind projects would add new sources of light to onshore and offshore areas, including nighttime vessel lighting and fixed lighting at onshore substations and/or converter stations and POIs and up to 897 WTGs and 20 OSSs or met towers (Appendix D, Tables D.A2-1 and D.A2-2). BOEM expects that lighting at onshore substations or converter stations and POIs would have negligible impacts on recreation and tourism. Impacts of vessel lighting would be short term for the duration that the vessel is engaged in construction, O&M, or decommissioning activities and is either anchored or transiting at night. WTGs would be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively. Impacts of lighting on WTG and OSS structures would be long term.

Aviation warning lighting required for WTGs would be visible from beaches and coastlines within the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for up to 897 WTGs (Appendix D, Table D.A2-1). The installation of these WTGs—affixed with red flashing lights mounted on opposite rear sides of the nacelle and spaced around the mast midway between the nacelle and above mean sea level within the offshore wind lease areas—would have long-term minor to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view, and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles (24.1 kilometers) from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS); however, the WTGs for the study were 574 feet tall, which is about half the height of the proposed Project's WTGs. Therefore, the visual prominence of the proposed WTGs would be greater than what is represented in the study. A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5–8 miles [8–13 kilometers]) would adversely affect the rental price of properties with ocean views (Lutzeyer et al. 2017). It did not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles (24.1 or more kilometers) from shore. More than 95 percent of the WTG positions likely to be present based on anticipated offshore wind lease area build-out in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

The New Jersey shore that is within the viewshed of planned offshore wind projects has been extensively developed. Because of the high development density, existing nighttime lighting is prevalent. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments. Visible aviation warning lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view.

In addition to recreational fishing, some recreational boating in the region involves whale watching and other wildlife viewing activity. A 2013 BOEM study evaluated the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish. The study found that existing guidelines "appear to provide for the marking and lighting of WTGs that will pose minimal if any impacts on birds, bats, marine mammals, sea turtles or fish" (Orr et al. 2013). By extension, existing lighting guidelines or ADLS (if implemented) would impose a minimal impact on recreational fishing or wildlife viewing.

As a result, although lighting on WTGs would have a continuous, long-term, adverse impact on recreation and tourism, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to the New Jersey shore and elevated areas, with less impact on the recreation and tourism industry as a whole.

An ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. Activation of ADLS, if implemented, would occur for less than 11 hours per year, as compared to standard continuous FAA hazard lighting (COP Volume II, Section 4.3.2.2; Atlantic Shores 2023). An ADLS-controlled obstruction lighting system could result in an over 99 percent reduction in system activated duration as compared to a traditional always-on obstruction lighting system (COP Appendix II-M4; Atlantic Shores 2023).

Noise: Noise from operation of construction equipment, pile driving, and vehicle and vessel traffic could result in adverse impacts on recreation and tourism. Onshore construction noise near beaches, parkland, recreation areas, or other areas of public interest would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Similarly, offshore construction noise would intrude upon the natural sounds of the marine environment. Construction noise could cause some boaters to avoid construction areas, although the most intense noise sources (such as pile driving) would originate within the temporary safety zones that USCG will establish for areas of active construction, which will be off-limits to boaters. BOEM conducted a qualitative analysis of impacts on recreational fisheries for the construction phases of offshore wind development in the Atlantic OCS region. Results showed the construction phase is expected to have a slightly negative to neutral impact on recreational fisheries due to both direct exclusion of fishing activities and displacement of mobile target species by construction noise (Kirkpatrick et al. 2017).

BOEM expects that the impact of noise on recreation and tourism during construction would be short term and localized. Multiple construction projects occurring simultaneously would increase the number of locations within the geographic analysis area that experience noise disruptions. The impact of noise during O&M would be localized, continuous (for operation of WTGs and OSS), and long term, with brief periods of more-intense noise during occasional repair activities.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing within the geographic analysis area. Pile driving using an impact hammer would cause the most impactful noises. Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by construction of WTGs, OSSs, and submarine cables. Recreational fishing for HMS such as tuna, shark, and marlin is more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, more likely to experience short-term impacts resulting from the noise generated by construction for planned offshore wind projects. Construction noise could contribute to short-term impacts on marine mammals, with resulting impacts on chartered tours for whale watching or other wildlife viewing. However, planned projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers) that would avoid and minimize underwater noise impacts on marine mammals.

Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals, and consequently little effect on recreational fishing or sightseeing. BOEM expects that planned offshore wind construction would result in localized, short-term, impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple, simultaneous construction projects would increase the spatial and temporal extent of short-term disturbance to marine species within the geographic analysis area. As shown in Table D.A2-1 in Appendix D, BOEM expects that up to seven offshore wind projects (not including the Proposed Action) could be under construction simultaneously in the recreation and tourism geographic analysis area in 2026. No long-term, adverse impacts are anticipated, provided that mitigation measures are implemented to prevent population-level harm to fish and marine mammal populations.

Port utilization: Ports within the geographic analysis area for recreation and tourism that could be used for construction and O&M of offshore wind development include the ports of Atlantic City, New Jersey; the Paulsboro Marine Terminal, Repauno Port and Rail Terminal, and the New Jersey Wind Port (Lower Alloways Creek), New Jersey. The Atlantic City port may also provide facilities for recreational vessels or may be on waterways shared with recreational marinas, and may experience increased activity, expansion, or dredging. These ports, and other regional ports suitable for staging and construction of other offshore wind development projects, are primarily industrial in character, with recreational activity as a secondary use.

Port improvements could result in short-term delays and crowding during construction but could provide long-term benefits to recreational boating if the improvements result in increased berths and amenities for recreational vessels, or improved navigational channels.

Presence of structures: The construction and installation of up to 897 WTGs and 20 OSSs or met towers within the recreation and tourism geographic analysis area would contribute to impacts on recreational fishing and boating (Appendix D, Tables D.A2-1 and D.A2-2). The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, planned offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects. The WTGs and OSSs installed within offshore wind lease areas are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue. On the other hand, fish aggregation could have negative impacts on recreation and tourism by causing increased natural predation and subsequent fishing effort, resulting in a decrease in fish stocks.

The presence of planned offshore wind structures would increase the risk of allision or collision with other vessels and the complexity of navigation within the geographic analysis area. Generally, the vessels more likely to allide with WTGs or OSSs would be smaller vessels moving within and near wind farm installations, such as recreational vessels. Planned offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the adverse impact of the planned offshore wind structures on recreational boating would be limited by the distance offshore. Recreational boating routes in the geographic analysis area mainly occur within 3 miles (4.8 kilometers) of the New Jersey shore (COP Volume II, Section 7.3.1.1; Atlantic Shores 2023).

The geographic analysis area would have an estimated 1,085 acres (439 hectares) of scour protection for WTG foundations and 990 acres (401 hectares) of hard cable protection (Appendix D, Table D.A2-2), which would result in an increased risk of entanglement. Accurate marine charts could make operators of recreational vessels aware of the locations of the cable protection and scour protection. If the hazards are not noted on charts, operators may lose anchors, leading to increased risks associated with drifting vessels that are not securely anchored. Lessees would engage with both USCG and NOAA in developing a comprehensive aid to navigation plan. Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Smaller commercial or recreational vessels anchoring in the offshore wind lease areas may have issues with anchors failing to hold near foundations and any scour protection. Considering the small size of the geographic analysis area compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario, it is unlikely that offshore wind activities would affect vessel-anchoring activities. Because anchoring is uncommon in water depths where the No Action Alternative WTGs would be installed, anchoring risk is more likely to be an impact over export cables in shallower water closer to coastlines. The risk to recreational boating would be localized, continuous, and long term.

Planned offshore wind structures could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The WTG and OSS structures could produce artificial reef effects (COP Volume II, Section 4.5.2.5; Atlantic Shores 2023). The "reef effect" refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat. The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters traveling farther from shore in order to fish. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. However, an increase in fish species could also lead to additional natural predation and consequently a growth in fishing effort, which could decrease fish stocks. Although the likelihood of recreational vessels visiting the offshore structures would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the offshore wind lease areas. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels.

As it relates to the visual impacts of structures, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.6.9 describes the visual impacts from offshore wind infrastructure. If the purpose of the viewer's sightseeing excursion is to observe the mass and scale of the WTGs' offshore presence, then the increasing visual dominance would benefit the viewer's experience as the viewer navigates toward the WTGs. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then the increasing visual dominance may detract from the viewer's experience.

Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism found that established offshore wind facilities in Europe did not result in decreased tourist numbers, tourist experience, or tourist revenue; that study also found that the BIWF's WTGs in Rhode Island provide excellent sites for fishing and shell fishing (Smythe et al. 2018). A survey-based study found that for prospective offshore wind facilities (based on visual simulations), proximity of WTGs to shore is correlated to the share of respondents who would expect a worsened experience visiting the coast (Parsons and Firestone 2018).

- At 15 miles (24.1 kilometers), the percentage of respondents who reported that their beach experience would be worsened by the visibility of WTGs was about the same as the percentage of those who reported that their experience would be improved (e.g., by knowledge of the benefits of offshore wind).

- About 68 percent of respondents indicated that the visibility of WTGs would neither improve nor worsen their experience.
- Reported trip loss (respondents who stated that they would visit a different beach without offshore wind) averaged 8 percent when wind projects were 12.5 miles (20 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32 kilometers) offshore.
- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

A 2019 survey of 553 coastal recreation users in New Hampshire included participants in water-based recreation activities such as fishing from shore and boats, motorized and non-motorized boating, beach activities, and surfing at the New Hampshire seacoast. Most (77 percent) supported offshore wind development along the New Hampshire coast, while 12 percent opposed it and 11 percent were neutral. Regarding the impact on their outdoor recreation experience, 43 percent anticipated that offshore wind development would have a beneficial impact, 31 percent anticipated a neutral impact, and 26 percent anticipated an adverse impact (Ferguson et al. 2020). Similar sentiment is expected among coastal recreation users in New Jersey.

The shore areas within the viewshed of the WTGs are highly developed. Public beaches and tourism attractions in this area are highly valued for scenic, historic, and recreational qualities, and draw large numbers of daytime visitors during the summertime tourism seasons. When visible (i.e., on clear days, in locations with unobstructed ocean views), WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view.

Based on the currently available studies, portions of the up to 897 WTGs (Appendix D, Table D.A2-1) associated with the No Action Alternative could be visible from shorelines (depending on vegetation, topography, weather, atmospheric conditions, and the viewers' visual acuity). WTGs visible from some shoreline locations in the geographic analysis area would have adverse impacts on visual resources when discernable due to the introduction of industrial elements in previously undeveloped views. Based on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation would be long term, continuous, and adverse. Seaside locations could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to affect shore-based or marine recreation and tourism in the geographic analysis area as a whole.

Traffic: Planned offshore wind project construction and decommissioning, and, to a lesser extent, planned offshore wind project operation would generate increased vessel traffic that could inconvenience recreational vessel traffic within the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the planned offshore wind construction areas. Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action, which is projected to generate an average of two to six vessel roundtrips per day collectively between construction staging port facilities under consideration and offshore construction areas (COP Volume II, Section 4.3.2.4; Atlantic Shores 2023). Two to six vessel trips per day are also expected during

Project operations (COP Volume II, Section 4.7.2.1; Atlantic Shores 2023). Between 2023 and 2030, as many as eight offshore wind projects (not including the Proposed Action) could be under construction simultaneously within the geographic analysis area (Appendix D, Table D.A2-1). During such periods, assuming similar vessel counts, construction of offshore wind projects would generate an average of 550 to 2,050 annual round trips depending on whether service operations vessels (SOVs) or crew transfer vessels (CTVs) are used (COP Volume II, Section 7.6.2.1; Atlantic Shores 2023). If Atlantic Shores employs an SOV-based O&M strategy, those SOVs would likely be operated out of existing ports such as Lower Alloways Creek Township (New Jersey Wind Port), the Port of New Jersey/New York, or another industrial port identified in COP Volume II, Table 7.5-1 (Atlantic Shores 2023) that has suitable water depths to support an SOV.

This level of increase in vessel traffic from CTVs operating from Atlantic City would represent only a modest increase compared to the background volumes of vessel traffic in and around offshore Atlantic City, New Jersey, and BOEM expects that vessel traffic would have minor impacts on recreation and tourism in the geographic analysis area.

Conclusions

Impacts of Alternative A – No Action. BOEM anticipates that recreation and tourism impacts as a result of ongoing activities associated with the No Action Alternative (including commercial fishing, emplacement of submarine cables and pipelines, dredging and port improvement projects, marine minerals use and ocean dredging, military use, marine transportation, and onshore development activities) would be **minor** because these are typical activities occurring along the New Jersey coastline and would not substantially affect visitor use or experience.

Cumulative Impacts of Alternative A – No Action. Planned offshore wind activities would have localized, short-term, **minor** impacts on recreation and tourism related to land disturbance, cable emplacement and maintenance, noise, and traffic. Planned offshore wind activities would have localized, long-term, **minor** impacts on recreation and tourism due to anchoring and lighting, and localized, long-term, **minor** adverse and **minor beneficial** impacts on recreation and tourism due to the presence of structures, with beneficial impacts attributed to the anticipated reef effect resulting from installation of new offshore structures. BOEM expects the combination of ongoing and planned activities including planned offshore wind to result in **minor** impacts on recreation and tourism.

BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in overall **minor** adverse and **minor beneficial** impacts. Planned offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and cable emplacement during construction and the presence of offshore structures during operations. Noise and cable emplacement could temporarily displace recreational uses at construction sites and affect recreational fishing and sightseeing as a result of the impacts on fish, invertebrates, and marine mammals. The long-term presence of offshore wind structures would result in increased navigational complexity, potential entanglement and loss of gear, and visual impacts from offshore structures. BOEM also anticipates that the planned offshore wind activities in the analysis area would result in **minor beneficial** impacts due to the presence of offshore structures and cable hard cover, which could provide opportunities for fishing and sightseeing due to the reef effect.

3.6.8.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following proposed PDE parameters would influence the magnitude of the impacts on recreation and tourism:

- The Project layout including the number, type, height, and placement of the WTGs and OSSs, and the design and visibility of lighting on the structures;
- Arrangement of WTGs and accessibility of the WTAs to recreational boaters; and
- The duration and time of year during which onshore and nearshore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix D. Below is a summary of potential variances in impacts:

- WTG number, size, location, and lighting: More WTGs and larger turbine sizes closer to shore could increase visual impacts that affect onshore recreation and tourism as well as recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- WTG arrangement and orientation: Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.
- Duration and timing of construction: Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season. A shorter or longer duration for construction activities would decrease or increase the time that recreational uses could be displaced from construction sites.

3.6.8.5 Impacts of Alternative B – Proposed Action on Recreation and Tourism

The Proposed Action would install up to 200 WTGs, up to 10 small OSSs, 1 met tower, 547 miles (880 kilometers) of interarray cable, and 441 miles (710 kilometers) of export cable in the geographic analysis area between 2025 and 2027 (Appendix D, Table D.A2-1). There are three landfall location options in Atlantic City for the Atlantic ECC and one landfall location option in Monmouth County for the Monmouth ECC for the Proposed Action. BOEM expects the Proposed Action to affect recreation and tourism through the following primary IPFs.

Anchoring: Anchoring could potentially affect recreational boating in the geographic analysis area both through the presence of an increased number of anchored vessels during offshore wind construction, O&M, and decommissioning (creating space use conflicts) and through the creation of offshore areas with cable or scour protection where anchors of smaller recreational vessels may fail to hold.

Construction of the Proposed Action between 2024 and 2027 would increase the number of vessels anchored offshore. Most construction vessels used for the Atlantic Shores South Project would maintain position using dynamic positioning, which limits the use of anchors and jack-up features. Atlantic Shores would implement safety zones around active construction sites, which would reduce the potential for interaction between recreational and tour boats with anchored construction vessels; however, safety zones would also temporarily displace those uses from the work area. Vessel anchoring would also occur during O&M but at a reduced frequency. The Proposed Action would add an estimated 162 acres (66 hectares) of scour protection for foundations and 595 acres (241 hectares) of hard cable protection to the geographic analysis area (Appendix D, Table D.A2-2), which could make anchoring more difficult for recreational boats.

Anchored vessels for construction, O&M, and decommissioning of the Proposed Action would have localized, intermittent, short-term impacts on recreational boating. The addition of scour and cable protection would have localized, long-term impacts on anchoring for recreational boats. BOEM expects that recreational boaters could navigate around anchored vessels and adjust the locations for dropping anchor to avoid cable and scour protection with only brief inconvenience, and impacts would be minor.

Cable emplacement and maintenance: Cable emplacement would generate vessel traffic and trenching along cable routes, creating space use conflicts and resulting in short-term disturbance to species important to recreation and tourism. Recreational and tour boats traveling near the offshore cable routes would need to navigate around vessels and access-restricted areas associated with the offshore cable installation. Atlantic Shores would regularly work with USCG to communicate these zones and other work areas to the boating public via Local Notices to Mariners (COP Volume II, Section 7.7.8; Atlantic Shores 2023). Space use conflicts with recreation and tourism related to offshore cable emplacement would result in localized, short-term, minor impacts.

Cable installation could also affect fish and marine mammals of interest for recreational fishing and sightseeing through dredging and resulting underwater noise and turbidity. Impacts of cable installation on fish and marine mammals would be localized and short term, and affected species are expected to recover upon completion of the activity, resulting in minor impacts on recreation and tourism (see Section 3.5.6, *Marine Mammals*, Section 3.5.7, *Sea Turtles*, and Section 3.6.6, *Navigation and Vessel Traffic*).

Land disturbance: Construction of the Proposed Action would require installation of landfalls, onshore export cable and interconnection cable, and onshore substations or converter stations and POIs, which could result in localized, short-term disturbance to recreational activity or tourism-based businesses near construction sites. Onshore construction activities could disrupt access to public use areas and degrade the recreational experience through establishment of restricted work zones and increases in traffic, noise, and construction emissions. Atlantic Shores would use ultra-low sulfur diesel (ULSD) fuel, which would reduce air emissions during construction (COP Volume II, Section 3.1.2.7; Atlantic Shores 2023). Shoreside recreational fishing sites may potentially be affected during cable placement activity and maintenance. Recreational fishing and related sites in proximity to the Atlantic and Monmouth onshore export cable routes include Ventnor City Fishing Pier, Brigantine South End Beach & Jetty, and Atlantic City Jetties North & South in Atlantic County, as well as Manasquan Beach in Monmouth County (NOAA 2022b). BOEM expects impacts of land disturbance during construction, O&M, and decommissioning would be localized and short term.

The proposed onshore substations or converter stations and POIs would be in predominantly high- and medium-intensity developed areas, and construction is not expected to affect recreation or tourism in the long term. Overall, BOEM expects that impacts of the Proposed Action on recreation and tourism due to land disturbance would be negligible to minor, due to the temporary nature of construction impacts and limited geographic extent of impacts related to conversion of affected properties from existing uses to a use for an electric utility.

Lighting: The Proposed Action would add new sources of light to onshore and offshore areas including nighttime vessel lighting and fixed lighting on up to 200 WTGs, up to 10 OSSs, 2 onshore substations or converter stations, and 2 onshore POIs. Onshore substations or converter stations and POIs would be in developed areas, and BOEM expects that lighting at onshore substations or converter stations and POIs would have negligible impacts on recreation and tourism. Impacts of vessel lighting would be short term for the duration that the vessel is engaged in construction, O&M, or decommissioning activities and is either anchored or transiting at night. WTGs would be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively (REC-11, Appendix G, Table G-1). Impacts of lighting on WTG and OSS would be long term.

Aviation warning lighting required for WTGs would be visible from beaches and coastlines within the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for 200 WTGs of the Proposed Action (Appendix D, Table D.A2-1). The installation of these WTGs affixed with red flashing lights mounted on opposite rear sides of the nacelle and spaced around the mast midway between the nacelle and above mean sea level within the offshore wind lease areas would have long-term, minor to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The New Jersey shore that is within the viewshed of the Proposed Action has been extensively developed. Because of the high development density, existing nighttime lighting is prevalent. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments. Visible aviation warning lighting would add a built visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view. Atlantic Shores plans to use an ADLS, subject to FAA and BOEM approval, which could substantially reduce the amount of time that the aviation obstruction lights are actually illuminated. An ADLS automatically activates all aviation obstruction lights when aircraft approach the WTA; at all other times, the lights are off. Atlantic Shores would implement an ADLS or similar system on WTGs as a base case, pending commercial availability, technical feasibility, and agency review and approval. The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation.

As a result, although lighting on WTGs would have a long-term impact, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to the New Jersey shore and elevated areas, with less impact on the recreation and tourism industry as a whole. Due to the distance of the Proposed Action's WTGs and OSSs from shore and potential to implement ADLS or a similar system on WTGs, BOEM expects that aviation hazard lighting for the Proposed Action would result in long-term, intermittent, minor impacts on recreation and tourism in the geographic analysis area. Lighting associated with vessel traffic and onshore substations or converter stations and POIs would have negligible impacts on recreation and tourism.

Noise: Noise from the operation of construction equipment, pile driving, and vehicle or vessel traffic could result in adverse impacts on recreation and tourism. Onshore construction noise near beaches, parkland, recreation areas, or other areas of public interest would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Atlantic Shores would implement measures such as use of mufflers, adjustable backup alarms, and noise barriers to reduce onshore construction noise (COP Volume II, Section 8.1.5; Atlantic Shores 2023). The construction schedule would be developed in accordance with municipal noise ordinances (REC-03, Appendix G, Table G-1).

Similarly, offshore construction noise would intrude upon the natural sounds of the marine environment. Construction noise could cause some boaters to avoid construction areas, although the most intense noise sources (such as pile driving) would originate within the safety zones established for areas of active construction, which would exclude recreational and tour boats. BOEM expects that the impact of noise on recreation and tourism during construction would be short term and localized. The impact of noise during O&M would be localized, continuous (for operation of WTGs and OSSs), and long term, with brief periods of more-intense noise during occasional repair activities.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing within the geographic analysis area. Pile driving using an impact hammer would cause the most impactful noises. Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by the construction of WTGs and OSSs. Recreational fishing such as for HMS including tuna, shark, and marlin is more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, more likely to experience short-term impacts resulting from the noise generated by construction within the Lease Area.

Construction noise could contribute to short-term impacts on marine mammals, with resulting impacts on chartered tours for whale watching or other wildlife viewing. Atlantic Shores would implement measures such as seasonal restrictions on construction activity to avoid months (January to April) when North Atlantic right whale densities are higher, initiation of pile driving (if used) only when it is expected that pile driving can be completed during daylight hours, and equipment operating procedures (e.g., soft starts, ramp-downs, and shut-downs) to reduce impacts of underwater noise on marine mammals (COP Volume II, Section 8.2.3; Atlantic Shores 2023). Lower levels of noise associated with cable installation activities could also affect fish species and marine mammals in the nearshore environment. Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals, and consequently little effect on recreational fishing or sightseeing.

Overall, noise generated from construction and installation, O&M, and decommissioning of the Proposed Action alone would have localized, short-term, minor impacts on recreation and tourism

Port utilization: Within the geographic analysis area, the Proposed Action would use an O&M facility at Atlantic City Harbor (Atlantic County) for O&M support. The Proposed Action would use several port facilities in New Jersey, Virginia, and Texas. Ports in New Jersey anticipated to be used for construction include the New Jersey Wind Port (Salem County), the Paulsboro Marine Terminal (Gloucester County), and Repauno Port and Rail Terminal (Gloucester County) (COP Volume I, Section 4.10.3, Table 4.10-2; Atlantic Shores 2023). These construction ports are outside of the geographic analysis area for recreation and tourism.

Material storage, day-to-day management of inspection and maintenance activities, vehicle parking, marine coordination, vessel docking, and dispatching of technicians would take place at the O&M facility in Atlantic City, New Jersey (COP Volume I, Section 5.5; Atlantic Shores 2023). Increased vessel traffic and construction activity during marina upgrades at Atlantic City may result in short-term delays and crowding during construction. The Proposed Action would have a short-term, negligible impact on recreation and tourism due to port utilization within the geographic analysis area.

Presence of structures: The construction and installation of up to 200 WTGs, up to 10 OSSs, and 1 met tower within the Lease Area would contribute to impacts on recreational fishing and boating. The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects. The WTGs and OSSs installed within the WTA are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue. On the other hand, fish aggregation could lead to additional natural predation and increased fishing effort, resulting in a decrease in fish stocks.

The presence of offshore wind structures would increase the complexity of navigation within the Lease Area and risk of allision (with fixed structures) or collision (with other vessels). The presence of structures within the Lease Area could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the impact on recreational boating would be limited by the distance offshore. Recreational boating routes in the geographic analysis area mainly occur within 3 miles (4.8 kilometers) of the New Jersey shore (COP Volume II, Section 7.3.1.1; Atlantic Shores 2023).

The Proposed Action would install an estimated 289 acres (117hectares) of scour protection for foundations and 294 acres (119 hectares) of offshore export cable hard protection in the geographic analysis area (see Table D.A2-2 in Appendix D), increasing the risk of entanglement with fishing gear. Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Also, because anchoring is more common in shallower water depths, anchoring risk is more likely to have an impact over export cables in shallower water closer to coastlines. The risk to recreational boating from the addition of scour and cable protection would be localized, continuous, and long term.

Construction of new offshore structures in the Lease Area could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. Although some recreational anglers would avoid the WTA, the scour protection around the WTG foundations would likely attract forage fish as well as game fish, which could provide new opportunities for certain recreational anglers. Evidence from BIWF indicates an increase in recreational fishing near the WTGs (Smythe et al. 2018). The WTG and OSS structures are also likely to produce artificial reef effects. The “reef effect” refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat (COP Volume II, Section 4.5.2.5; Atlantic Shores 2023). The reef effect could attract species of interest for recreational fishing, resulting in an increase in recreational boaters traveling farther from shore in order to fish. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. However, an increase in fish species could also lead to additional natural predation and consequently a growth in fishing effort, which could decrease fish stocks. Although the likelihood of recreational vessels visiting the offshore structures would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the Lease Area. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels.

As it relates to the visual impacts of structures, the vertical presence of the Proposed Action’s up to 200 WTGs, up to 10 OSSs, and 1 met tower on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.6.9 describes the visual impacts from offshore wind infrastructure. During construction, viewers on the New Jersey shore would see the upper portions of tall equipment such as mobile cranes. These cranes would move from WTG to WTG as construction progresses, and thus would not be long-term fixtures. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a short-term, minor impact on recreation and tourism.

The visual contrast created by the WTGs during operations could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer's values, the activity engaged in, and the purpose for visiting the area. Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism have identified variable reactions to offshore wind, with respondents having positive, neutral, or negative views of the effect that offshore wind infrastructure would have on their experience of coastal recreation (Parsons and Firestone 2018; BOEM 2021), while a study in Europe found that established offshore wind facilities did not result in decreased tourist numbers, tourist experience, or tourist revenue (Smythe et al. 2018).

Based on the impacts of the WTGs and OSSs on navigation and fishing, the potential reef effects of these structures, and the risks to anchoring and gear loss associated with scour or cable protection, the Proposed Action would have long-term, continuous, minor beneficial and minor adverse impacts on recreation and tourism.

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk along routes between ports and the offshore construction areas, and within the Lease Area during Project construction, O&M, and decommissioning. The Proposed Action is projected to generate an average of two to six vessel roundtrips per day collectively between construction staging port facilities under consideration and offshore construction areas (COP Volume II, Section 4.3.2.4; Atlantic Shores 2023). Two to six vessel trips per day are also expected during Project operations (COP Volume II, Section 4.7.2.1; Atlantic Shores 2023). The Proposed Action could generate as many as 1,705 total trips during construction and installation and 1,880 trips annually during O&M. The proposed layout was developed in close coordination with fishermen and to align with the predominant flow of vessel traffic (REC-07, Appendix G, Table G-1). A Marine Coordinator would be employed to monitor daily vessel movements, implement communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project area. The Marine Coordinator would be responsible for coordinating with the USCG for any required Notice to Mariners (REC-20, Appendix G, Table G-1).

If all Project construction activities were to occur simultaneously, a total of 51 vessels could be present; however, this is unlikely (COP Volume II, Section 7.6.2.1; Atlantic Shores 2023). Between 2023 and 2027 as many as eight offshore wind projects (including the Proposed Action) could be under construction simultaneously within the geographic analysis area. During such periods, assuming similar vessel counts, construction of offshore wind projects would generate an average of 550 to 2,050 annual round trips depending on whether SOVs or CTVs are used (COP Volume II, Section 7.6.2.1; Atlantic Shores 2023). CTVs are expected to operate out of the Atlantic City port. SOVs are expected to operate out of ports other than Atlantic City.

This level of increase in vessel traffic from CTVs operating from Atlantic City would represent only a modest increase compared to the background volumes of vessel traffic in and around offshore Atlantic City, New Jersey, and BOEM expects that vessel traffic would have long-term, minor impacts on recreation and tourism in the geographic analysis area.

Non-routine activities such as response to spills from maintenance or repair vessels would generally require intense, temporary activity to address emergency conditions or respond to an oil spill. Non-routine activities could temporarily prevent or deter recreation or tourist activities near the site of a given non-routine event. Atlantic Shores would develop an emergency plan in coordination with the USCG and Oil Spill Response Plan to minimize risk of sediment contamination (COP Volume II, Sections 2.1.2.2 and 7.4.4.1; Atlantic Shores 2023). A construction schedule that minimizes overlap with the tourist season and other seasonal events would be developed to ensure construction activities do not occur from Memorial Day to Labor Day, thereby reducing impacts such as vessel traffic, noise, and other construction activity that might otherwise adversely affect communities during this time (REC-01, REC-02, Appendix G, Table G-1). With implementation of navigation-related mitigation measures, the impacts of non-routine activities on recreation and tourism would be minor.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* improvements to the existing marine infrastructure within an approximate 20.6-acre (8.3-hectare) site at the Atlantic City, New Jersey, Inlet Marina area are planned in connection with construction of the O&M facility of the Proposed Action. The connected action includes construction of a new 356-foot (109-meter) bulkhead to replace the existing and deteriorating 250-foot (76-meter) bulkhead. Additionally, the connected action would include maintenance dredging at the site. Atlantic Shores is proposing to implement the construction of the new bulkhead, and the City of Atlantic City would complete the maintenance dredging at the site.

BOEM expects the connected action to affect recreation and tourism through the following primary IPFs.

Noise: Noise from the operation of construction equipment and associated vehicle traffic could result in impacts on recreation and tourism by temporarily disturbing the natural sounds of the marine environment or the expected quiet of recreation areas. However, onshore construction would be limited to areas zoned for heavy industries that generate ongoing noise and traffic. Noise from constructing the connected action would have temporary but negligible impacts on recreation and tourism.

Land disturbance: The proposed construction activities could result in localized, temporary disturbance to recreation activities or tourism-based businesses near the construction site. However, the connected action is anticipated to have negligible impacts on recreation and tourism due to land disturbance.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities, including offshore wind activities, and the connected action.

Anchoring: The Proposed Action would contribute a noticeable increment to the cumulative anchoring impacts on recreational boating, which would result in localized minor impacts on recreation and tourism related to anchoring.

Cable emplacement and maintenance: The Proposed Action would contribute a noticeable increment to the cumulative impacts of cable emplacement and maintenance on recreational marine activities from ongoing and planned activities. The cumulative impacts would likely be minor due to the localized and temporary nature of the impacts and ability of displaced users to use alternate nearby locations during construction and installation, O&M, and decommissioning of offshore export cables. With the exception of the Ocean Wind 1 Project, specific cable locations associated with other offshore wind projects have not been identified within the geographic analysis area.

Land disturbance: The Proposed Action would contribute a noticeable increment to the cumulative land disturbance impacts on recreation and tourism and would result in localized, minor impacts on recreation and tourism.

Lighting: BOEM expects that lighting for the Proposed Action would contribute a noticeable increment to the cumulative lighting impacts from ongoing and planned activities, which would have negligible to minor impacts on recreation and tourism.

Noise: The Proposed Action would contribute a noticeable increment to the cumulative noise impacts on marine recreation activities from ongoing and planned activities, which would likely be minor due to the localized and temporary nature of the impacts and ability of displaced users to use alternate nearby locations during construction and decommissioning. Impacts of noise on recreation and tourism during operations would be negligible and long term.

Port utilization: The Proposed Action would contribute a noticeable increment to the cumulative port utilization impacts on recreation and tourism from ongoing and planned activities including offshore wind, which would be localized, long term, continuous, and negligible.

Presence of structures: Structures from other planned offshore wind development would generate comparable types of impacts as the Proposed Action alone. The geographic extent of impacts would increase as additional offshore wind projects are constructed, but the level of impacts considering the Proposed Action and other ongoing and planned activities would likely be the same. The Proposed action would contribute a noticeable increment to the cumulative impacts on recreation and tourism, which would range from minor beneficial (related to reef effects and recreational fishing and sightseeing opportunity) to minor adverse (related to increased navigational complexity, space use conflicts, anchoring, and gear entanglement or loss).

Traffic: The Proposed Action would contribute an undetectable increment to the cumulative vessel traffic impacts on recreation and tourism from ongoing and planned activities, which would be short term and minor during construction and installation and long term and minor during operations.

Conclusions

Impacts of Alternative B – Proposed Action. In summary, the impacts resulting from individual IPFs associated with the Proposed Action alone would be **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor beneficial** (related to the presence of structures), resulting in an overall **minor** impact. IPFs could disrupt recreation and tourism during construction but be localized and short term, and recreation and tourism could be temporarily displaced to alternate areas. During operations, the presence of offshore structures would increase navigational complexity in the Lease Area, and scour and cable protection could increase the risk of gear entanglement or loss, and difficulty with anchoring. Beneficial impacts on recreation and tourism would result from the reef effect (providing additional locations for recreational for-hire fishing trips) and the sightseeing attraction of offshore wind energy structures.

BOEM expects that the connected action alone would have **negligible** impacts on recreation and tourism.

Cumulative Impacts of Alternative B – Proposed Action. The incremental impacts contributed by the Proposed Action to the cumulative impacts on recreation and tourism would range from undetectable to noticeable. The contribution of the Proposed Action to the cumulative impacts of individual IPFs resulting from ongoing and planned activities (including planned offshore wind) would increase the geographic extent of impacts as additional offshore wind projects are constructed, but the level of impacts considering the Proposed Action and other ongoing and planned activities would likely be the same: negligible to minor adverse (related to IPFs for anchoring due to obstacles posed by an increased number of anchored vessels during offshore wind construction, land disturbance due to the short-term impact of cable installation on recreational activity or tourism-based businesses near construction sites, lighting due to long term negligible visual impacts, cable emplacement due to disruption of species important to recreation and tourism businesses, noise due to disruption of otherwise quiet or natural-sounding conditions, and traffic due to the increased congestion recreational and tourism vessels would face); and minor adverse to minor beneficial (related to the presence of structures, as the Proposed Action's WTGs would encourage the reef effect and therefore support new marine species habitats important to recreation and tourism, but would also increase navigational complexity for recreational and tourism vessels). Considering all IPFs together, the overall impacts of the Proposed Action alone or in combination with ongoing and planned activities would range from **minor** adverse to **minor beneficial**.

3.6.8.6 Impacts of Alternatives C and E on Recreation and Tourism

Impacts of Alternatives C and E. Impacts of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) and E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. The construction of Alternative C could install fewer WTGs (up to 29 fewer WTGs) and associated offshore substations (1 fewer offshore substation) and interarray cables, which would slightly reduce the construction impact footprint and installation period. The removal of these WTGs and OSS would result in a negligible reduction of impacts on visual resources compared to the Proposed Action, unnoticeable to the casual viewer. Alternative E would modify the wind turbine array layout through the exclusion or micrositing of up to 5 WTG positions to create a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) and Ocean Wind 1 Lease

Area (OCS-A 0498) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation. This setback would be an improvement to vessel navigation and SAR considerations over no separation between lease areas. Alternatives C and E could potentially reduce gear entanglements and loss as well as allisions, and recreational fishing may see a slight decrease due to fewer structures providing reef habitat for targeted species. Fewer vessels and vessel trips would be expected, which would reduce the risk of discharges, fuel spills, and trash in the area and decrease the risk of collision with marine mammals and sea turtles (Sections 3.5.6 and 3.5.7).

Cumulative Impacts of Alternative C and E. The incremental impacts contributed by Alternatives C and E to the cumulative impacts on recreation and tourism would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative C and E. The **minor** adverse impacts and **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternatives C and E. The impacts associated with Alternatives C and E would be slight improvements over the Proposed Action's impacts, because Alternative C would potentially reduce the amount of time (and therefore noise and disruption) associated with WTG installation, and Alternative E would lessen the potential impacts on recreational fishing and navigation; however, the impact level would not change.

Cumulative Impacts of Alternative C and E. The incremental impacts contributed by Alternatives C and E to the cumulative impacts on recreation and tourism would be the same as under the Proposed Action and would range from negligible to minor adverse impacts and minor beneficial impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternatives C and E when each combined with ongoing and planned activities including planned offshore wind would likely be **minor** adverse and **minor beneficial**.

3.6.8.7 Impacts of Alternative D on Recreation and Tourism

Impacts of Alternative D. Impacts of Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures on visual resources. Alternative D would alter the layout and number of WTGs to reduce visual impacts. Alternative D1 would remove turbines up to 12 miles (19.3 kilometers) from shore, resulting in the removal of up to 21 WTGs. Alternative D1 would also restrict the turbines in Project 1 to a maximum hub height of 522 feet (159 meters) ASML and maximum blade tip height of 932 feet (284 meters) ASML. Alternative D2 would remove turbines up to 12.75 miles (20.5 kilometers) from shore, resulting in the removal of up to 31 WTGs. The removal of these WTGs would ensure that the closest key observation viewpoint to the nearest project components would be at least 12 miles (19.3 kilometers) away rather than approximately 9 miles (14.5 kilometers) away. The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) ASML and maximum blade tip height of 932 feet (284 meters) ASML. Alternative D3 would remove turbines up to 10.8 miles (17.4 kilometers) from shore, resulting in the removal of up to 6 WTGs. The remaining WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. Therefore, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area depending on the purpose of the viewer's sightseeing excursion. If the purpose is to observe the mass and scale of the WTGs' offshore presence, then decreasing visual dominance by removing WTGs would not benefit the viewer's experience from shore. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then decreasing visual dominance by removing WTG positions would benefit the viewer's experience. When visible (i.e., on clear days, in locations with unobstructed ocean views), WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean.

A 2013 study concluded that the predominant focus of visual attention occurs at distances up to 10 miles (16 kilometers); facilities were noticeable to casual observers at distances of almost 18 miles (29 kilometers) and were visible with extended or concentrated viewing at distances beyond 25 miles (40 kilometers) (COP Volume II, Section 5.2.3; Atlantic Shores 2023). Because the proposed Project's WTGs are approximately twice as tall as those described in the study, the WTGs would be noticeable at farther distances during clear conditions. Therefore, even with the removal of the closest WTG positions and the hub height and blade tip restrictions, other WTGs would still be visible.

Alternative D could also potentially reduce gear entanglements and loss as well as allisions and is likely to lead to a slight decrease in recreational fishing. Turbines are very likely to provide a reef habitat for targeted species, and while the exact ecosystem response to the turbines is unknown, fewer structures would likely lead to a decrease in this effect. Fewer vessels and vessel trips would be expected, which would reduce the risk of discharges, fuel spills, and trash in the area and decrease the risk of collision with marine mammals and sea turtles (Sections 3.5.6 and 3.5.7).

Cumulative Impacts of Alternative D. The incremental impacts contributed by Alternative D to the cumulative impacts on recreation and tourism would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative D. The **minor** adverse and **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternative D. The impacts associated with Alternative D would be slight improvements over the Proposed Action's impacts by reducing the visual impacts of WTGs, but the impact level would not change.

Cumulative Impacts of Alternative D. The incremental impacts contributed by Alternative D to the cumulative impacts on recreation and tourism would be the same as under the Proposed Action and would range from negligible to minor adverse impacts and negligible to minor beneficial impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative D when combined with ongoing and planned activities including planned offshore wind would likely be **minor** adverse and **minor beneficial**.

3.6.8.8 Impacts of Alternative F on Recreation and Tourism

Impacts of Alternative F. Impacts of Alternative F (Foundation Structures) would be similar to those of the Proposed Action for recreation and tourism except for the impact of foundation structures. The construction of Alternative F would either use monopile and piled jacket, suction bucket, or gravity-based foundations. Alternative F1 would use piled foundations, Alternative F2 would use suction bucket foundations, and Alternative F3 would use gravity-based foundations. Piled (monopile and piled jackets) foundations require impact pile driving, which would generate noise that can adversely affect species important to recreational fishing and sightseeing, such as whales (COP Volume II, Section 8.2.2; Atlantic Shores 2023). Suction bucket foundations, on the other hand, require non-impulsive pile installation methods, which would result in lower peak pressure levels than impact pile driving. Noise from suction bucket installation is unlikely to harm fish or pelagic invertebrates due to the lower peak pressure levels and relatively short duration (COP Volume II, Section 4.6.2.3.2; Atlantic Shores 2023).

Gravity-based foundations may require seabed preparation, which would consist of removal of the top layer of sediment to establish a level surface (COP Volume II, Section 2.1.2.2; Atlantic Shores 2023). Removing the uppermost sediment layer and any other sediments that are too weak to support the foundation would temporarily disturb benthic habitats; however, benthic organisms would be expected to recover quickly, and the total area of disturbance would be small relative to the surrounding habitat (COP Volume II, Section 4.5.2.1; Atlantic Shores 2023). Piled foundations may also require seabed preparation prior to installation, causing increased sedimentation and turbidity (COP Volume I, Section 4.2.1; Atlantic Shores 2023). Suction bucket foundations are not expected to require seabed preparation, although it may be required to establish a level surface in the seabed (COP Volume I, Section 4.2.2; Atlantic Shores 2023).

The different foundation types could each serve as artificial reef structures, influencing fish aggregation due to the “reef effect” (COP Volume II, Section 4.5.2.5; Atlantic Shores 2023). The “reef effect” refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat. The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters traveling farther from shore in order to fish. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. However, an increase in fish species could also lead to additional natural predation and consequently a growth in fishing effort, which could decrease fish stocks.

Cumulative Impacts of Alternative F. The incremental impacts contributed by Alternative F to the cumulative impacts on recreation and tourism would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative F. The **minor** adverse impacts and **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternative F. The impacts associated with Alternative F would be slight improvements over the Proposed Action's impacts due to the potential for fish aggregation, but the impact level would not change.

Cumulative Impacts of Alternative F. The incremental impacts contributed by Alternative F to the cumulative impacts on recreation and tourism would be the same as under the Proposed Action and would range from negligible to minor adverse impacts and negligible to minor beneficial impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative F when combined with ongoing and planned activities including planned offshore wind would likely be **minor** adverse and **minor beneficial**.

3.6.8.9 Proposed Mitigation Measures

No measures to mitigate impacts on recreation and tourism have been proposed for analysis.

3.6.8.10 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F from anchoring, land disturbance, lighting, cable emplacement, noise, and traffic would be similar to those of the Proposed Action: **minor** adverse and **minor beneficial** (related to the presence of structures, and whether fish aggregation would increase fishing trips and revenue or decrease fish stocks). The Proposed Action and alternatives could disrupt recreation and tourism during construction, but impacts would be localized and short term, with recreation and tourism possibly displaced temporarily to alternate areas. During operations, the presence of offshore structures would increase navigational complexity in the Lease Area, and scour and cable protection could increase the risk of gear entanglement or loss, and the difficulty with anchoring. Beneficial impacts on recreation and tourism are likely to result due to the reef effect (providing additional locations for recreational for-hire fishing trips) and sightseeing attraction of offshore wind energy structures.

By installing fewer structures, Alternative C would slightly reduce the construction impact footprint and installation period. By altering the layout and number of WTGs, Alternative D would reduce negative visual impacts for tourists who want to experience a vast pristine ocean with less of a developed/industrial visual element. By modifying the wind turbine layout through the exclusion of WTG positions to create a setback from the boundary between the Ocean Wind 1 and Atlantic Shores South Lease Area, Alternative E would improve vessel navigation and safety for recreational fishing vessels in the WTA. Alternatives C, D, and E could also reduce gear entanglements and loss as well as allisions. There would be fewer vessels and vessel trips, reducing the risk of discharges, fuel spills, and trash in the area and decreasing the risk of collision with marine mammals and sea turtles. However, the presence of fewer structures could reduce reef habitat for targeted species, decreasing recreational fishing in the area.

By using different foundation structures, Alternative F could either increase construction noise that adversely affects species important to recreational fishing and sightseeing or reduce noise during foundation installation. Certain foundations require seabed preparation, which increases turbidity and sedimentation and affects benthic habitats, while other foundations do not require removing the top layer of sediment. The foundations in Alternative F could also either encourage or discourage fish aggregation due to the “reef effect,” potentially increasing or decreasing recreational fishing in the area. Fish aggregation could result in recreational boaters traveling farther from shore in order to fish but could also result in increased natural predation and fishing, leading to a decrease in fish stocks.

3.6.9 Scenic and Visual Resources

This section discusses potential impacts on seascape, open ocean, and landscape character and viewers from the proposed Project, alternatives, and ongoing and planned activities in the scenic and visual resources geographic analysis area, as advised in the Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Developments on the Outer Continental Shelf of the United States (BOEM 2021) and the Guidelines for Landscape and Visual Impact Assessment (3rd Edition) (Landscape Institute and Institute of Environmental Management and Assessment 2013). The 45.1-mile (72.6-kilometer) radius geographic analysis area, as shown on Figures 3.6.9-1 and 3.6.9-2, includes the New Jersey coastline from Cape May Borough to Hamilton Township and extends 68.9 miles (110.9 kilometers) offshore and 36 miles (57.9 kilometers) inland to incorporate potential views of the Project. The onshore geographic analysis area encompasses the 3-mile (4.8-kilometer) perimeters for the Cardiff and Larrabee onshore substations. Geographic analysis areas extend 0.25 mile (0.4 kilometer) for landfalls, onshore export cable routes to the onshore substations, and the connections from the onshore substations to the existing grid.

Appendix H, *Seascape, Landscape, and Visual Impact Assessment*, contains additional analysis of the seascape character units, open ocean character unit, landscape character units, and viewer experiences that would be affected by the Proposed Action and alternatives, as well as visual simulations of the Proposed Action alone and in combination with other reasonably foreseeable offshore wind projects (i.e., cumulative simulations). Cumulative simulations assess where the WTGs proposed for other planned offshore wind projects may combine with the Project to produce cumulative visual effects. The cumulative impacts analysis area includes the visibility buffers of lease areas along the New York to Maryland coast. The buffers constitute the maximum theoretical distance a WTG could be visible and were developed using earth curvature (EC)–calculated distances based on WTG heights. Figure 3.6.9-1 shows the buffer for each lease area and Figure 3.6.9-2 shows the buffer for each lease area clipped to the geographic analysis area of the Atlantic Shores South Project. In this way, Figure 3.6.9-2 demonstrates what could be seen from various points within the Atlantic Shores South geographic analysis area.

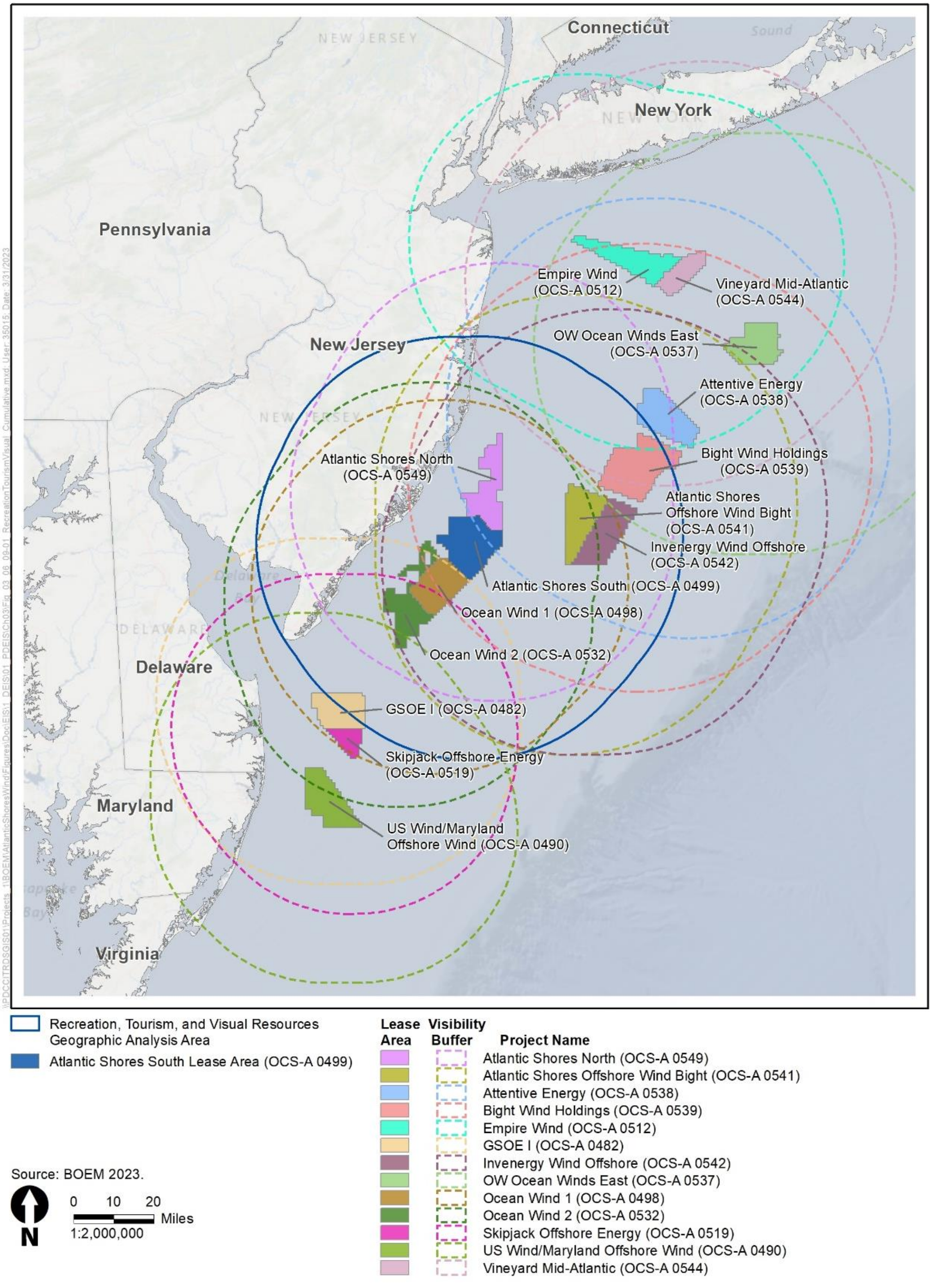


Figure 3.6.9-1. Scenic and Visual Resources geographic analysis area and lease visibility buffers

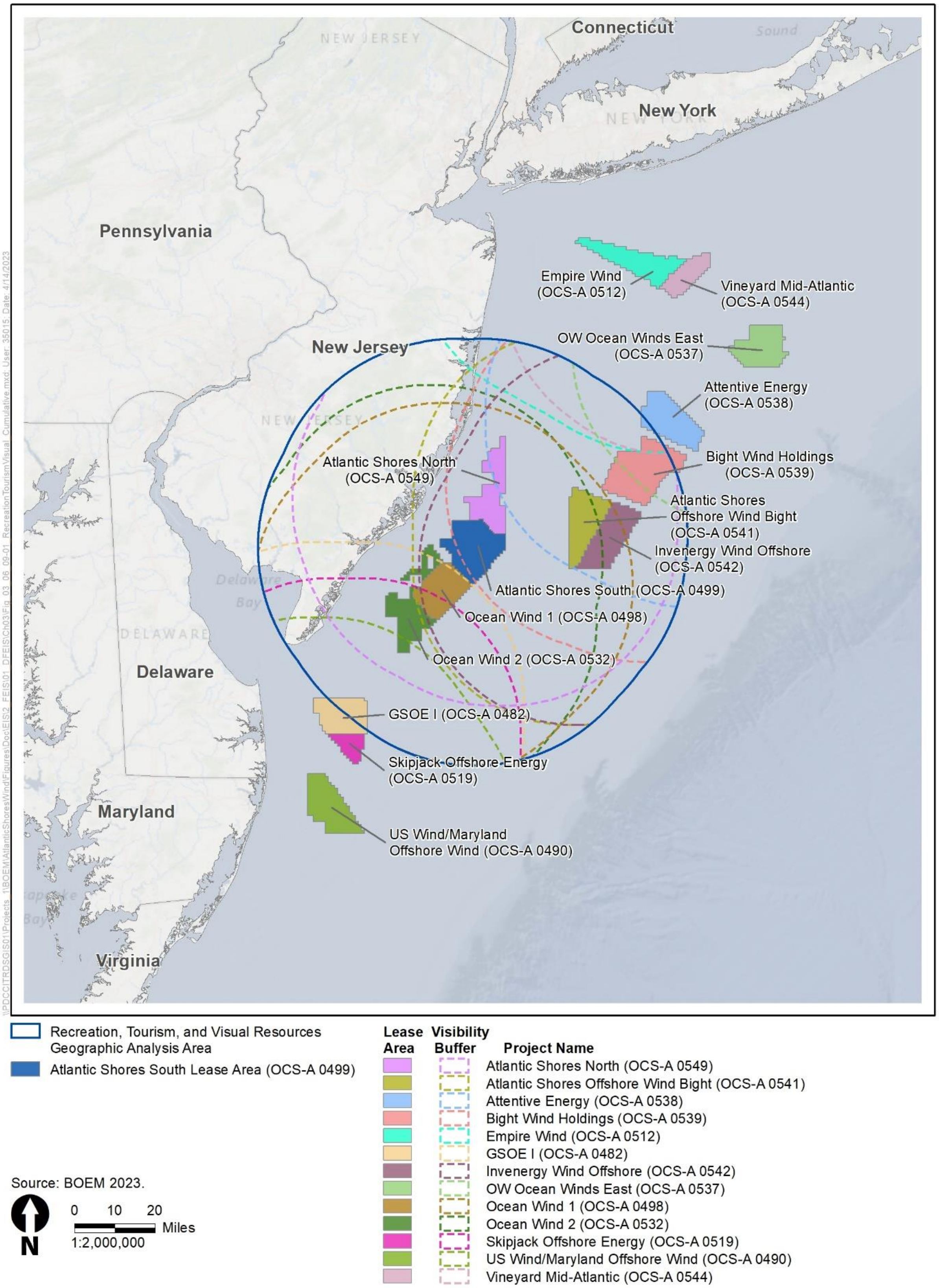


Figure 3.6.9-2. Scenic and Visual Resources geographic analysis area and cumulative impacts analysis area

3.6.9.1 Description of the Affected Environment and Future Baseline Conditions

Seascape and Landscape Impact Assessment Affected Environment

New Jersey's Public Trust Doctrine (New Jersey Supreme Court 1821) holds all tidally flowed lands in trust for the use and enjoyment of the public. This includes the ocean, bays, and tidal rivers, as well as the adjacent shoreline over which these waters flow and, in certain circumstances, some amount of upland area, even if the upland area is privately owned. This section summarizes the seascape, open ocean, landscape, and viewer baseline conditions as described in Volume II, Appendices I-1 (Visual Impact Assessment [VIA]- WTA), I-2 (Visual Impact Assessment-Onshore Facilities-Cardiff), and I-3 (Visual Impact Assessment-Onshore Facilities-Larrabee) of the Atlantic Shores South COP (Atlantic Shores 2023). The demarcation line between seascape and open ocean is the U.S. state jurisdictional boundary, 3 nautical miles (3.45 statute miles [5.5 kilometers]) seaward from the coastline (U.S. Congress Submerged Lands Act, 1953). This line coincides with the area of sea visible from the shoreline. The line defining the separation of seascape and landscape stems from the juxtaposition of apparent seacoast and landward landscape elements, as defined by terrain, water (bays and estuaries), vegetation, and structures.

Laws, Ordinances, and Regulations

Seascape, landscape, and visual resource protection and management laws, ordinances, and regulations summaries are listed in Table 3.6.9-1 (COP Volume II, Appendix II-M1; Atlantic Shores 2023).

Table 3.6.9-1. Laws, Ordinances, and Regulations

Jurisdiction	Document	Scenic Objectives
Federal		
National Park Service	National Register of Historic Places (National Historic Preservation Act 1966)	The geographic analysis area contains 43 historic districts and individual properties listed or eligible for listing on the National Register of Historic Places and two properties or districts listed as National Historic Landmarks (NHL). The two NHL sites include the Atlantic City Convention Hall in Atlantic City and Lucy, the Margate Elephant in Margate City. They are sited approximately 11.4 miles (18.3 kilometers) and 14.4 miles (23.2 kilometers) from the WTA, respectively.
National Park Service	Public Law 100-515 (1988)	The New Jersey Coastal Heritage Trail was established by federal legislation to promote awareness, stewardship, and protection of natural and cultural resources along 300 miles (482.8 kilometers) of New Jersey's Atlantic coast and Delaware Bay.
National Park Service	National Natural Landmarks Program (2021)	Manahawkin Bottomland Hardwood Forest is the only designated National Natural Landmark (NNL) within the geographic analysis area and is located approximately 21.0 miles (33.8 kilometers) from the WTA.
U.S. Fish and Wildlife Service	National Wildlife Refuge System (2021)	The Edwin B. Forsythe NWR is located 9.2 miles (14.8 kilometers) from the nearest proposed WTG. The Cape May NWR is located 22.9 miles (36.9 kilometers) from the WTA.

Jurisdiction	Document	Scenic Objectives
USDA Forest Service and USDI National Park Service	Wild and Scenic Rivers Act (1968)	The National Wild and Scenic Rivers System was created to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition. Within the ZVI there is one such designated resource, the Great Egg Harbor Wild and Scenic River, located approximately 19.6 miles (31.5 kilometers) from the WTA.
State of New Jersey		
State Historic Preservation Office	New Jersey State Register of Historic Places	The geographic analysis area contains historic resources that the state has determined are worthy of preservation, but which have either not been determined eligible for inclusion or have not been evaluated for listing in the National Register of Historic Places.
Department of Transportation	Scenic Byways (2018)	One Scenic Byway, the Southern Pinelands Natural Heritage Trail, is located within the ZVI approximately 16.7 miles (26.9 kilometers) from the WTA.
Department of Environmental Protection	State Forests (2020)	Bass River State Forest, located approximately 18.0 miles (29.0 kilometers) from the nearest WTG, is the closest State Forest to the WTA. The forest provides recreational opportunities such as hiking, picnicking, camping, and hunting, as well as swimming, fishing, boating, and canoeing on Lake Absegami. Wharton State Forest is located approximately 23.7 miles (38.1 kilometers) from the WTA. The forest includes rivers and streams for canoeing, hiking trails, unpaved roads for mountain biking and horseback riding, and lakes, ponds, and fields for wildlife viewing. Belleplain State Forest is located approximately 26.7 miles (43.0 kilometers) from the WTA. The forest was established for recreation, wildlife management, timber production, and water conservation and includes Lake Nummy, a popular swimming, boating, and fishing area.
Department of Environmental Protection	State Wildlife Management Areas (2021)	There are 16 State Wildlife Management Areas (WMAs) within the geographic analysis area. These state-owned lands are managed to provide wildlife habitat and accommodate wildlife-related recreation (hunting, bird watching, etc.). The closest WMA to the WTGs is the Absecon WMA, located 10.3 miles (16.6 kilometers) from the WTA.
Department of Environmental Protection	State Nature Reserves (2018)	Twelve State Nature Preserves occur within the geographic analysis area. North Brigantine State Natural Area is located 8.9 miles (14.3 kilometers) from the WTA. The natural area is located on the central New Jersey coast and is part of the longest stretch of undeveloped barrier island beach in the state. The natural area provides recreational opportunities such as walking, wildlife viewing, sunbathing, and fishing.
Department of Environmental Protection	State Parks (2020)	Corson's Inlet State Park is located 21.3 miles (34.3 kilometers) from the WTA. This oceanfront park offers hiking, fishing, crabbing, boating, and sunbathing. Island Beach State Park and Barnegat Lighthouse State Park are located 26.9 miles (43.3 kilometers) and 27.2 miles (43.8 kilometers), respectively, from the WTA. Island Beach State Park is a 10-mile-long (16.1-kilometer-long) barrier island between the Atlantic Ocean and Barnegat Bay that offers swimming, picnicking, bicycling, horseback riding, sailboarding, surfing, scuba diving, and hunting.

Jurisdiction	Document	Scenic Objectives
		Barnegat Lighthouse State Park features the Barnegat Lighthouse as well as recreational opportunities such as hiking trails, fishing, wildlife viewing, and picnicking.
Atlantic County		
Atlantic County	Atlantic County, New Jersey Master Plan (2018) Atlantic County, New Jersey Open Space and Recreation Plan (2018)	The Master Plan includes a goal to preserve and protect resources, environmentally sensitive areas, particularly watersheds, recharge areas, threatened and endangered species habitat, scenic view sheds, and other valuable features. The Pine Barrens Byway, which includes a variety of historic and scenic sites, is partially located within the county. There are no specific provisions of additional planned locations to preserve and protect scenic view sheds from within the community or the ocean/beach areas. The Open Space and Recreation Plan includes goals and objectives that are to be consistent with the state-wide Master Plan open space goals. This plan provides no specific provisions of planned locations to preserve and protect scenic view sheds from within the community or the ocean/beach areas.
Absecon, City of	2016 Reexamination Report (2017)	Objectives or problems identified from previous plans and reports that relate to scenic or visual quality include the need to develop and implement programs and regulatory controls to protect scenic resources. The residential structures along the Shore Road Corridor and adjacent streets are specifically referenced. Efforts taken since 2005 to address protect scenic resources that are identified include a renovation to Howlett Hall. No recommendations for future goals or objectives are made for protection of scenic resources. However, the plan introduces recommendations for historic preservation, which include streetscape improvements and additional historical signage to promote local history and culture, and zoning measures to preserve the architectural character of the Shore Road Corridor. Provisions pertaining to the visual quality in this report mostly address aesthetic standards, as expressed through streetscape and architectural standards. There is no specific mention of the preservation of outward views from within communities, nor ocean/beach views.
Atlantic City	Atlantic City Master Plan (2008) Master Plan Reexamination Report (2016)	The Atlantic City Master Plan (2008): Identifies several provisions pertaining to visual quality or scenic resources, the majority of which occur in the Open Space and Recreation or Conservation Elements. An objective to "[p]reserve and protect open space areas that have scenic views and/or important historical, cultural significance and exceptional ecological value" is identified in the Open Space and Recreation Element. This Element also identifies Gardner's Basin Maritime Park as having scenic quality in the statement, "the Park offers an alternative to the resort's casino industry by allowing non-gambling visitors to seek quiet respite in the City's most scenic park by simply sitting by the water's edge, dining, taking in a boat ride or visiting the Aquarium." The Conservation Element describes the scenic value of wetlands and marshes in the statement, "[t]he flat landscape of tidal marshes provide grand scenic views of Atlantic City's spectacular urban skyline, thus enhancing the tourist experience." The land use

Jurisdiction	Document	Scenic Objectives
		section also identifies a development strategy that could create a "view corridor" extending from Melrose Park south to the Atlantic Ocean, and an improvement to the fishing pier located on West End Avenue that could enhance "beautiful views over the preserved wetlands" from this location. Although these resources are identified as being scenic for the outward views that they offer, no provisions are made to protect or preserve these views. Provisions pertaining to the visual quality in this report mostly address aesthetic standards, as expressed through streetscape, architectural standards, and preservation of historic structures.
Brigantine, City of	2016 Master Plan Re-examination Report (2016)	An objective identified from the previous planning documents includes an intent to "implement programs and regulatory controls designed to protect the scenic resources of the community." Previous actions taken to address this objective include zoning controls such as building height restrictions and setbacks. A "2016 follow-up" within this section of the report identifies public concern for access to scenic resources: "[a]nother aspect of the planning process has been the desire expressed by local residents for scenic views and resources to be protected and accessible to all. The development of the waterfronts, in particular the back bay areas has provided limited public access to street ends and points of access to the bay visually in many locations." It also identifies that there is "…an ongoing concern about visual access and scenic corridors on the Island, and there is a continuing desire to renovate some of the less desirable views…" and a need to promote and preserve access to the Bay and Atlantic Ocean. A general goal "to promote a desirable visual environment through creative development techniques and good civic design and arrangements" is in the 2016 General Goals and Objectives Statement section. Provisions are made in subsequent sections to respond to this objective and improve the visual environment through changes to building setbacks, height restrictions, and similar measures. However, no additional measures intended to protect or enhance visual access and protecting scenic corridors are proposed.
Corbin City	None Identified	
Egg Harbor Township	Egg Harbor Township Master Plan (2002) Master Plan Reexamination Report (2017)	The Great Egg Harbor River and its tributaries are described as a scenic resource in the following statement, "[t]he Great Egg Harbor River and its tributaries contain an abundance of scenic landscapes – lakes, streams, pristine forest areas, and cedar / hardwood swamps. The Pinelands Comprehensive Management Plan designates the lower and middle portions of the river and its tributaries as scenic corridors of "special significance" within the Pinelands." It identifies the need to incorporate resource protection measures and proposes the creation of a River Conservation (RC) overlay zoning district and the establishment of a land use plan that protects river resources. Several possible recommendations for this zoning district are identified, including "adopt design guidelines that include recommendations for… minimizing the visual impacts of development as seen from the River." The River Management Plan provides a model ordinance

Jurisdiction	Document	Scenic Objectives
		for what a future RC overlay district could consist of. This includes zoning controls, such as vegetation buffer requirements, setback and building height requirements, and prohibited land uses. As of the 2017 Reexamination Report, there was no progress in implementing the proposed RC zone overlay; therefore, it is still a recommendation in the zoning section of this plan. No specific provisions or review process that specifically requires minimization of visual impact beyond restrictions is identified.
Estell Manor	None Identified	
Galloway Township	Master Plan Reexamination Report (2020)	An objective identified from the previous planning documents is to preserve and protect open space areas having scenic views and/or important historical, cultural, or agricultural significance. Another identified objective is to maintain continuous networks of open spaces along streams, scenic areas, and critical environmental areas. The plan, however, provides no recommended changes or further initiatives in regard to these objectives that would enhance or protect visual and scenic access.
Linwood, City of	City of Linwood Master Plan (2002) Master Plan Reexamination Report (2018)	The City of Linwood's goals include the provision to preserve Linwood's historic, scenic, and recreational assets. However, there is no specific mention of the preservation of outward views from within the community, nor ocean/beach views. There are no provisions in the reexamination report for the preservation of outward views from within the community, nor ocean/beach views.
Northfield, City of	City of Northfield Master Plan Re-examination (2008)	The objectives identified from previous planning documents include those that promote a desirable visual environment through creative development techniques that respect the environmental qualities and constraints of the City. The report identifies an objective to promote the conservation of historic sites and districts, open space, energy resources, and valuable natural resources in the City to prevent degradation of the environment through improper use of land. There are no provisions in the reexamination report for the preservation of outward views from within the community, nor ocean/beach views.
Pleasantville, City of	Master Plan Elements (2016)	There are no provisions in the Master Plan for scenic assets or the preservation of outward views from within the community, nor ocean/beach views.
Port Republic, City of	None Identified	
Somers Point, City of	Somers Point Master Plan Reexamination (2015)	There are no provisions in the reexamination report for scenic assets or the preservation of outward views from within the community, nor ocean/beach views.
Ventnor City	2016 Master Plan Reexamination (2016)	There are no provisions in the reexamination report for scenic assets or the preservation of outward views from within the community, nor ocean/beach views.
Burlington County	Parks and Open Space Master Plan (2002)	An objective of this plan is to identify and preserve areas of significant scenic beauty. The objective narrative includes "roads that provide visual or physical access to extraordinary scenic, cultural, recreational, or natural features will be submitted to the

Jurisdiction	Document	Scenic Objectives
		New Jersey Department of Transportation (NJDOT) for designation in accordance with the New Jersey Scenic Byways Program." The plan also recommends that the county staff should work with outside agencies to identify, map, and develop viewsheds and areas of significant beauty. As a part of the county's goal to advance the county's cultural character and heritage through development of the county park system, the county has plans to erect interpretative signs to promote historic viewsheds. There are no provisions in the Master Plan for scenic assets or the preservation of outward views from ocean/beach views.
Cape May County	Cape May County Open Space and Recreation Plan (Adopted 2005, Amended 2007) 2021 Comprehensive Plan – Editorial Draft (2021)	The Cape May County Open Space and Recreation Plan was prepared to meet the goal of preserving and protecting natural and scenic resources. There are no provisions in the plan for specific scenic assets or the preservation of outward views from within the community, nor ocean/beach views. There are no provisions in the comprehensive plan report for specific scenic assets or the preservation of outward views from within the community, nor ocean/beach views.
Dennis Township	Natural Resources Inventory (Adopted 2007, Revised 2010) Master Plan – Land Use Plan (Adopted 2009, Revised 2012) Community Forestry Management Plan 2009 – 2014, Updated for 2015-2019 (2014)	While the Natural Resource Inventory lists the scenic assets of the Township, there are no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views. The Town of Dennis Land Use Plan includes a goal to retain a scenic landscape edge along all roads to buffer and to maintain the unique scenic attributes of the Township's environment. However, the plan provides no specific policies or scenic assets to protect for outward views from within the community, nor beach/ocean views. The Township of Dennis Forestry Plan provides no specific policies or scenic assets to protect for outward views from within the community, nor beach/ocean views.
Middle Township	Natural Resources Inventory (Adopted 2007, Revised 2010) Master Plan Reexamination Report (2010) Master Plan – Land Use Plan Updates (2010)	While the Natural Resource Inventory lists the scenic assets of the Township, there are no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views. The Township of Middle Master Plan Reexamination Report includes no specific policies or scenic assets to protect for outward views from within the community, nor beach/ocean views. The Middle Township Master Plan Land Use Update provides no specific policies or scenic assets to protect for outward views from within the community, nor beach/ocean views.
North Wildwood, City of	None Identified	
Ocean City	City of Ocean City Master Plan (Adopted 1988, Revised 2006) Ocean City Open Space & Recreation Plan (2014) Master Plan Reexamination Report (2019)	An objective of the Ocean City Master Plan is to promote a desirable visual environment through creative development techniques with respect to environmental assets and constraints of the overall city and of individual development sites. Another objective is to encourage the preservation and restoration of historically significant buildings and sites within the city in order to maintain the heritage of Ocean City for enjoyment of future generations. There are development provisions for accessory structures in the waterfront neighborhoods of the city to preserve

Jurisdiction	Document	Scenic Objectives
		waterfront views. The Ocean City Open Space and Recreation Plan includes a conservation goal to preserve and maintain the ecological, historical, visual, recreational and scenic resources of the City. The Plan includes guidelines to acquire sites of special scenic value that should be protected to preserve or enhance the character of the community. The Master Plan Reexamination Report includes no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Sea Isle City	2017 Master Plan Reexamination Report (2017)	While the Master Plan Reexamination Report lists the scenic assets of the City, there are no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Stone Harbor Borough	Stone Harbor Master Plan (2009) Borough of Stone Harbor Master Plan Reexamination Report (2019)	The Land Use Recommendations of the Master Plan include that as the waterfront districts are redeveloped, protected vistas of the bay waters should be incorporated into new development plans and street ends should resolve in terminating vistas of scenic or remarkable landmarks. The recommendations further include architectural standards to maintain views of the bay and waterfront. The Reexamination Report mentions that the Public Use District marina does not provide a sense of place, both form and function are not commensurate with the science qualities of its prime waterfront location. A recommended Marina District Master Plan has not been completed.
Upper Township	Upper Township Master Plan Reexamination Report and Land Use Plan Amendment (2006) Natural Resources Inventory (2006) 2018 Master Plan Reexamination Report (2018) 2020 Master Plan Reexamination Report (2020)	The Master Plan includes no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views. While the Natural Resource Inventory lists the scenic assets of the Township, there are no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views. The Reexamination Reports of 2018 and 2020 include no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Ocean County		
Ocean County	Conservation Plan Element-Environmental Resources and Recreation Inventory 2009 2011 Comprehensive Master Plan (2011) Open Space, Parks & Recreation Plan (2020)	The Comprehensive Master Plan includes no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views. The Conservation Plan Element's overall goal is to preserve and maintain the ecological, historic, visual, recreational, and scenic resources of the City. However, there are no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views. The Open Space, Parks, and Recreation Plan includes no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views.

Jurisdiction	Document	Scenic Objectives
Barnegat Township	2011 Barnegat Township Master Plan (2011)	The Master Plan includes no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Beach Haven Borough	Beach Haven Borough Comprehensive Master Plan (2017)	A goal of the Comprehensive Master Plan within the Public Access Plan Section is to maintain and continue to promote a visually pleasing aesthetic along the waterfront areas. However, there are no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Berkeley Township	Berkeley Township Comprehensive Master Plan (1997) General Reexamination of the Master Plan (2019) Environmental Resources Inventory (2012)	The Township Master Plan and the Reexamination Report include no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views. The Township Environmental Resources Inventory includes no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Eagleswood Township	None Identified	
Lacey Township	Master Plan (1991) Master Plan Reexamination Report (2012) Lacey Township Master Plan Updated – Revised Land Use Element (2016)	The Township Master Plan includes a townscape objective that states that any and all elements that could be obtrusive to the boating public should be reviewed and specifically addressed through view studies or simulations prior to receiving approvals. The Township Reexamination Report includes no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views. The Revised Land Use Element also includes no specific provisions for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Little Egg Harbor Township	1999 Master Plan (1999)	The Township Master Plan includes a goal to promote a desirable visual environment through conservation and preservation of valuable natural features. However, it includes no specific provisions or scenic assets for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Long Beach Township	Master Plan Update (2017)	The Comprehensive Master Plan includes no specific provisions or scenic assets for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Ocean Township	Ocean Township Master Plan (1990) 2019 Master Plan Reexamination Report (2019)	The Ocean Township Master Plan includes a conservation goal to identify scenic areas within the Township and provide for their preservation. The Reexamination Report includes no specific provisions or scenic assets for protecting or enhancing the outward views from within the community, nor beach/ocean views.
Stafford Township	Natural Resources Inventory (2016) Township of Toms River Master Plan (2017)	The Master Plan Land Use Element includes no specific provisions for the preservation of outward views from within communities, nor ocean/beach views. The Natural Resource Inventory includes no specific provisions for the preservation of outward views from within communities, nor ocean/beach views.

Jurisdiction	Document	Scenic Objectives
Toms River Township	Natural Resources Inventory (2016) Township of Toms River Master Plan (2017)	The Master Plan Land Use Element includes no specific provisions for the preservation of outward views from within communities, nor ocean/beach views. The Natural Resource Inventory includes no specific provisions for the preservation of outward views from within communities, nor ocean/beach views.
Tuckerton Borough	None Identified	

Figure 3.6.9-3 provides an overview of seascape and landscape in the geographic analysis area, including the key observation point (KOP) locations. Figure 3.6.9-4 shows the extent of visibility of the Offshore Project WTA and onshore substations and/or converter stations.

The geographic analysis area's landforms, water, vegetation, and built environment structures contain common and distinctive landscape features as outlined in Table 3.6.9-2.

Table 3.6.9-2. Landform, water, vegetation, and structures

Category	Landscape Features
Landform	Flat shorelines to gently sloping beaches, dunes, islands, and inland topography.
Water	Ocean, bay, estuary, tidal river, river, and stream water patterns.
Vegetation	Tidal salt marshes and estuarine biomes, beach grass, meadows, and maritime forests; vegetation community indicator species: beach plum (*Prunus maritime*), sweet pepperbush (*Clethra alnifolia*), highbush blueberry (*Vaccinium corymbosum*), poison ivy (*Toxicodendron radicans*), sour gum (*Nyssa sylvatica*), swamp magnolia (*Magnolia virginiana*), red cedar (*Juniperus virginiana*), and red maple (*Acer rubrum*).
Structures	Buildings, plazas, signage, walks, parking, roads, trails, seawalls, jetties, and infrastructure.

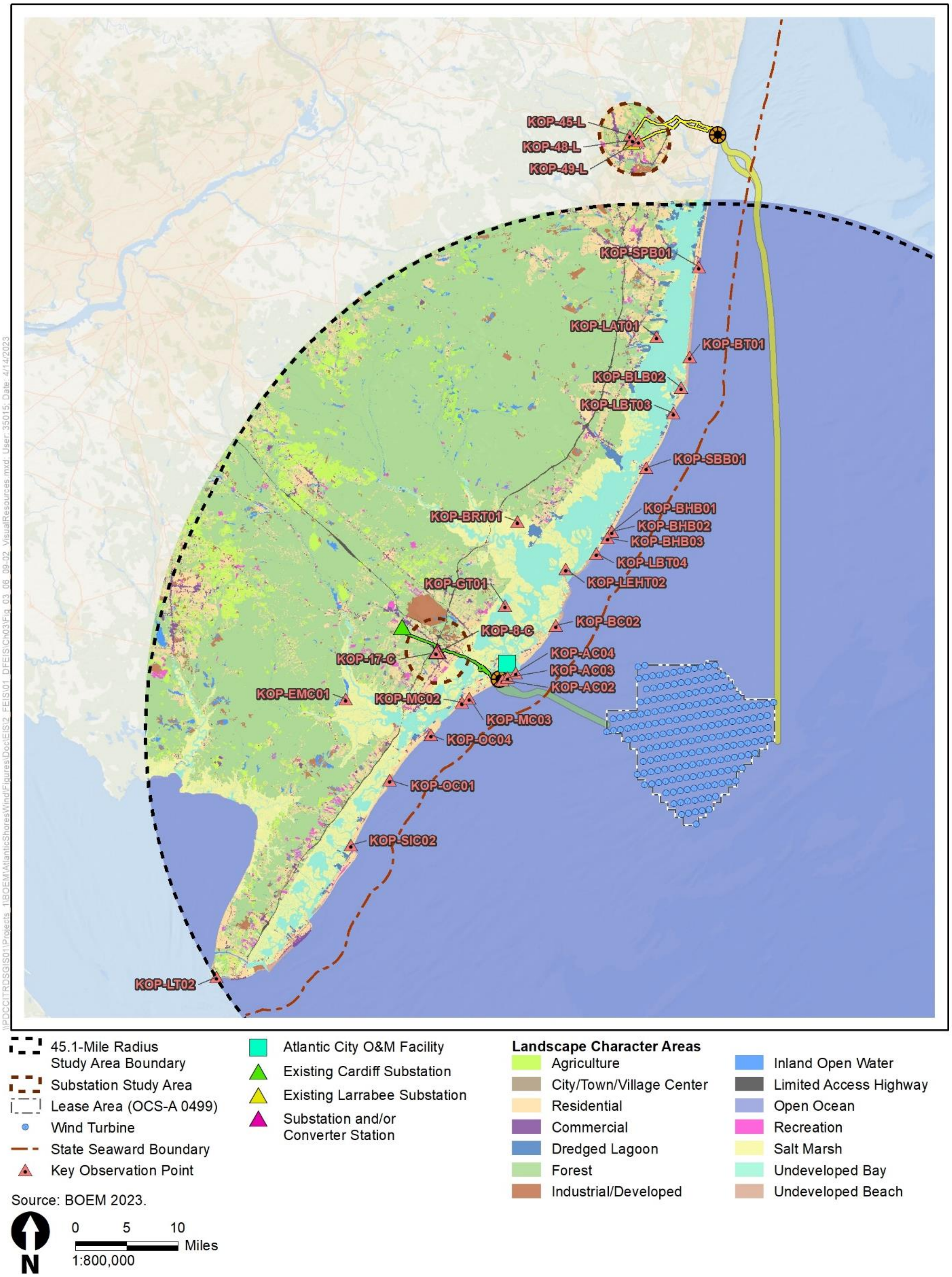


Figure 3.6.9-3. Scenic resources and key observation points

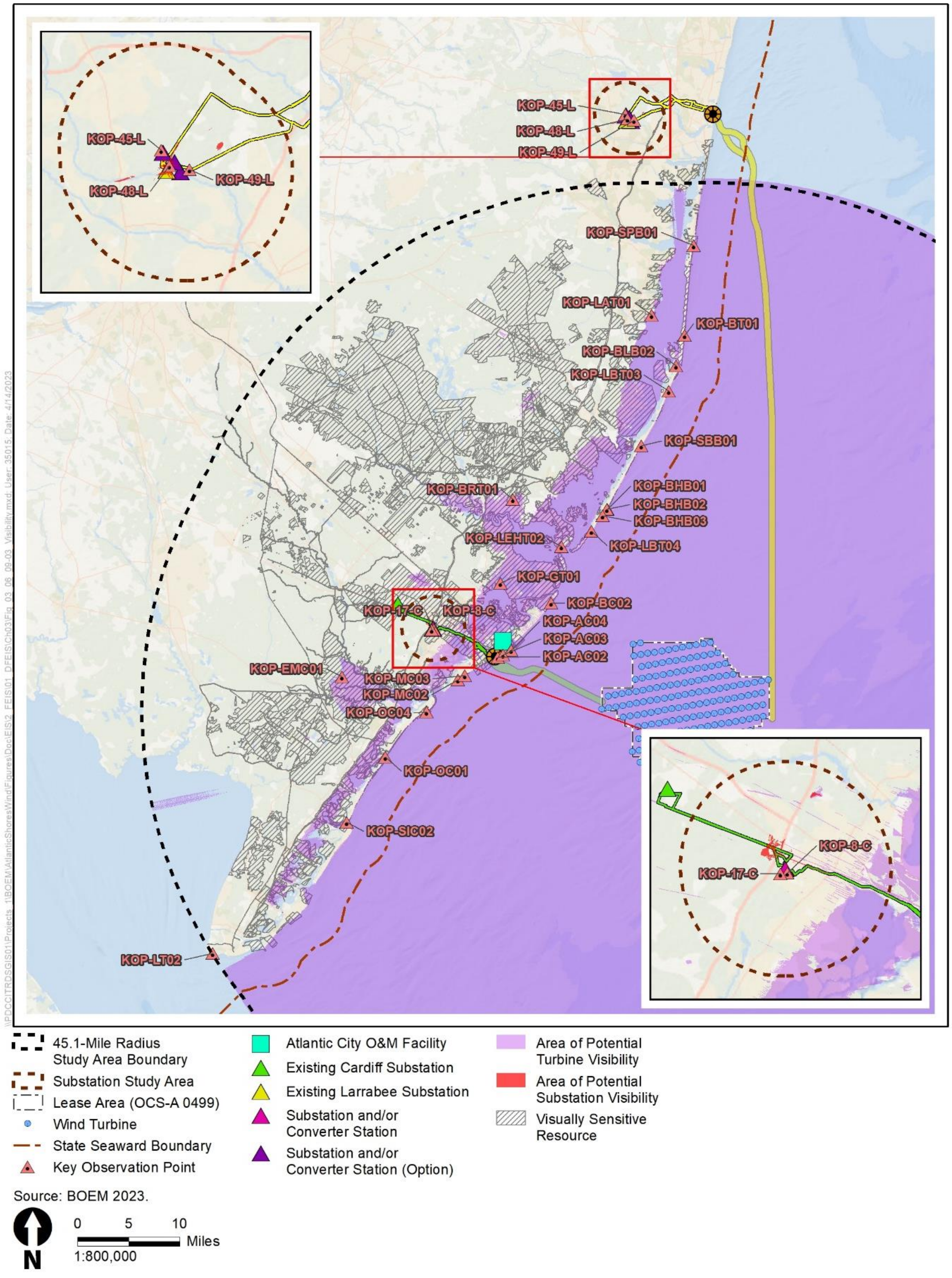


Figure 3.6.9-4. Offshore and onshore facility viewsheds

The visual characteristics of the seascape, open ocean, and landscape in the geographic analysis area, including surroundings of the WTA, landfall sites, offshore and onshore export cable corridors, and onshore substation and/or converter station areas, contain both locally common and regionally distinctive physical features, characters, and experiential views (Table 3.6.9-3).

Table 3.6.9-3. Seascape, open ocean, and landscape conditions

Category	Seascape, Open Ocean, and Landscape
Seascape	Intervisibility by pedestrians and boaters within coastal and adjacent marine areas (3.45 miles [5.6 kilometers]) within the 45.1-mile (72.6-kilometer) radius geographic analysis area.
Seascape Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, whitecaps, and breakers.
Seascape Character	Experiential characteristics stem from built and natural landscape forms, lines, colors, and textures to the foreground water's tranquil, mirrored, and flat; active, rolling, and angular; vibrant, churning, and precipitous. Forms range from horizontal planar to vertical structures', landscapes', and water's slopes; lines range from continuous to fragmented and angular; colors of structures, landscape, and the water's foam and spray reflect the changing colors of the daytime and nighttime, built environment, land cover, sky, clouds, fog, and haze; and textures range from mirrored smooth to disjointed coarse.
Open Ocean	Intervisibility from seagoing vessels within the open ocean (beyond the 3.45-mile [5.6-kilometer] seascape area) within the 45.1-mile (72.6-kilometer) geographic analysis area, including recreational cruising and fishing boats, commercial "cruise ship" routes, commercial fishing activities, tankers and cargo vessels, and air traffic over and near the WTG array and cable routes.
Open Ocean Features	Physical features range from flat water to ripples, waves, swells, surf, foam, chop, whitecaps, and breakers.
Open Ocean Character	Experiential characteristics range from tranquil, mirrored, and flat; to active, rolling, and angular; to vibrant, churning, and precipitous. Forms range from horizontal planar to vertical slopes; lines range from continuous and horizontal to fragmented and angular; colors of water, foam, and spray reflect the changing colors of sky, clouds, fog, haze, and the daytime and nighttime, built environment and land cover; and textures range from mirrored smooth to disjointed coarse.
Landscape	Intervisibility within the adjacent inland areas, seascape, and open ocean; nighttime views diminished by ambient light levels of shorefront development; open, modulated, and closed views of water, landscape, and built environment; and pedestrian, bike, and vehicular traffic throughout the region.
Landscape Features	Natural elements: landward areas of barrier islands, bays, marshlands, shorelines, vegetation, tidal rivers, flat topography, and natural areas. Built elements: boardwalks, bridges, buildings, gardens, jetties, landscapes, life-saving stations, umbrellas, lighthouses, parks, piers, roads, seawalls, skylines, trails, single-family residences, commercial corridors, village centers, mid-rise motels, moderate to high-density residences, and high-rise casinos.

Category	Seascape, Open Ocean, and Landscape
Landscape Character	Tranquil and pristine natural, to vibrant and ordered, to chaotic and disordered.
Designated Public Places	Barnegat Branch Trail, Barnegat Lighthouse State Park, Bass River State Forest, Belleplain State Forest, Cape May National Wildlife Refuge, Cape May State Park, Corson's Inlet State Park, Crook Horn Creek, Edwin B. Forsythe National Wildlife Refuge, Emil Palmer Park, Enos Pond County Park, Forked River State Marina, Forked River Mountain WMA, Garden State Parkway, Gillian's Wonderland Pier, Great Egg Harbor Bay, Island Beach State Park, National Natural Landmark Manahawkin Bottomland Hardwood Forest, Ocean City Boardwalk, Ocean City Park, Peck Bay, Sandcastle Park, Southern Pinelands Natural Heritage Trail, Stainton Wildlife Refuge, Stone Harbor Bird Sanctuary, Tuckahoe WMA, Upper Barnegat Bay WMA, Vincent Klune Park, and Wharton State Forest.

WMA = Wildlife Management Area

The geographic analysis area's seascape character areas, open ocean character area, and landscape character areas are classified by broadly defined USEPA Level IV Ecoregions (COP Volume II, Appendix II-M1; Atlantic Shores 2023). These areas are based on major features and elements in the characteristic landscape that define the physical character, "feel," and "experiential qualities" of the geographic analysis area and include open ocean, shoreline, coast, marsh and bay, and inland areas. Seascape, open ocean, and landscape character areas provide specific spatial locations and description of the existing area and provide a framework to systematically analyze potential visual effects throughout the geographic analysis area (COP Volume II, Appendix II-M1, Section 1.2.3; Atlantic Shores 2023). The extents of seascape character areas, open ocean character area, and landscape character areas used in this analysis are summarized in Table 3.6.9-4.

Table 3.6.9-4. Seascape, open ocean, and landscape character areas

Regional Landscape and Character Area	Square Miles (Square Kilometers) of Seascape, Ocean, and Landscape Character Area	Square Miles (Square Kilometers) Within the Zone of Potential Visual Influence	Percentage of Character Area in the Zone of Potential Visual Influence
Open Ocean	6,657.8 (17,243.6)	6,657.8 (17,243.6)	100
Shoreline/Barrier Island			
Atlantic City[1]	3.1 (112.68)	0.2 (0.5)	6.9
Commercial Beachfront	1.4 (3.6)	0.9 (2.3)	68.7
Commercial Strip Development[1]	29.5 (76.4)	0.4 (1.0)	1.5
Dredged Lagoon	14.3 (37.0)	3.5 (9.1)	3.3
Recreation[1]	20.2 (52.3)	0.6 (1.6)	3.2
Residential Beachfront	8.2 (21.3	3.1 (7.9)	37.0
Town/Village Center[1]	2.6 (6.7)	<0.1 (<0.3)	0.3
Undeveloped Beach	7.9 (20.5)	3.05 (7.9)	38.5
Inland Bay			
Bayfront Residential	3.3 (8.5)	0.2 (0.5)	6.1
Salt Marsh	214.7 (556.1)	112 (290.1)	52.1
Undeveloped Bay	209.1 (549.7)	155.6 (403.1)	74.4
Inland/Mainland			
Agriculture	110.2 (8.0)	<0.1 (<0.1)	<0.1
Atlantic City [1]	3.1 (112.68)	0.2 (0.5)	6.9

Regional Landscape and Character Area	Square Miles (Square Kilometers) of Seascape, Ocean, and Landscape Character Area	Square Miles (Square Kilometers) Within the Zone of Potential Visual Influence	Percentage of Character Area in the Zone of Potential Visual Influence
Commercial Strip Development[1]	29.5 (76.4)	0.4 (1.0)	1.5
Forest	1,273.1 (3,297.3)	2.1 (5.4)	0.2
Industrial Developed	37.8 (97.9)	2.6 (6.7)	6.8
Inland Open Water	26.6 (68.9)	0.7 (1.8)	2.6
Inland Residential	223.8 (579.6)	1.1 (2.8)	0.5
Limited Access Highway	9.6 (24.9)	0.3 (7.8)	3.6
Recreation[1]	20.2 (52.3)	0.6 (1.6)	3.2
Town/Village Center[1]	2.6 (6.7)	<0.1 (<0.3)	0.3
Onshore Cardiff Area			
Commercial	2.628 (6.806)	0.065 (0.168)	2.49
Forest	9.891 (25.617)	0.025 0.065)	0.25
High Density Residential	1.017 (2.634)	0.025(0.064)	2.43
Industrial	2.103 (5.049	0.020 (0.051)	0.97
Inland Bay	1.497 (3.877)	0.000 (0.000)	0.06
Inland Water	0.232 (0.602)	<0.001 (0.002)	<0.01
Low Density Residential	1.018 (2.638)	0.001 (0.003)	0.06
Medium Density Residential	7.732 (20.028)	0.004 (0.011)	0.97
Recreation	0.720 (1.865)	0.002 (0.004)	1.86
Salt Marsh	3.224 (8.351)	0.000 (0.000)	0.00
Transportation	0.556 (1.441)	0.010 (0.027)	0.3
Onshore Larrabee Brook Road Area			
Agriculture	1.560 (4.041)	0.032 (0.084)	2.07
Commercial	2.505 (6.487)	0.004 (0.011)	0.16
Forest	14.379 (37.243)	0.227 (0.587)	1.58
High Density Residential	2.081 (5.089)	0.001 (0.001)	0.03
Industrial	1.971 (5.104)	0.077 (0.199)	3.91
Inland Water	0.366 (0.949)	0.001 (0.001)	0.13
Low Density Residential	3.251 (8.419)	0.028 (0.073)	0.86
Medium Density Residential	9.426 (24.413)	0.003 (0.008)	0.03
Recreation	1.337 (4.463)	0.005 0.013)	0.37
Transportation	0.377 (0.977)	0.000 (0.000)	0.00
Onshore Larrabee Randolph Road Area			
Agriculture	1.560 (4.041)	0.004 (0.013)	0.31
Commercial	2.505 (6.487)	0.000 (0.000)	0.00
Forest	14.379 (37.243)	0.035 (0.091)	0.25
High Density Residential	2.081 (5.089)	0.001 (0.003)	0.05
Industrial	1.971 (5.104)	0.67 (0.174)	3.41
Inland Water	0.366 (0.949)	<0.001 (<0.001)	0.02
Low Density Residential	3.251 (8.419)	0.006 (0.015)	0.18
Medium Density Residential	9.426 (24.413)	<0.001 (<0.001)	<0.01
Recreation	1.337 (4.463)	0.001 (0.003)	0.09
Transportation	0.377 (0.977)	0.000 (0.000)	0.00

Regional Landscape and Character Area	Square Miles (Square Kilometers) of Seascape, Ocean, and Landscape Character Area	Square Miles (Square Kilometers) Within the Zone of Potential Visual Influence	Percentage of Character Area in the Zone of Potential Visual Influence
Onshore Larrabee Lanes Pond Road Area			
Agriculture	1.560 (4.041)	0.019 (0.048)	1.19
Commercial	2.505 (6.487)	0.000 (0.000)	0.00
Forest	14.379 (37.243)	0.020 (0.052)	0.14
High Density Residential	2.081 (5.089)	<0.001 (<0.001)	<0.01
Industrial	1.971 (5.104)	<0.001 <0.001)	0.54
Inland Water	0.366 (0.949)	<0.001 <0.001)	0.26
Low Density Residential	3.251 (8.419)	0.028 (0.072)	0.85
Medium Density Residential	9.426 (24.413)	0.001 (0.001)	0.01
Recreation	1.337 (4.463)	<0.001 (<0.001)	<0.01
Transportation	0.377 (0.977)	0.000 (0.000)	0.00

Source: COP Volume II, Appendix II-M1, Table 1.2-2; Atlantic Shores 2023.
[1] Character area occurs in more than one regional landscape.

Scenic resource susceptibility, value, and sensitivity analyses document the region's world-renowned views, nature, culture, and history. The Project's affected character area extents are calculated through geographic information system (GIS) visibility studies and calculate the Project's affected resources' extents, verified and augmented by expert onsite analysis (COP Volume II, Appendix II-M1; Atlantic Shores 2023).

Susceptibility is informed by the overall character of a particular seascape or landscape area, or by an individual element and/or feature, or by a particular aesthetic, experiential, and perceptual aspect that contributes to the character of the area. Value stems from the characteristics and qualities of the natural and cultural environments, and the perceptual, experiential, and aesthetic qualities of the potentially affected ocean, seascapes, and landscapes. Sensitivity results from consideration of both susceptibility and value. As is common in NEPA, a higher rating prevails over a lower rating.

Open ocean sensitivity ratings for ocean character areas (OCAs) include the following.

- **High**: Open ocean characteristics are highly susceptible to the project and highly valued by residents and visitors.
- **Medium**: Open ocean characteristics have medium susceptibility to the project and are of medium value to residents and visitors.
- **Low**: Open ocean characteristics have low susceptibility to the project and are of low value.

The sensitivity of the geographic analysis area's seascape character (SCA) is defined by its innate features and elements, its susceptibility to the Project, and its value to residents and visitors. Seascape sensitivity ratings include the following.

- **High**: Seascape characteristics are highly susceptible to the project and highly valued by residents and visitors.
- **Medium**: Seascape characteristics have medium susceptibility to the project and are of medium value to residents and visitors.
- **Low**: Seascape characteristics have low susceptibility to the project and are of low value to residents and visitors.

The sensitivity of the geographic analysis area's landscape character (LCA) is defined by its innate features and elements, its susceptibility to the Project, and its value to residents and visitors. Landscape sensitivity ratings include the following.

- **High**: Landscape characteristics are highly susceptible to the project and highly valued by residents and visitors.
- **Medium**: Landscape characteristics have medium susceptibility to the project and are of medium value to residents and visitors.
- **Low**: Landscape characteristics have low susceptibility to the project and are of low value to residents and visitors.

Table 3.6.9-5 lists the susceptibility, value, and sensitivity ratings within the OCAs, SCAs, and LCAs.

Table 3.6.9-5. Open ocean, seascape, and landscape sensitivity

Open Ocean, Seascape, and Landscape Character Area	Susceptibility	Value	Sensitivity
Open Ocean	High	High	High
Seascape Character Areas			
Atlantic City	High	High	High
Commercial Beachfront	High	High	High
Commercial Strip Development	Low	Low	Low
Dredged Lagoon	High	High	High
Recreation	High	High	High
Residential Beachfront	High	High	High
Town/Village Center	High	High	High
Undeveloped Beach	High	High	High
Landscape Character Areas			
Agriculture	High	High	High
Atlantic City	High	High	High
Bayfront Residential	High	High	High
Commercial Strip Development	Low	Low	Low

Open Ocean, Seascape, and Landscape Character Area	Susceptibility	Value	Sensitivity
Forest	Medium	High	High
Industrial Developed	Low	Low	Low
Inland Open Water	High	High	High
Inland Residential	High	High	High
Limited Access Highway	Medium	Medium	Medium
Recreation	High	High	High
Salt Marsh	High	High	High
Town/Village Center	High	High	High
Undeveloped Bay	High	High	High
Cardiff Landscape Character Area			
Commercial	Medium	Medium	Medium
Forest	High	High	High
High Density Residential	Medium	Medium	Medium
Industrial	Low	Low	Low
Inland Bay	High	High	High
Inland Water	High	High	High
Low Density Residential	High	High	High
Medium Density Residential	High	High	High
Recreation	High	High	High
Salt Marsh	High	High	High
Transportation	Medium	Medium	Medium
Larrabee Landscape Character Area			
Agriculture	High	High	High
Commercial	Medium	Medium	Medium
Forest	High	High	High
High Density Residential	Low	Low	Low
Industrial	Low	Low	Low
Inland Water	High	High	High
Low Density Residential	High	High	High
Medium Density Residential	High	High	High
Recreation	High	High	High
Transportation	Medium	Medium	Medium
Larrabee Randolph Road Landscape Character Area			
Agriculture	High	High	High
Commercial	Medium	Medium	Medium
Forest	High	High	High
High Density Residential	Low	Low	Low
Industrial	Low	Low	Low
Inland Water	High	High	High
Low Density Residential	High	High	High
Medium Density Residential	High	High	High
Recreation	High	High	High
Transportation	Medium	Medium	Medium

Open Ocean, Seascape, and Landscape Character Area	Susceptibility	Value	Sensitivity
Larrabee Lanes Pond Road Landscape Character Area			
Agriculture	High	High	High
Commercial	Medium	Medium	Medium
Forest	High	High	High
High Density Residential	Low	Low	Low
Industrial	Low	Low	Low
Inland Water	High	High	High
Low Density Residential	High	High	High
Medium Density Residential	High	High	High
Recreation	High	High	High
Transportation	Medium	Medium	Medium

Source: COP Volume II, Appendix II-M1, Table 1.2-2; Atlantic Shores 2023.
[1] Multiple character areas occur in more than one regional landscape.

OCA, SCA, and LCA susceptibility ratings range within high, medium, and low, depending on their exposure from the Project and on their intrinsic characteristics. Project visibility within SCAs and LCAs is influenced by intervening landforms, structures, and vegetation. Most susceptible to change are the undeveloped beach, beach residential beachfront, and commercial beachfront SCAs due to character-changing exposure. Least susceptible to change are the high density residential, industrial, and forest LCAs.

OCA, SCA, and LCA value ratings range within high, medium, and low, depending primarily on their special designations at national, state, and local levels and individual elements, particular landscape features, or notable aesthetic, perceptual, or experiential qualities. Table 3.6.9-6 lists places with national, state, and local designations and categories of places that are valued by residents and visitors.

Table 3.6.9-6. Seascape and landscape with national, state, and/or local designations

Settings	Conditions
Seascape[1] Ocean shoreline, beach, dune, adjacent areas, and ocean areas within 3.45 statute miles (5.5 kilometers) of the shoreline.	Seascapes with national, state, and/or local designations: Barnegat Branch Trail, Barnegat Lighthouse State Park, Bass River State Forest, Belleplain State Forest, Cape May National Wildlife Refuge, Cape May State Park, Corson's Inlet State Park, Crook Horn Creek, Edwin B. Forsythe National Wildlife Refuge, Emil Palmer Park, Enos Pond County Park, Forked River State Marina, Forked River Mountain WMA, Garden State Parkway, Gillian's Wonderland Pier, Great Egg Harbor Bay, Island Beach State Park, National Natural Landmark Manahawkin Bottomland Hardwood Forest, Ocean City Boardwalk, Ocean City Park, Peck Bay, Sandcastle Park, Southern Pinelands Natural Heritage Trail, Stainton Wildlife Refuge, Stone Harbor Bird Sanctuary, Tuckahoe WMA, Upper Barnegat Bay WMA, Vincent Klune Park, and Wharton State Forest. Beaches, seaward boardwalks, jetties, and piers.

Settings	Conditions
Landscape[2] Areas inland of the seascape	Cemeteries, churches, historic sites, lighthouses, scenic overlooks, nature areas, recreation areas, schools, town halls, and residential areas within the geographic analysis area. Landscapes with national, state, local designations or local value: Absecon Bay, Barnegat Bay, Barnegat Branch Trail, Barnegat Lighthouse State Park, Bass River State Forest, Belleplain State Forest, Cape May National Wildlife Refuge, Cape May State Park, Corson's Inlet State Park, Crook Horn Creek, Edwin B. Forsythe National Wildlife Refuge, Emil Palmer Park, Enos Pond County Park, Forked River State Marina, Forked River Mountain WMA, Garden State Parkway, Gillian's Wonderland Pier, Great Bay, Great Egg Harbor Bay, Great Sound, Island Beach State Park, Lakes Bay, Little Bay, Ludlam Bay, Manahawkin Bay, National Natural Landmark Manahawkin Bottomland Hardwood Forest, Ocean City Boardwalk, Ocean City Park, Peck Bay, Reeds Bay, Sandcastle Park, Southern Pinelands Natural Heritage Trail, Stainton Wildlife Refuge, Stone Harbor Bird Sanctuary, Stites Sound, Townsend Sound, Tuckahoe WMA, Upper Barnegat Bay WMA, Vincent Klune Park, and Wharton State Forest.

[1] Locations also listed under Landscape extend to both Seascape and Landscape.

[2] Locations also listed under Seascape extend to both Landscape and Seascape.

WMA = Wildlife Management Area

Table 3.6.9-7 lists the jurisdictions with ocean beach views and ocean views from an inland landscape, bay, estuary, marsh, pond, or river. The range of conditions, including the contexts of North Brigantine Natural Area, Seaside Park Beach, and Cape May State Park Lighthouse, are portrayed on Figures 3.6.9-4, 3.6.9-5, and 3.6.9-6, respectively.

Table 3.6.9-7. Jurisdictions with ocean views

Ocean View	Jurisdiction
Seascape jurisdictions with an ocean beach	Atlantic City, Barnegat Light Borough, Beach Haven Borough, Berkeley Township, Brigantine, Cape May, Egg Harbor, Galloway Township, Harvey Cedars Borough, Long Beach Township. Longport Borough, Lower Township, Margate City, Ocean City, North Wildwood, Sea Isle City, Seaside Heights Borough, Seaside Park Borough, Ship Bottom Borough, Stone Harbor Borough, Surf City Borough, Toms River Township, Upper Township, Ventnor City, Wildwood, and Wildwood Crest.
Landscape jurisdictions with ocean views from a land area, bay, estuary, marsh, pond, or river	Atlantic City, Barnegat Light Borough, Bass River Township, Beach Haven Borough, Berkeley Township, Brick Township, Brigantine, Cape May, Dennis Township, Eagleswood Township, Egg Harbor, Egg Harbor Township, Galloway Township, Harvey Cedars Borough, Howell Township, Lacey Township, Lakewood Township, Little Egg Harbor Township, Long Beach Township. Longport Borough, Lower Township, Manchester Township, Margate City, Ocean City, North Wildwood, Sea Isle City, Seaside Heights Borough, Seaside Park Borough, Ship Bottom Borough, Stone Harbor Borough, Surf City Borough, Toms River Township, Upper Township, Ventnor City, Wall Township, Washington Township, Wildwood, and Wildwood Crest.

Figure 3.6.9-4. North Brigantine Natural Area

Figure 3.6.9-5. Seaside Park Beach

Figure 3.6.9-6. Cape May Point State Park Lighthouse

VIA Affected Environment

KOPs represent individuals or groups of people who may be affected by changes in views and visual amenity. Based on higher viewer sensitivity, viewer exposure, and context photography, 26 designated KOPs (Table 3.6.9-8) become the locational bases for detailed analyses of the geographic analysis area's seascape, open ocean, landscape, and viewer experiences (COP Volume II, Appendix II-M1; Atlantic Shores 2023). Offshore viewing receptors include the fishing boats, pleasure crafts, and cruise ships that represent marine activities in the area. Daytime and nighttime views range from 0-mile (0-kilometer) to 45.1-mile (72.6-kilometer) distances.

Table 3.6.9-8. Representative offshore analysis area view receptor contexts and key observation points

Context	Key Observation Points
Vantage Point	KOP-AC02 Jim Whelan Boardwalk Hall, Atlantic City Convention Center NHL KOP-AC03 Madison Hotel (Daytime) KOP-AC03 Madison Hotel (Nighttime) KOP-AC04 Ocean Casino Resort – Sky Garden (Daytime) KOP-AC04 Ocean Casino Resort – Sky Garden (Nighttime) KOP-MC02 Lucy the Margate Elephant NHL KOP-OC04 Gillian's Wonderland Amusement Park KOP-SIC02 Townsend Inlet Bridge KOP-BLB01 Barnegat Lighthouse Observation Point
Linear Receptor	KOP-BHB02 Beach Haven, Center Street KOP-BHB03 Beach Haven, Holyoke Avenue KOP-LBT03 Long Beach Island Beach KOP-OO2Representative Cruise Ship and Commercial Shipping Lanes
Historic or Scenic Area	KOP-BC02 North Brigantine Natural Area KOP-BHB01 Beach Haven Historic District (Daytime) KOP-BHB01 Beach Haven Historic District (Nighttime) KOP-BLB02 Barnegat Lighthouse State Park KOP-BRT01 Bass River State Forest KOP-BT01 Island Beach State Park KOP-EMC01 Tuckahoe WMA KOP-GT01 Edwin B. Forsythe NWR, Galloway Township KOP-LAT01 Edwin B. Forsythe National Wildlife Refuge-Woodmansee Estate (Daytime) KOP-LAT01 Edwin B. Forsythe National Wildlife Refuge-Woodmansee Estate (Nighttime) KOP-LBT04 Edwin B. Forsythe NWR, Holyoke KOP-LEHT02 Great Bay Boulevard WMA/Rutgers Field Station KOP-LT02 Cape May Point State Park KOP-MC03 Huntington Park KOP-OC01 Corson's Inlet State Park KOP-OO1 Representative Recreational Fishing, Pleasure, and Tour Boat Area KOP-SBB01 Ship Bottom Borough Municipal Park KOP-SPB01 Seaside Park Borough

KOPs selected for viewer analyses in the substation areas include two locations with existing views of the Cardiff substation and three locations with existing views of the Larrabee substation and/or converter station options. The two KOPs in the vicinity of the Cardiff onshore substation and three KOPs in the vicinity of Larrabee onshore substation options and their viewing contexts are listed in Table 3.6.9-9.

Table 3.6.9-9. Representative onshore analysis area view receptor contexts and key observation points

Context	Key Observation Points
Vantage Point	NA
Linear Receptor	KOP-17-C Cardiff Tilton Road KOP-45-L Larrabee Lanes Pond Road KOP-48-L Larrabee Randolph Road KOP-49-L Larrabee Oak Glen Road
Historic or Scenic Area	KOP-8-C Cardiff Tilton Club

The range of sensitivity of view receptors and people viewing the Project is determined by their engagement, view expectations, susceptibility to the Project, and the value of the receptor. The susceptibility of KOP viewers considers both view location and activity: review of relevant designations and the level of policy importance that they signify (such as landscapes designated at national, state, or local levels). Value is rated based on scenic quality, rarity, recreational value, representativeness, conservation interests, perceptual aspects, and artistic associations. Judgments regarding seascape, landscape, and KOP sensitivity are informed by the VIA (COP Volume II, Appendix II-M1, Atlantic Shores 2023). Table 3.6.9-10 lists the sensitivity issues identified for the Seascape and Landscape Impact Assessment (SLIA) and the VIA, as well as the indicators and criteria used to assess impacts for the EIS.

Table 3.6.9-10. View receptor sensitivity ranking criteria

Sensitivity	Sensitivity Criteria
High	Residents with views of the proposed Project from their homes; people with a strong cultural, historic, religious, or spiritual connection to landscape or seascape views; people engaged in outdoor recreation whose attention or interest is focused on the seascape, open ocean, and landscape, and on particular views; visitors to historic or culturally important sites, where views of the surroundings are an important contributor to the experience; people who regard the visual environment as an important asset to their community, churches, schools, cemeteries, public buildings, and parks; and people traveling on scenic highways and roads, or walking on beaches and trails, specifically for enjoyment of views.
Medium	People engaged in outdoor recreation whose attention or interest is unlikely to be focused on the landscape and on particular views because of the type of activity but where views and the aesthetic environment create a more desirable and enjoyable experience; people at their places of livelihood, commerce, and personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, but where the seascape and landscape setting adds value to the quality of their activity; and, generally, those commuters and other travelers traversing routes that are not dominated by scenic developments, but the overall visual setting adds value to the experience.
Low	People engaged in outdoor activities whose attention or interest is not focused on the landscape or on particular views because of the type of activity. The setting is inconsequential and adds little or no value to the viewer experience.

Table 3.6.9-11 lists offshore KOP viewer sensitivity ratings, and Table 3.6.9-12 lists onshore KOP viewer sensitivity ratings.

Table 3.6.9-11. Offshore Project area key observation point viewer sensitivity ratings

Key Observation Points	Susceptibility	Value	Sensitivity
High			
KOP-AC02 Jim Whelan Boardwalk Hall, Atlantic City Convention Center NHL	High	High	High
KOP-AC03 Madison Hotel (Daytime)	High	High	High
KOP-AC03 Madison Hotel (Nighttime)	High	High	High
KOP-AC04 Ocean Casino Resort – Sky Garden (Daytime)	High	High	High
KOP-AC04 Ocean Casino Resort – Sky Garden (Nighttime)	High	High	High
KOP-BC02 North Brigantine Natural Area	High	High	High
KOP-BHB01 Beach Haven Historic District (Daytime)	High	High	High
KOP-BHB01 Beach Haven Historic District (Nighttime)	High	High	High
KOP-BHB02 Beach Haven, Center Street	High	High	High
KOP-BHB03 Beach Haven, Holyoke Avenue	High	High	High
KOP-BLB02 Barnegat Lighthouse State Park	High	High	High
KOP-BT01 Island Beach State Park	High	High	High
KOP-GT01 Edwin B. Forsythe NWR, Galloway Township	High	High	High
KOP-LAT01 Edwin B. Forsythe NWR-Woodmansee Estate (Daytime)	High	High	High
KOP-LAT01 Edwin B. Forsythe NWR-Woodmansee Estate (Nighttime)	High	High	High
KOP-LBT03 Long Beach Island Beach	High	High	High
KOP-LBT04 Edwin B. Forsythe NWR, Holyoke	High	High	High
KOP-LEHT02 Great Bay Boulevard WMA/Rutgers Field Station	High	High	High
KOP-LT02 Cape May Point State Park	High	High	High
KOP-MC02 Lucy the Margate Elephant NHL	High	High	High
KOP-MC03 Huntington Park	High	High	High
KOP-OC01 Corson's Inlet State Park	High	High	High
KOP-OC04 Gillian's Wonderland Amusement Park	High	High	High
KOP-OO1 Recreational Fishing, Pleasure, and Tour Boat Area	High	High	High
KOP-OO2 Commercial and Cruise Ship Shipping Lanes	High	High	High
KOP-SBB01 Ship Bottom Borough Municipal Park	High	High	High
KOP-SPB01 Seaside Park Borough	High	High	High
KOP-SIC02 Townsend Inlet Bridge	High	High	High
Medium			
KOP-BRT01 Bass River State Forest	Medium	High	Medium
KOP-EMC01 Tuckahoe WMA	Medium	High	Medium
Low	None		

Table 3.6.9-12. Onshore Project area key observation point viewer sensitivity ratings

Context	Key Observation Points
High	KOP-8-C Cardiff Tilton Club KOP-17-C Cardiff Tilton Road KOP-45-L Larrabee Lanes Pond Road KOP-48-L Larrabee Randolph Road KOP-49-L Larrabee Oak Glen Road
Medium	None
Low	None

While not designated as representative KOPs, daytime and nighttime scenic aerial tour viewers, arriving and departing Atlantic City International Airport and Ocean City Municipal Airport, and en-route airport flights traversing the coast, range from foreground to background viewing situations. Aircraft viewers are more frequently affected by view-limiting atmospheric conditions than are land and ocean receptors.

The nearest proposed WTG is offshore 7.6 nautical miles (8.7 statute miles [14 kilometers]) from the North Brigantine Natural Area shoreline. Onshore to offshore view conditions vary both daily and monthly (Atlantic Shores 2023). Averaged meteorological and atmospheric conditions indicates limited visibility of the WTA from the islands and their beaches on 50 percent of daylight hours on 78 percent of days and provide clear visibility on 50 percent of daylight hours on 22 percent of days (1 of every 4 to 5 days). COP Volume II, Appendix II-M1, Attachment H, *Visibility Modeling Study* (Atlantic Shores 2023) considers WTA visibility at key observation points.

Views from nearer the shoreline are more limited by atmospheric conditions than views from interior island areas. Many viewers, particularly recreational users, are more likely to be present on beaches on clearer days, when viewing conditions are better than on rainy, hazy, or foggy days. Therefore, affected environment and visual impact assessments of the Project are based on clear-day and clear-night visibility. Elevated walks and walls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and interior island areas may be diminished by ambient light levels and glare of developments.

Ocean receptors include the people on recreational and fishing boats, pleasure craft, tour boats, and commercial fishing boats with WTA visibility out to 42.5 miles (68.4 kilometers), and cruise ships with elevated 63-foot (19.2-meter) visibility out to 49.3 miles (79.3 kilometers).

The Cardiff onshore substation and/or converter station would occupy portions of previously developed industrial facilities. The Larrabee onshore substation and/or converter station would occupy portions of both developed industrial facilities and undeveloped landscape.

3.6.9.2 Impact Level Definitions for Scenic Resources and Viewer Experience

Definitions of impact levels are provided in Table 3.6.9-13. There are no beneficial impacts on scenic and visual resources.

Table 3.6.9-13. Impact level definitions for scenic and visual resources

Impact Level	Impact Type	Definition
Negligible	Adverse	SLIA: Very little or no effect on seascape/landscape unit character, features, elements, or key qualities either because unit lacks distinctive character, features, elements, or key qualities; values for these are low; or Project visibility would be minimal. VIA: Very little or no effect on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or Project visibility would be minimal.
Minor	Adverse	SLIA: The Project would introduce features that may have low to medium levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The project features may introduce a visual character that is slightly inconsistent with the character of the unit, which may have minor to medium negative effects on the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Project would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium effect on the viewer's experience. The viewer receptor sensitivity/susceptibility/value is low. If the value, susceptibility, and viewer concern for change is medium or high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change, but that has a high level of viewer concern (combination of susceptibility/value) may justify adjusting to a moderate level of impact.
Moderate	Adverse	SLIA: The Project would introduce features that would have medium to large levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Project would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative effect on the unit's features, elements, or the qualities. In areas affected by large magnitudes of change, the unit's features, elements, or key qualities have low susceptibility and/or value. VIA: The visibility of the Project would introduce a moderate to large level of change to the view's character; may have a moderate to large levels of visual prominence that attracts and holds but may or may not dominate the viewer's attention; and has a moderate effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Moderate impacts are typically associated with medium viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has medium levels of change; or low viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has large changes to the character. If the value, susceptibility, and viewer concern for change is high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified.

Impact Level	Impact Type	Definition
Major	Adverse	SLIA: The Project would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Project would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative effect on the unit's features, elements, or key qualities. The concern for change (combination of susceptibility/value) to the character unit is high. VIA: The visibility of the Project would introduce a major level of character change to the view; will attract, hold, and dominate the viewer's attention; and have a moderate to major effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to high. If the magnitude of change to the view's character is medium, but the susceptibility or value at the KOP is high, then evaluate the nature of the sensitivity to determine if elevating the impact to major is justified. If the sensitivity (combination of susceptibility/value) at the KOP is low in an area where the magnitude of change is large, then evaluate the nature of the sensitivity to determine if lowering the impact to moderate is justified.

3.6.9.3 Impacts of Alternative A – No Action on Scenic and Visual Resources

When analyzing the impacts of the No Action Alternative on scenic and visual resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for scenic and visual resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*.

Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for seascape, open ocean, landscape, and viewers described in Section 3.6.9.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities that contribute to impacts on scenic and visual resources in the geographic analysis area primarily involve onshore development and construction activities and offshore vessel traffic. These activities have the potential to contribute to new structures, traffic congestion, and nighttime light impacts. See Appendix D, Table DA1-22 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for scenic and visual resources. There are no ongoing offshore wind activities within the geographic analysis area for scenic and visual resources.

Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities in the geographic analysis area that contribute to impacts on seascape, open ocean, landscape, and viewers include activities related to development of undersea transmission lines, gas pipelines, and submarine cables; dredging and port improvements; marine minerals extraction; military use; marine transportation; and onshore development activities (see Appendix D for a description of planned activities in the geographic analysis area). Planned activities have the potential to affect seascape character, open ocean character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, air emissions, and accidental releases to the landscape or seascape.

Tables H-18 to H-21 in Appendix H consider effects on seascape, open ocean, landscape, and viewers of offshore wind development without the Proposed Action and in combination with the Proposed Action.

The discussion that follows summarizes the potential impacts of ongoing and planned offshore wind activities on scenic and visual resources during construction and installation, O&M, and decommissioning of the projects. Offshore wind projects other than the Proposed Action that contribute to impacts on scenic and visual resources include the following eight projects within the geographic analysis area: Atlantic Shores North (OCS-A 0549), Ocean Wind 1 (OCS-A-0498), Ocean Wind 2 (OCS-A 0532), Attentive Energy (OCS-A 0538), Bight Wind Holdings (OCS-A 0539), Atlantic Shores Offshore Wind Bight (OCS-A 0541), Invenergy Wind Offshore (OCS-A 0542), and GSOE I (OCS-A 0482); and an additional five within the cumulative impacts analysis area: Empire Wind 1 (part of OCS-A 0512), Empire Wind 2 (part of OCS-A 0512), OW Ocean Winds East (OCS-A 0537), Skipjack (part of OCS-A 0519), and US Wind/Maryland Offshore Wind (part of OCS-A 0490) (Appendix D, Table D.A2-1). The cumulative simulations (Appendix H, Attachment H-1) are based on known WTG location and height information as of July 2022. The information regarding WTG heights is based on the best available information about commercially available WTGs at this time. The cumulative simulations estimate these projects to collectively install 2,216 WTGs between 2023 and 2030.

BOEM expects planned offshore wind activities to affect visual and scenic resources through the following primary IPFs.

Accidental releases: Accidental releases during construction and installation, O&M, and decommissioning of offshore wind projects (excluding the Proposed Action) could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean area, and landscapes. The potential for accidental releases would be greatest during construction and installation and decommissioning of offshore wind projects, and would be lower but continuous during O&M. Accidental releases would cause short-term negligible to minor impacts.

Land disturbance: Other offshore wind development would require installation of onshore export cables, onshore substations and/or converter stations, and transmission infrastructure to connect to the electric grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and installation and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of project infrastructure for offshore wind energy projects; however, BOEM anticipates these projects would generally have localized, short-term, negligible to minor impacts on scenic and visual resources during construction and installation, O&M, or decommissioning due to land disturbance.

Lighting: Construction-related nighttime vessel lighting would be used if offshore wind development projects include nighttime, dusk, or early morning construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for up to 2,216 WTGs within the geographic analysis area (excluding the Proposed Action). The impact of vessel lighting on scenic and visual resources during construction and installation would be localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M of planned offshore wind facilities, and the impact on seascape character, open ocean character, nighttime viewer experience, and valued scenery from vessel lighting would be intermittent and long term.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines in the geographic analysis area and would have major impacts on scenic and visual resources. FAA hazard lighting systems would be in use for the duration of O&M. The cumulative effect of these WTGs and associated synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle in the offshore wind lease areas would have long-term, minor to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night compared to the standard continuous, medium-intensity red strobe FAA warning system due to the reduced duration of activation. Based on recent studies (Atlantic Shores 2023), the reduced time of FAA hazard lighting with an ADLS is expected to reduce the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without an ADLS.

Presence of structures: The placement of 2,216 WTGs from other offshore wind projects in the geographic analysis area would contribute to adverse impacts on scenic and visual resources. Appendix H provides simulations of offshore wind development without the Proposed Action from eight KOPs with views to the south, southwest, and west. In the geographic analysis area, all lease areas would have the potential to be seen within the same viewshed as the Project from ground-level coastal KOPs. The total number of WTGs that would be visible from any single KOP would be less than the 2,216 WTGs considered under the planned activities scenario. For example, a total of 250 WTGs would be theoretically visible from KOP-BC02 North Brigantine Natural Area and a total of 411 WTGs would be theoretically visible from KOP-OC04 Gillian's Wonderland Amusement Park (BOEM 2022). The presence of structures associated with offshore wind development would affect seascape character, open ocean character, landscape character, and viewer experience, as simulated from sensitive onshore receptors (Appendix H). The seascape character, open ocean character, and landscape character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character and from onshore facilities by approximately 2030 and would result in major impacts.

Traffic (vessel): Other offshore wind project construction and installation, decommissioning, and, to a lesser extent, O&M would generate increased vessel traffic that could contribute to adverse moderate to major impacts on scenic and visual resources in the geographic analysis area. The impacts would occur primarily during construction and installation along routes between ports and the offshore wind construction areas. Assuming vessel traffic of other projects is similar to that of the Proposed Action (i.e., approximately 51 vessels operating in the Project area or over the offshore export cable route at any given time [COP Volume II, Section 7.6.2.1; Atlantic Shores 2023]), each project would generate between 15 and 35 vessels operating in the WTA or over the offshore export cable route at any given time during the construction and installation phase (Section 3.6.6, *Navigation and Vessel Traffic)*. Stationary and moving construction vessels would change the daytime and nighttime seascape and open ocean character from open ocean to active waterway.

Onshore and offshore visual impacts would continue from visible vessel activity related to O&M of offshore wind facilities. Based on the estimates for the nearby Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North Projects, the offshore wind projects in the geographic analysis area would have approximately 22 vessels operating in the Project area at any given time (Section 3.6.6). During O&M of offshore wind projects (excluding the Proposed Action), vessel traffic would result in long-term, intermittent contrasts to seascape and open ocean character and in the viewer experience of valued scenery. Vessel activity would increase again during decommissioning at the end of the assumed 35-year operating period of each project, with impacts similar to those described for construction and installation.

Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, current regional trends and activities would continue, and scenic and visual resources would continue to be affected by natural and human-caused IPFs. Ongoing non-offshore wind activities would have continuing short- and long-term impacts on seascape, open ocean, landscape, and viewer experience, primarily through the daytime and nighttime presence of structures, lighting, and vessel traffic. The character of the coastal landscape would change in the short term and long term through natural processes and planned activities that would continue to shape onshore features, character, and viewer experience. Ongoing activities in the geographic analysis area that contribute to visual impacts include construction activities and vessel traffic, which lead to increased nighttime lighting, visible congestion, and the introduction of new structures. The No Action Alternative would result in **negligible** to **major** impacts on scenic and visual resources from ongoing activities.

Cumulative Impacts of Alternative A – No Action. Planned activities in the geographic analysis area other than offshore wind include new cable emplacement and maintenance, dredging and port improvements, marine minerals extraction, military use, marine transportation, and onshore development activities. Other offshore wind projects planned within the geographic analysis area would lead to the construction of approximately 2,216 WTGs in areas where no offshore structures currently exist and would change the surrounding marine environment from undeveloped ocean to a wind farm environment. The seascape character and open ocean character would reach the maximum level of change to their features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030. The No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **major** impacts on visual and scenic resources within the geographic analysis area due to the addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.

3.6.9.4 Relevant Design Parameters and Potential Variances in Impacts

This Draft EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on scenic and visual resources.

- The Project layout, including the number, size, and placement of the WTGs, met tower, and OSSs, and the design of lighting systems for structures.
- The number and type of vessels involved in construction and installation, O&M, and decommissioning, and time of day that construction and installation, O&M, and decommissioning would occur.
- Onshore cable export route options and the size and location of onshore substations.

Variability of the proposed Project design exists as outlined in Appendix C. The following is a summary of potential variances in impacts.

- **WTG number, size, location, and lighting:** More WTGs and larger turbine sizes closer to shore would increase visual impacts from onshore KOPs. The design and type of WTG lighting would affect nighttime visibility of WTGs from shore. Implementation of ADLS technology would reduce visual impacts.
- **Vessel lighting:** Nighttime construction and installation, O&M, and decommissioning activities that involve nighttime lighting would increase visibility at night.
- L**ocation and scale of Onshore Project components:** Installation of larger-scale Onshore Project components in closer proximity to sensitive receptors would have greater impacts.

At distances of 12 miles (19.3 kilometers) or closer, the form of the WTG may be the dominant visual element creating the visual contrast regardless of color. At greater distances, color may become the dominant visual element creating visual contrast under certain visual conditions that give visual definition to the WTG's form and line.

3.6.9.5 Impacts of Alternative B – Proposed Action on Scenic and Visual Resources

This section addresses the impacts associated with construction and installation, O&M, and decommissioning of the Proposed Action on seascape character, open ocean character, and landscape character (SLIA) and on viewer experience (VIA) in the geographic analysis area. The SLIA levels consider the sensitivity of the character areas' physical elements and features and the aesthetic, perceptual, and experiential aspects that make them distinctive. SLIA impacts combine OCA, SCA, and LCA sensitivity and the magnitudes of intervisibility and incompatibility of the character of the Project with the character of the OCA, SCA, and LCA.

The VIA level is judged with reference to the sensitivity of the view receptor and the magnitude of change, which considers the noticeable features; distance and field of view (FOV) effects; view framing and intervening foregrounds; and the form, line, color, and texture contrasts; scale of change; and prominence in the characteristic seascape, open ocean, and landscape.

The degree of adverse effects is determined through application of the following criteria.

- The Proposed Action's characteristics, contrasts, scale of change, prominence, and spatial interactions with the special qualities and extents of the baseline seascape, open ocean, and landscape characters.
- Intervisibility between viewer locations and the Proposed Action's features.
- The sensitivities of viewers.

Viewers or visual receptors in the Proposed Action's zone of theoretical visibility include the following.

- Residents living in coastal communities or individual residences.
- Tourists visiting, staying in, or traveling through the area.
- Recreational users of the seascape, including those using ocean beaches and tidal areas.
- Recreational users of the open ocean, including those involved in yachting, fishing, boating, and passage on ships.
- Recreational users of the landscape, including those using landward beaches, golf courses, cycle routes, and footpaths.
- Tourists, workers, visitors, or local people using transport routes.
- People working in the countryside, commerce, or dwellings.
- People working in the marine environment, such as those on fishing vessels and crews of ships.

Onshore to offshore view distances to the Project WTA range from 8.7 miles (14.0 kilometers) to 45 miles (72.4 kilometers). At the 8.7-mile (14.0-kilometer) distance and at the near center of the northwest-facing boundary of the WTA array, the Project would occupy 59.7° (48 percent) of the typical human's 124° horizontal FOV and 1.4° (2.5 percent) of the typical 55° vertical FOV (measured from eye level). This vertical measure also indicates the perceived proportional size and relative height of a WTA. At 40 miles (64.4 kilometers) distance, the Project may appear 0.03° above the horizon and 16° along the horizon, 0.04 percent and 12 percent of the human vertical and horizontal FOV, respectively. WTG, met tower, and OSS visibility would be variable throughout the day depending on specific factors. View angle, sun angle, atmospheric conditions, and distance would affect the visibility and noticeability. Visual contrast of WTGs, met tower, and OSSs would vary throughout daylight hours depending on whether the WTGs, met tower, and OSSs are backlit, side-lit, or front-lit and based on the visual character of the horizon's backdrop. These variations through the course of the day may result in periods of major visual effects, while at other times of day would have moderate, minor, or negligible effects.

Consideration of atmospheric visibility conditions between potential shoreline viewing receptors and the Proposed Action WTGs and met tower concluded that: (1) the first row of Atlantic Shores South WTGs and met tower would be visible from the nearest shoreline KOP (8.7 miles (14.0 kilometers) over approximately 50 percent of the year; (2) the first two rows would be visible over approximately 40 percent of the year; and (3) portions of the nearest four rows could be visible during approximately 25 percent of the year (COP Volume II, Appendix II-M1; Atlantic Shores 2023). Analysis of the meteorological data for 13 KOPs for each of the 12 months of the year is summarized in Figure 3.6.9-7. January conditions resulted in the highest levels of WTA and met tower visibility and April conditions resulted in the lowest visibility (COP Volume II, Appendix II-M1; Atlantic Shores 2023).

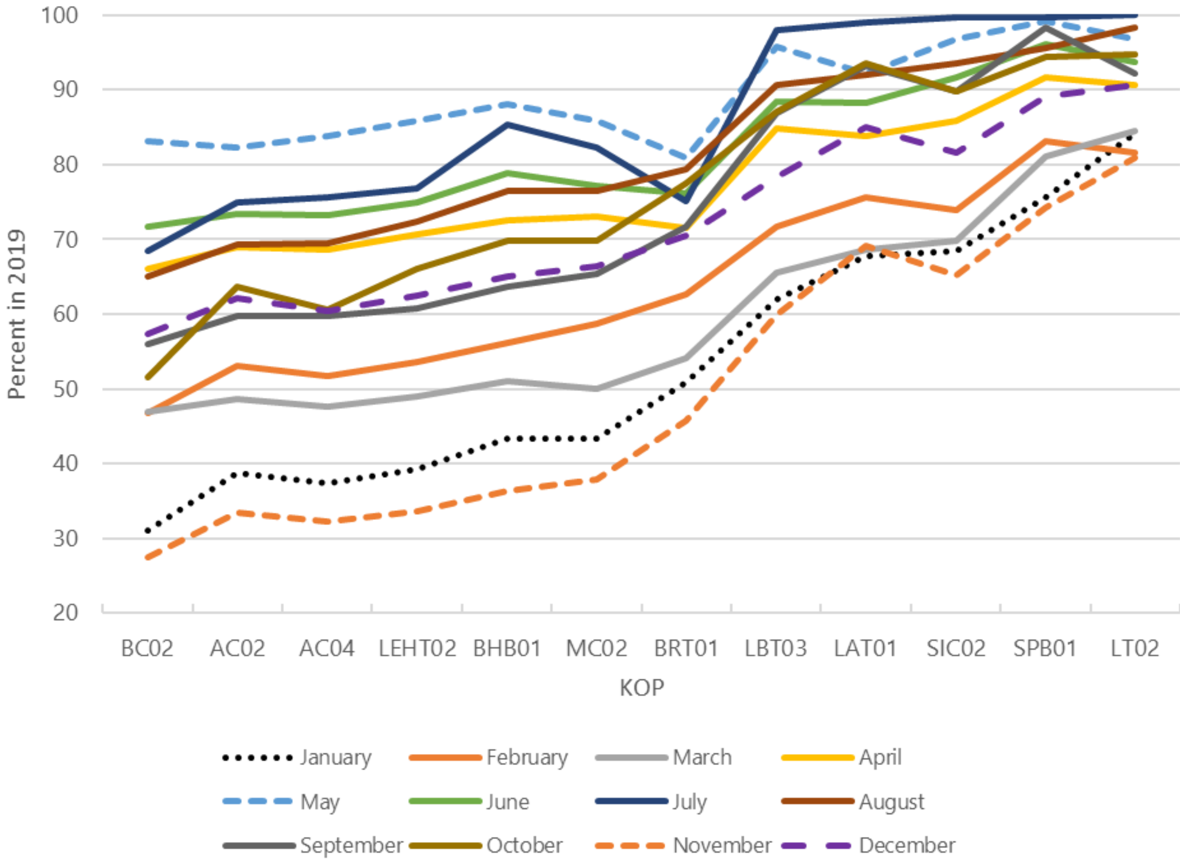


Figure 3.6.9-7. KOPs obscured visibility comparison

Accidental releases: Accidental releases during construction and installation, O&M, and decommissioning of the Proposed Action could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Near shore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and installation and decommissioning and would be lower but continuous during O&M, resulting in overall negligible to minor impacts.

Land disturbance: The Proposed Action would require installation of onshore export cables, construction of two onshore substations and/or converter stations, and transmission infrastructure to connect to the electrical grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and installation and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. Impacts from the Proposed Action related to land disturbance would be negligible to minor.

Lighting (offshore): Nighttime vessel lighting could result from construction and installation, O&M, and decommissioning of the Proposed Action if these activities are undertaken during nighttime, evening, or early morning hours. Vessel lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore and offshore viewing locations based on viewer distance and atmospheric conditions. The impact of vessel lighting on scenic and visual resources during construction and installation and decommissioning would be moderate to major, localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M, but long-term impacts would be less due to the lower number of forecast vessel trips. Nighttime vessel lighting for the Proposed Action in combination with other offshore wind development would affect seascape character, open ocean character, nighttime viewer experience, and valued scenery. This impact would be localized and short term during construction and installation and decommissioning, and intermittent and long term during O&M.

Permanent aviation warning lighting on WTGs and the met tower would be visible from beaches and coastlines in the geographic analysis area and would have impacts on scenic and visual resources. Field observations associated with visibility of FAA hazard lighting under clear-sky conditions indicate that FAA hazard lighting may be visible at a distance of 40 miles (64.4 kilometers) or more from the viewer. Darker-sky conditions may increase this distance due to increased contrast of the light dome (reflections from the ocean) and cloud reflections caused by the hazard lights.

Atlantic Shores, contingent on FAA and BOEM approval, has committed to installing ADLS on WTGs and met towers, which activates the hazard lighting system in response to detection of nearby aircraft (COP Volume II, Appendix II-M1; Atlantic Shores 2023). The synchronized flashing of the navigational lights occurs only when aircraft are present, resulting in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The shorter-duration synchronized flashing of ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. ADLS hazard lighting would be in use for the duration of O&M of the Proposed Action and would have intermittent and long-term effects on sensitive onshore and offshore viewing locations based on viewer distance and angle of view, and assuming no obstructions.

Based on estimates from Atlantic Shores, ADLS-controlled obstruction lights would be activated for nearly 9 hours over a 1-year period (COP Volume II, Appendix II-M4; Atlantic Shores 2023). It is estimated that the reduced time of FAA hazard lighting resulting from an implemented ADLS would reduce the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The OSSs would be lit and marked in accordance with Occupational Safety and Health Administration lighting standards to provide safe working conditions when O&M personnel are present. The OSSs would have nighttime lighting up to 295.3 feet (90.0 meters) above sea level. Due to EC, from eye levels of 5.9 feet (1.8 meters), these lights would become invisible above the ocean surface beyond approximately 23.8 miles (38.3 kilometers). Lights of the OSS, when lit for maintenance, potentially would be visible from beaches and adjoining areas during hours of darkness. The nighttime sky light dome and cloud lighting caused by reflections from the water surface may be seen from distances beyond the 45.1-mile (72.6-kilometer) geographic analysis area, depending on variable ocean surface, cloud, and atmospheric reflectivity.

Lighting (onshore): Nighttime facility lighting would result from construction and installation, O&M, and decommissioning of the Proposed Action. Facility lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore viewing locations. The impact of lighting on scenic and visual resources during construction and installation and decommissioning would be moderate to major, localized, and short term. Visual impacts of nighttime facility lighting would continue during O&M. This impact would be localized and short term during construction and installation and decommissioning, and long term during O&M.

Presence of structures: The Proposed Action would install up to 200 WTGs extending up to 1,046.6 feet (319.0 meters) above MLLW, a single permanent met tower extending up to 590.6 feet (180 meters) above MLLW, and up to 10 OSSs extending up to 344.5 feet (105 meters) above MLLW in the Lease Area, for a maximum of 205 offshore structures. The WTGs would be color treated white or light gray, no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey. Contrast evaluations in the impact analysis assume the WTGs would be RAL 9010 Pure White representing the most contrasting color of the two options. WTGs color treated with RAL 7035 Light Grey would help reduce potential visibility against the horizon. The presence of structures within the geographic analysis area under the Proposed Action would affect seascape character, open ocean character, landscape character, and viewer experience. The magnitude of WTG and OSS impact is defined by the contrast, scale of the change, prominence, FOV, viewer experience, geographical extent, and duration, correlated against the sensitivity of the receptor, as simulated from onshore KOPs. COP Volume II, Appendix II-M1(Atlantic Shores 2023) presents WTG and OSS visual simulations from onshore KOPs considered in this analysis. The onshore Cardiff and Larrabee areas' Proposed action would install substation and/or converter station facilities. The magnitude of onshore substation and/or converter station impact is defined by the contrast, scale of the change, and prominence, correlated against the sensitivity of the receptor, as simulated from Cardiff and Larrabee KOPs. COP Volume II, Appendices II-M2 and II-M3 (Atlantic Shores 2023) present substation and/or converter station visual simulations from KOPs considered in this analysis. The effects analyses involved consideration of those COP VIA clear-day simulations of similar distance, variability of viewer location within KOP vicinity, variability of sun angles throughout the day, and nighttime variability of cloud cover, ocean reflections, and moonlight.

Appendix H provides an assessment of the Proposed Action's character-changing effects by seascape character area, open ocean character area, and landscape character area. Appendix H provides an assessment of the Proposed Action's noticeable elements, distance effects, FOV effects, foreground elements and influence, scale effects, prominence effects, and contrast rating effects by offshore and onshore KOPs. The seascape character units, open ocean character unit, landscape character units, and viewer experiences would be affected by the Proposed Action's noticeable elements (Appendix H, Table H-11), applicable distances (Appendix H, Table H-12), and FOV extents (Appendix H, Table H-13) open views versus view framing or intervening foregrounds (Appendix H, Table H-14); and form, line, color, and texture contrasts in the characteristic seascape, open ocean, and landscape (Appendix H, Table

H-15). Higher impact significance stems from unique, extensive, and long-term appearance of strongly contrasting vertical structures in the otherwise horizontal open ocean environment, where structures are an unexpected element and viewer experience includes formerly open views of high-sensitivity seascape, open ocean, and landscape, and from high-sensitivity view receptors. Table 3.6.9-14 considers the totality of the Proposed Action's level of impact by seascape character unit, open ocean character unit, and landscape character unit. Table 3.6.9-15 considers the totality of the Proposed Action's level of impact for character units in the onshore facility viewsheds.

Appendix H, Table H-10 lists the applicable impact level for each KOP based on specific measures of distance, occupied field of view, noticeable facility elements, visual contrasts, scale of change, and prominence.

Table 3.6.9-14. Impact levels on seascape character, open ocean character, and landscape character

Impact Level	Seashore Character Areas, Open Ocean Character Area, and Landscape Character Areas	Overall Character Area (square miles [square kilometers])	Impacted Character Area (square miles [square kilometers])
Major	Atlantic City	3.1 [112.68]	0.12 [.30]
	Bayfront Residential	3.3 [8.5]	0.02 [0.04]
	Commercial Beachfront	1.4 [3.6]	0.26 [0.66]
	Dredged Lagoon	14.3 [37.0]	<0.01 [<0.01]
	Open Ocean	6,657.8 (17,243.6]	1,103.89 [2,859.05]
	Residential Beachfront	8.2 [21.3]	0.68 [1.76]
	Salt Marsh	214.7 [556.1]	8.26 [21.40]
	Town/Village Center	2.6 [6.7]	0.01 [0.03]
	Undeveloped Bay	209.1 [549.7]	4.64 [12.03]
	Undeveloped Beach	7.9 [20.5]	1.30 [3.36]
Moderate	Agriculture	110.2 [8.0]	0.01 [0.03]
	Atlantic City	3.1 [112.68]	0.10 [0.26]
	Bayfront Residential	3.3 [8.5]	0.14 [0.36]
	Commercial Beachfront	1.4 [3.6]	0.22 [0.58]
	Dredged Lagoon	14.3 [37.0]	0.32 [0.83]
	Inland Open Water	26.6 [68.9]	0.06 [0.16]
	Inland Residential	223.8 [579.6]	0.69 [1.79]
	Limited Access Highway	9.6 [24.9]	0.31 [0.80]
	Open Ocean	6,657.8 [17,243.6]	1,540.14 [3,988.93]
	Recreation	20.2 [52.3]	0.35 [0.90]
	Residential Beachfront	8.2 [21.3]	<0.01 [<0.03]
	Salt Marsh	214.7 [556.1]	76.70 [198.65]
	Undeveloped Bay	209.1 [549.7]	92.58 [239.78]
	Undeveloped Beach	7.9 [20.5]	0.58 [1.51]
Minor	Agriculture	110.2 [8.0]	0.02 [0.04]
	Bayfront Residential	3.3 [8.5]	0.05 [0.12]
	Commercial Beachfront	1.4 [3.6]	0.46 [1.21]
	Commercial Strip Development	29.5 [76.4]	0.09 [0.23]
	Dredged Lagoon	14.3 [37.0]	0.15 [0.38]
	Forest	1,273.1 [3,297.3]	1.65 [4.27]
	Industrial/Developed	37.8 [97.9]	0.38 [0.99]
	Inland Open Water	26.6 [68.9]	0.64 [1.65]

Impact Level	Seashore Character Areas, Open Ocean Character Area, and Landscape Character Areas	Overall Character Area (square miles [square kilometers])	Impacted Character Area (square miles [square kilometers])
	Inland Residential	223.8 [579.6]	0.09 [0.25]
	Limited Access Highway	9.6 [24.9]	0.03 [0.08]
	Open Ocean	6,657.8 [17,243.6]	3.901.58 [10,105.03]
	Recreation	20.2 [52.3]	0.28 [0.72]
	Residential Beachfront	8.2 [21.3]	2.38 [6.17]
	Salt Marsh	214.7 [556.1]	27.01 [69.95]
	Town/Village Center	2.6 [6.7]	<0.01 [<0.03]
	Undeveloped Bay	209.1 [549.7]	58.43 [151.35]
	Undeveloped Beach	7.9 [20.5]	2.17 [5.63]
Negligible	Unseen Seascape Character Areas and Landscape Character Areas		

Table 3.6.9-15. Impact levels on onshore facility landscape character areas

Impact Level	Onshore Landscape Character Areas	Overall Character Area (square miles [square kilometers])	Impacted Character Area (square miles [square kilometers])
Major	**Cardiff Onshore Area**		
	Forest	9.891 [25.617]	0.025 [0.065]
	High Density Residential	1.017 [2.634]	0.025 [0.064]
	Low Density Residential	1.018 [2.638]	0.001 [0.001]
	Medium Density Residential	7.732 [20.028]	0.004 [0.011]
	Recreation	0.720 [1.865]	0.002 [0.004]
	Transportation	0.556 [1.441]	0.010 [0.027]
	Larrabee Brook Road Onshore Area		
	Agriculture	1.560 [4.041]	0.032 [0.084]
	Commercial	2.505 [6.487]	0.004 [0.011]
	Forest	14.379 [37.243]	0.227 [0.587]
	High Density Residential	2.081 [5.089]	0.001 [0.001]
	Industrial	1.971 [5.104])	0.077 [0.199]
	Inland Water	0.366 [0.949]	0.001 [0.001]
	Low Density Residential	3.251 [8.419]	0.028 [0.073]
	Medium Density Residential	9.426 [24.413]	0.003 [0.008]
	Recreation	1.337 [4.463]	0.005 [0.013]
	Larrabee Lanes Pond Road Onshore Area		
	Agriculture	1.560 [4.041]	0.019 [0.048]
	Forest	14.379 [37.243]	0.020 [0.052]
	High Density Residential	2.081 [5.089]	<0.001 [<0.001]
	Industrial	1.971 [5.104]	<0.001 [<0.001]
	Inland Water	0.366 [0.949]	<0.001 [<0.001]
	Low Density Residential	3.251 [8.419]	0.028 [0.072]
	Medium Density Residential	9.426 [24.413]	0.001 [0.001]
	Recreation	1.337 [4.463]	<0.001 [<0.001]

Impact Level	Onshore Landscape Character Areas	Overall Character Area (square miles [square kilometers])	Impacted Character Area (square miles [square kilometers])
Minor	**Cardiff Onshore Area**		
	Commercial	2.628 [6.806]	0.066 [0.169]
	Industrial	2.103 [5.049]	0.020 [0.053]
	Larrabee Randolph Road Onshore Area		
	Agriculture	1.560 [4.041]	0.004 [0.013]
	Forest	14.379 [37.243]	0.035 [0.091]
	High Density Residential	2.081 [5.089]	0.001 [0.003]
	Industrial	1.971 [5.104]	0.67 [0.174]
	Inland Water	0.366 [0.949]	<0.001 [<0.001]
	Low Density Residential	3.251 [8.419]	0.006 [0.015]
	Medium Density Residential	9.426 [24.413]	<0.001 [<0.001]
	Recreation	1.337 [4.463]	0.001 [0.003]

Table 3.6.9-16 considers the totality of the Proposed Action's level of impact (the Sensitivity Level and Magnitude of Change; BOEM 2021) on offshore and onshore KOPs. All KOPs are rated high sensitivity (Atlantic Shores 2023). Appendix H, Table H-10 lists the applicable impact level for each KOP based on specific measures of distance, occupied field of view, noticeable facility elements, visual contrasts, scale of change, and prominence.

The major impact level results from:

- Wind farm facilities located from 0.0 mile (0.0 kilometer) to 14.4 miles (23.2 kilometers) of the KOP's viewers and onshore facilities located between 0.1 mile (0.2 kilometer) and 0.2 mile (0.3 kilometer) of the KOP's viewers;
- Extensive FOV occupied by the facilities;
- Greater extents of noticeable facility elements in the view;
- Strong-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, and textures;
- Large-rated scale of change by facilities; and
- 5- or 6-rated prominence[1] in the view.

[1] WTGs and OSS prominence: 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer, but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers' attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (Sullivan 2013)

The moderate impact level results from:

- Wind farm facilities located between 13.0 miles (20.9 kilometers) and 32.2 miles (51.8 kilometers) of the KOP's viewers and onshore facilities located at 0.3 mile (0.4 kilometer) of the KOP's viewers;
- Moderate FOV occupied by the facilities;
- Moderate extents of noticeable facility elements in the view;
- Moderate-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, and textures;
- Medium-rated scale of change by facilities; and
- 3- or 4-rated prominence in the view.

The minor impact level results from:

- Wind farm facilities located between 32.0 miles (51.5 kilometers) and 45.0 miles (72.4 kilometers) of the KOP's viewers;
- Minor FOV occupied by the facilities;
- Minor extents of noticeable facility elements in the view;
- Weak-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, and textures;
- Small-rated scale of change by facilities; and
- 1- or 2-rated prominence in the view.

Table 3.6.9-16. Proposed Action impact on viewer experience

Level of Impact	Offshore and Onshore Key Observation Points
Major	VIA: KOP-AC02 Jim Whelan Boardwalk Hall, Atlantic City Convention Center NHL KOP-AC03 Madison Hotel (Daytime) KOP-AC03 Madison Hotel (Nighttime)[1] KOP-AC04 Ocean Casino Resort – Sky Garden (Daytime) KOP-AC04 Ocean Casino Resort – Sky Garden (Nighttime)[1] KOP-BC02 North Brigantine Natural Area KOP-BHB01 Beach Haven Historic District (Daytime) KOP-BHB01 Beach Haven Historic District (Nighttime)[1] KOP-BHB02 Beach Haven, Center Street KOP-BHB03 Beach Haven, Holyoke Avenue KOP-LBT04 Edwin B. Forsythe NWR, Holyoke KOP-LEHT02 Great Bay Boulevard WMA/Rutgers Field Station KOP-MC02 Lucy the Margate Elephant NHL KOP-MC03 Huntington Park

Level of Impact	Offshore and Onshore Key Observation Points
	KOP-OO1 Recreational Fishing, Pleasure, and Tour Boat Area KOP-OO2 Commercial and Cruise Ship Shipping Lanes KOP-8-C Cardiff Tilton Club KOP-45-L Larrabee Lanes Pond Road KOP-49-L Larrabee Oak Glen Road
Moderate	VIA: KOP-BLB02 Barnegat Lighthouse State Park KOP-BT01 Island Beach State Park KOP-GT01 Edwin B. Forsythe NWR, Galloway Township KOP-LAT01 Edwin B. Forsythe NWR-Woodmansee Estate KOP-OC01 Corson's Inlet State Park KOP-OC04 Gillian's Wonderland Amusement Park KOP-SBB01 Ship Bottom Borough Municipal Park KOP-SIC02 Townsend Inlet Bridge
Minor	VIA: KOP-AC03 Madison Hotel (Nighttime)[2] KOP-AC04 Ocean Casino Resort – Sky Garden (Nighttime)[2] KOP-BHB01 Beach Haven Historic District (Nighttime)[2] KOP-BRT01 Bass River State Forest KOP-EMC01 Tuckahoe WMA KOP-LT02 Cape May Point State Park Lighthouse KOP-SPB01 Seaside Park Beach KOP-17-C Cardiff Tilton Road KOP-48-L Larrabee Randolph Road
Negligible	VIA: None

[1] ADLS when activated results in Major impact.

[2] ADLS when not activated reduces impacts from Major to Minor at these elevated KOPs and 13.0-mile (20.9-kilometer) proximity KOP. Minor impact is due to moonlit conditions.

The Proposed Action would also add two onshore substations and/or converter stations in Atlantic and Monmouth counties. Considering the location of the sites relative to scenic resources and public viewpoints, context of the sites and surrounding land uses, visual contrast between the substation sites and the surrounding landscape, and ability to screen the substation sites from public viewpoints, impacts of these Project features on scenic and visual resources would be minor to major. All landfall export cable infrastructure would be underground and would not contribute to impacts on scenic and visual resources through the presence of structures IPF.

Traffic (vessel): Construction and installation, O&M, and decommissioning of the Proposed Action would generate increased vessel traffic that could contribute to adverse impacts on scenic and visual resources in the geographic analysis area. The impacts would occur primarily during construction and installation along routes between ports and the offshore wind construction areas. Construction and installation of the Proposed Action is projected to generate 1,745 total vessel trips in the WTA (Section 3.6.6). O&M activities for the Proposed Action are anticipated to generate 1,861 vessel round trips per year between ports and the WTA (Section 3.6.6). Vessel traffic during O&M would result in long-term, intermittent contrasts to open ocean character and in the viewer experience of valued scenery. Vessel activity would increase again during decommissioning at the end of the operating period, with impacts similar to those described for construction and installation. Maintenance activities would cause minor effects on seascape character and open ocean character due to increased O&M vessel traffic to and from the Lease Area. Impacts from the Proposed Action related to vessel traffic would be minor to moderate.

Impacts of the Connected Action

As described in Chapter 2, *Alternatives,* the O&M facility would involve construction of a new building and associated parking structure (as part of the Proposed Action), repairs to the existing docks, and installation of a new bulkhead and new dock facilities. The bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). The bulkhead site and dredging activities are in-water activities that would be conducted within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area. BOEM expects the connected action to affect scenic and visual resources through the *Lighting* and *Traffic (vessel)* IPFs.

Lighting: Nighttime dredging, installation, and maintenance equipment lighting and vessel lighting could become visible in the seascape and by viewers if these activities are undertaken during nighttime, evening, or early morning hours. Vessel lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore viewing locations based on viewer distance and atmospheric conditions. The impact of equipment lighting and vessel lighting on scenic and visual resources during installation would be moderate to major, localized, and short term.

Traffic (vessel): Construction and installation and O&M activities would generate increased vessel traffic that could contribute to adverse impacts on scenic and visual resources in the viewshed. The impacts would occur primarily during installation along routes between ports and the Inlet Marina. Activities related to the connected action of the Proposed Action would be minor, localized, short term, and infrequent relative to the life of the Project.

Cumulative Impacts of Alternative B – Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities. Appendix H provides cumulative effects simulations of the Proposed Action from eight KOPs with views to the south, southeast, and southwest (Appendix H, Attachment H-2).

Accidental releases: Accidental releases during construction and installation, O&M, and decommissioning of planned offshore wind projects including the Proposed Action could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Near-shore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and installation and decommissioning of offshore wind projects, and would be lower but continuous during O&M. The combined accidental release impacts from the Proposed Action and other ongoing and planned activities would be negligible to minor.

Land disturbance: Planned offshore wind development including the Proposed Action would require installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electrical grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and installation and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of Project infrastructure for planned offshore wind energy projects; however, the Proposed Action in combination with other planned offshore wind development would generally have localized, short-term, negligible to minor impacts on scenic and visual resources during construction and installation and O&M due to land disturbance.

Lighting: Lighting from the Proposed Action in combination with other offshore wind projects would have minor to major, long-term cumulative impacts on scenic and visual resources. This range in impacts from lighting is due to variable distances from visually sensitive viewing locations and potential use of ADLS. The recreational and commercial fishing, pleasure, and tour boating community would experience major adverse effects in foreground views. If ADLS is implemented across all offshore wind projects in the geographic analysis area, then impacts from lighting would be reduced to negligible when the lights are in the off mode. The impact would be more adverse if other projects do not commit to using ADLS, or when the lights are in the on mode using ADLS technology.

Presence of structures: The Proposed Action would contribute up to 205 of a combined total of 2,421 WTGs that would be installed in the cumulative impacts analysis area between 2023 and 2030, which accounts for approximately 18 percent of offshore wind development planned for the geographic analysis area. The total number of WTGs that would be visible from any single KOP would be substantially fewer than the 2,421 WTGs considered under the planned activities scenario in combination with the Proposed Action. For example, 833 WTGs would be theoretically visible from KOP-AC04 Ocean Casino Resort – Sky Garden and 370 WTGs would be theoretically visible from KOP-SPB01 Seaside Park Beach (Appendix H, Attachment H-2). The presence of structures associated with offshore wind development in combination with the Proposed Action would have major seascape character, open ocean character, landscape character, and viewer experience impacts, as simulated from sensitive onshore receptors (Appendix H). Table 3.6.9-17 shows incremental magnitude of change to viewer experience of all WTAs in order of year constructed, WTA distances, and horizontal FOVs. The first row of each KOP lists incremental visibility for each individual WTA. The second row is cumulative: it adds visible WTGs and broadens the FOV with each WTA constructed.

Table 3.6.9-17. Cumulative WTAs' incremental magnitude of change by year constructed, WTA distances, horizontal FOVs, and impact

KOP[1]	Incremental and Cumulative Visibility	Distance in Miles (Kilometers), FOV degrees (% of 124°), and Impact														
		ASOWS[2] 2023–2025	OW1[2] 2024–2025	EW1[2] 2023–2027	EW2[2] 2025–2027	SW[2] 2024–2030	GSOE[2] 2023–2030	US[2] 2024	ASOWN[2] 2025–2030	OW2[2] 2026–2030	M-A[2] 2030	OWE[2] 2030	AE[2] 2030	BWH[2] 2030	ASOWB[2] 2030	IE[2] 2030
AC04	Nearest WTG Horizontal FOV Visible WTG, OSS[3] Impact	15.0 (24.1) 52.3° (42%) 205 **Major**	13.8 (22.2) 34.7° (28%) 111 **Major**	Not visible	Not visible	Not visible	45.3 (72.9) 16.5° (13%) 66 **Negligible**	Not visible	16.2 (26.1) 53° (43%) 164 **Major**	16.2 (26.1) 62° (50%) 111 **Major**	Not visible	Not visible	Not visible	50.3 (80.9) 15° (12%) 11 **Negligible**	41.4 (66.3) 26° (21%) 95 **Minor**	43.9 (70.6) 19° (15%) 70 **Minor**
	Visible WTGS[3] Horizontal FOV		316 59.4° (48%)				382 75.9° (61%)		546 140° (112%)	657 160° (129%)				668 160° (129%)	763 160° (129%)	833 160° (129%)
AC04 Night	Nearest WTG Horizontal FOV Visible WTG, OSS[3] Impact	15.0 (24.1) 52.3° (42%) 205 **Major**	13.8 (22.2) 34.7° (28%) 111 **Major**	Not visible	Not visible	Not visible	45.3 (72.9) 66 **Negligible**	Not visible	16.2 (26.1) 53° (43%) 164 **Major**	16.2 (26.1) 62° (50%) 111 **Major**	Not visible	Not visible	Not visible	50.3 (80.9) 15° (12%) 11 **Negligible**	41.4 (66.3) 26° (21%) 95 **Minor**	43.9 (70.6) 19° (15%) 70 **Minor**
	Visible WTGS[3] Horizontal FOV		316 59.4° (48%)				382 75.9° (61%)		546 140° (112%)	657 160° (129%)				668 160° (129%)	763 160° (129%)	833 160° (129%)
BC02	Nearest WTG Horizontal FOV Visible WTG, OSS[3] Impact	9.0 (14.5) 54.2° (44%) 205 **Major**	20.7 (33.3) 29.8° (24%) 111 **Moderate**	Not visible	Not visible	Not visible	Not visible	Not visible	11.3 (18.2) 57.8° (46%) 164 **Major**	20.7 (33.3) 42.2° (34%) 111 **Moderate**	Not visible	Not visible	Not visible	Not visible	37.5 (60.3) 25.8° (20%) 71 **Minor**	41.6 (66.9) 4° (3%) 4 **Negligible**
	Visible WTGS[3] Horizontal FOV		316 84° (68%)						546 135° (108%)	657 154° (124%)					728 154° (124%)	732 154° (124%)
BHB03	Nearest WTG Horizontal FOV Visible WTG, OSS[3] Impact	13.0 (20.9) 45.4° (37%) 205 **Major**	23.1 (37.2) 26.3° (21%) 111 **Moderate**	Not visible	Not visible	Not visible	Not visible	Not visible	9.6 (15.5) 56.8° (46%) 164 **Major**	29.9 (48.1) 24.7° (20%) 111 **Minor**	Not visible	Not visible	Not visible	40.3 (64.8) 16° (13%) 32 **Minor**	33.2 (53.4) 28.4° (23%) 95 **Moderate**	41.3 (66.5) 23° (18%) 51 **Minor**
	Visible WTGS[3] Horizontal FOV		316 58° (47%)						546 133° (107%)	657 143° (115%)				689 143° (115%)	784 143° (115%)	835 143° (115%)
LEHT02	Nearest WTG Horizontal FOV Visible WTG, OSS[3] Impact	11.9 (19.2) 46.4° (37%) 205 **Major**	20.6 (333.1) 28° (22.5%) 93 **Moderate**	Not visible	Not visible	Not visible	Not visible	Not visible	11.1 (17.9) 56° (45%) 131 **Major**	16.4 (26.4) 32° (26%) 41 **Moderate**	Not visible	Not visible	Not visible	Not visible	36.7 (59.1) 28.4° (23%) 5 **Negligible**	Not visible
	Visible WTGS[3] Horizontal FOV		298 63° (50%)						429 126° (101%)	470 140° (112%)					475 140° (112%)	
LT02	Nearest distance Horizontal FOV Visible WTG, OSS[3] Impact	45.0 (72.4) 18° (14%) 145 **Minor**	33.9 (54.6) 18.5° (15%) 105 **Moderate**	Not visible	Not visible	25.7 (41.4) 16° (13%) 33 **Moderate**	15.9 (25.6) 34.8° (28%) 80 **Major**	32.6 (52.5) 16° (13%) 98 **Minor**	55.5 (13.4° (10%) 13 **Negligible**	26.0 (41.8) 34.8° (31%) 111 **Moderate**	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
	Visible WTGS[3] Horizontal FOV		250 27° (22%)			283 43° (35%)	363 62° (50%)	461 77.8° (63%)	474 81.3° (65%)	585 98.3° (79%)						

KOP[1]	Incremental and Cumulative Visibility	Distance in Miles (Kilometers), FOV degrees (% of 124°), and Impact														
		ASOWS[2] 2023–2025	OW1[2] 2024–2025	EW1[2] 2023–2027	EW2[2] 2025–2027	SW[2] 2024–2030	GSOE[2] 2023–2030	US[2] 2024	ASOWN[2] 2025–2030	OW2[2] 2026–2030	M-A[2] 2030	OWE[2] 2030	AE[2] 2030	BWH[2] 2030	ASOWB[2] 2030	IE[2] 2030
OC04	Nearest WTG Horizontal FOV Visible WTG, OSS[3] Impact	17.2 (27.7) 50° (40%) 204 **Moderate**	15.6 (25.1) 38° (31%) 111 **Major**	Not visible	Not visible	Not visible	37.6 (60.5) 19° (15%) 32 **Minor**	Not visible	26.1 (42.0) 35.6° (29%) 118 **Moderate**	12.8 (20.6) 55.6° (45%) 111 **Major**	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
	Visible WTGS[3] Horizontal FOV		135 67° (54%)				167 86° (69%)		285 108° (87%)	396 137° (110%)						
SIC02	Nearest WTG Horizontal FOV Visible WTG, OSS[3] Impact	27.3 (43.9) 43.6° (35%) 200 **Moderate**	18.5 (29.8) 29.2° (23%) 111 **Moderate**	Not visible	Not visible	35.3 (56.8) 14° (11%) 33 **Minor**	26.6 (42.8) 25.7° (21%) 62 **Moderate**	45.2 (72.7) 9.3° (7%) 19 **Negligible**	37.6 (60.5) 26.4° (21%) 134 **Minor**	12.1 (19.5) 52.7° (42%) 111 **Major**	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
	Visible WTGS[3] Horizontal FOV		311 48° (39%)			344 62° (50%)	406 62° (50%)	425 62° (50%)	559 72° (58%)	670 101° (81%)						
SPB01	Nearest WTG Horizontal FOV Visible WTG, OSS[3] Impact	39.0 (62.8) 23.1° (19%) 118 **Minor**	Not visible	39.8 (64.1) 19.4° (16%) 52 **Minor**	44.6 (71.8) 4° (3%) 6 **Negligible**	Not visible	Not visible	Not visible	19.3 (31.1) 24° (19%) 157 **Moderate**	Not visible	Not visible	Not visible	42.4 (268.2) 11.3° (9%) 7 **Minor**	41.8 (67.3) 13.7° (11%) 13 **Minor**	39.5 (63.6) 7.3° (6%) 17 **Minor**	Not visible
	Visible WTGS[3] Horizontal FOV			170 42.5° (34%)	176 46.5° (37%)				333 57.4° (46%)				340 68.7° (55%)	353 82.4° (66%)	370 89.7° (72%)	

[1] KOP-OC04S = Ocean Casino Resort-Sky Garden; KOP-BC02 = North Brigantine Natural Area; KOP-BHB03 = Beach Haven, Holyoke Avenue; KOP-LEHT02 = Great Bay Boulevard WMA/Rutgers Field Station; KOP-LT02 = Cape May Point State Park Lighthouse; KOP-OC04 = Gillian's Wonderland Amusement Park; KOP-SIC02 = Townsend Inlet Bridge; and KOP-SPB01 = Seaside Park Beach.

[2] AE = Attentive Energy (previously [COP VIA] Hudson South B) OCS-A 0538; ASOWB = Atlantic Shores Offshore Wind Bight (previously [COP VIA] Hudson South E) OCS-A 0541; ASOWN = Atlantic Shores Offshore Wind North OCS-A 0549; ASOWS = Atlantic Shores Offshore Wind South OCS-A 0499; BWH = Bight Wind Holdings (previously [COP VIA] Hudson South C) OCS-A 0539; EW1 = Empire Wind 1 OCS-A 0512; EW2 = Empire Wind 2 OCS-A 0512; GSOE = Garden State Offshore Energy I OCS-A 0482; IE = Invenergy Wind Offshore (previously [COP VIA] Hudson South F) OCS-A 0542; M-A = Mid-Atlantic Offshore Wind (previously [COP VIA] Hudson North) OCS-A 0544; OW1 = Ocean Wind 1 OCS-A-0498; OW2 = Ocean Wind 2 OCS-A532; OWE = Ocean Wind East (previously [COP VIA] Central Bight) OCS-A 0537; SW = Skipjack OCS-A 0519; US = US Wind OCS-A 0490

[3] Theoretically visible based on clear sky and EC (see cumulative simulations in Appendix H, Attachment H-1).

The open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030 and result in major impacts. Atlantic Shores South's contribution to cumulative seascape character and landscape character impacts would range from 205 of 833 total WTGs visible from KOP-AC04 Ocean Casino Resort – Sky Garden, 25 percent of the total, to 200 of 670 total WTGs visible from KOP-SIC02 Townsend Inlet Bridge, 30 percent of the total (Atlantic Shores 2023). The seascape, open ocean, and landscape are highly valued scenery and rated high susceptibility.

Atlantic Shores South's WTG contribution to cumulative impacts from KOPs are as follows (Atlantic Shores 2023).

- KOP-AC04 Ocean Casino Resort – Sky Garden: 205 of 833 total WTGs visible, 25 percent of the total.
- KOP-BC02 North Brigantine Natural Area: 205 of 732 total WTGs visible, 34 percent of the total.
- KOP-BHB03 Beach Haven, Holyoke Avenue: 205 of 732 total WTGs visible, 28 percent of the total.
- KOP-LEHT02 Great Bay Boulevard WMA/Rutgers Field Station: 205 of 475 total WTGs visible, 43 percent of the total.
- KOP-LT02 Cape May Point State Park Lighthouse: 145 of 585 total WTGs visible, 25 percent of the total.
- KOP-OC04 Gillian's Wonderland Amusement Park: 204 of 396 total WTGs visible, 52 percent of the total.
- KOP-SIC02 Townsend Inlet Bridge: 200 of 670 total WTGs visible, 30 percent of the total.
- KOP-SPB01 Seaside Park Beach: 118 of 370 total WTGs visible, 32 percent of the total.

Traffic (vessel): Planned offshore wind project construction and installation, O&M, and decommissioning would increase vessel traffic in the geographic analysis area beyond what the Proposed Action would generate in isolation. As described in Section 3.6.6, during periods of overlapping construction in 2024–2025, offshore wind projects would generate between 165 and 385 vessel trips daily from Atlantic Coast ports to worksites in the geographic analysis area. During O&M, the Proposed Action and other offshore wind projects would generate up to 39 vessel trips per day in the geographic analysis area. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean characters from open ocean to active waterway. Increases in these vessel movements would be noticeable to onshore and offshore viewers, but are unlikely to have a significant effect.

Conclusions

Impacts of Alternative B – Proposed Action. Proposed Action effects on high- and moderate-sensitivity seascape character units, open ocean character units, and landscape character units would be **negligible**

to **major**, due to view distances (see effects ranges discussion in Appendix H); minor to moderate FOVs; strong, moderate, and weak visual contrasts; clear-day conditions; and nighttime ADLS activation. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected during construction and installation, O&M, and decommissioning by the Project's features, applicable distances, horizontal and vertical FOV extents, view framing or intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence. These assessments are documented in Appendix H. Project decommissioning effects would be similar to construction and installation effects. Due to distance, extensive FOVs, strong contrasts, large scale of change, and level of prominence, as well as heretofore undeveloped ocean views, the Proposed Action would have **major** impacts (the magnitude of change per BOEM 2021) on the open ocean character unit and viewer boating and cruise ship experiences. The daytime presence of offshore WTGs and OSSs, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSSs. In clear weather, the WTGs and OSSs would be an unavoidable presence in views from the coastline, with **minor** to **moderate** effects on seascape character and landscape character, and **major** effects on open ocean character.

Onshore, temporary, moderate effects would occur during construction and installation and decommissioning of the landfalls and onshore export cables. Effects during O&M activities would involve temporary vehicular and personnel presence and would be negligible. The context of the onshore substation and/or converter station sites surrounding industrial elements, strong visual contrast between the sites and the surrounding landscape, and the scale of change would be substantial as viewed from the KOPs. The Project's visibility would be prominent from the KOPs, and the value of the view is high, having moderate to high effect on viewers' quality of visual experience. Impacts of the onshore facilities on scenic and visual resources would be **negligible** to **major**.

BOEM expects that the connected action alone would have **minor** to **major** impacts on scenic and visual resources due to lighting and traffic.

Cumulative Impacts of Alternative B – Proposed Action. The incremental impacts contributed by the Proposed Action to the cumulative impacts on scenic and visual resources would be appreciable. BOEM anticipates that the impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind development would be **major**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.6.9.6 Impacts of Alternatives C, E, and F on Scenic and Visual Resources

Impacts of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would be similar to those of the Proposed Action. Alternative C could install fewer WTGs (up to 29 fewer WTGs) and one fewer offshore substation and associated interarray cables, or microsite them, which would slightly reduce the construction impact footprint and installation period. The removal of these WTGs and OSS would result in a negligible reduction of impacts on scenic resources and viewer experiences compared to the Proposed Action. Alternative E would modify the wind turbine array layout through the exclusion of WTG positions to create a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) and Ocean Wind 1 Lease Area (OCS-A 0498). The Alternative C and E modifications to layouts would result in a negligible reduction of impacts on scenic resources and viewer experiences compared to the Proposed Action. Alternative F's foundation structures would not be visible above the ocean surface.

Cumulative Impacts of Alternatives C, E, and F on Scenic and Visual Resources. The incremental impacts contributed by Alternatives C, E, and F to the cumulative impacts on seascape character, open ocean character, landscape character, and viewer experiences would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternatives C, E, and F. The **negligible** to **major** adverse impacts on seascape character, open ocean character, landscape character, and viewer experience associated with the Proposed Action would not change substantially under Alternatives C and E.

Cumulative Impacts of Alternatives C, E, and F. The incremental impacts contributed by Alternatives C, E, and F to the cumulative impacts on scenic resources and viewer experiences would be the same as under the Proposed Action and would range from **negligible** to **major** adverse impacts.

3.6.9.7 Impacts of Alternative D on Scenic and Visual Resources

Impacts of Alternative D. Under Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), the construction and installation, O&M, and eventual decommissioning of wind energy facilities on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, the layout and maximum number of WTGs would be adjusted to reduce visual impacts.

Under Alternatives D1, D2, and D3, up to 21 WTGs, 31 WTGs, and 6 WTGs, respectively, would be removed. The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum bade tip height of 932 feet (284 meters) AMSL. Appendix H, Tables H-22 and H-23 consider the effects of Alternative D1 on viewer experience. Appendix H, Tables H-24 and H-25 consider the effects of Alternative D2 on viewer experience. Appendix H, Tables H-26 and H-27 consider the effects of Alternative D3 on viewer experience. While a reduction in vertical field of view and contrasts would occur, the reduced impacts under Alternatives D1 and D2 would not be sufficient to change the level of impacts as compared with the Proposed Action.

Cumulative Impacts of Alternatives D on Scenic and Visual Resources. The incremental impacts contributed by Alternatives D to the cumulative impacts on seascape character, open ocean character, landscape character, and viewer experiences would be similar to those described under the Proposed Action.

Conclusions

Impacts of Alternative D. The effects of Alternatives D1, D2, and D3 on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Due to distance, extensive FOVs, high view prominence, strong contrasts, and heretofore undeveloped ocean views, Alternatives D1, D2, and D3 would have **major** effects on the seascape and open ocean unit character and viewer boating and cruise ship experiences. Appendix H, Tables H-22 through H-27 contain the alternatives' analyses. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternatives D1, D2, and D3 on high- and moderate-sensitivity landscape character units would be **negligible** to **major**. The daytime presence of offshore WTGs and OSS and nighttime moonlit conditions would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSS. In clear weather, the WTGs and OSS would be an unavoidable presence in views from the coastline, with **negligible** to **major** effects on seascape character, open ocean character, landscape character, and viewer experience.

Cumulative Impacts of Alternative D. BOEM anticipates that the contribution of Alternatives D1, D2, and D3 to the cumulative impacts associated with ongoing and planned activities would be **negligible** to **major**. The main drivers for this impact rating are the impacts associated with the presence of offshore structures in previously undeveloped ocean and substantially increased vessel traffic.

3.6.9.8 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of federal permitting, or through agency-to-agency negotiations, are described in Appendix G, Table G-2 and addressed in more detail in Table 3.6.9-18. This list of mitigation measures is subject to change following the completion of cooperating agency review.

Table 3.6.9-18. Proposed mitigation measures – scenic and visual resources

Measure	Description	Effect
Scenic and Visual Impact Monitoring Plan	In coordination with BOEM, the developer is to prepare and implement a scenic and visual resource monitoring plan that monitors and compares the visual effects of the wind farm during construction and operations/maintenance (daytime and nighttime) to the findings in the COP Visual Impact Assessment and verifies the accuracy of the visual simulations (photo and video). The monitoring plan should include monitoring and documenting the meteorological influences on actual wind turbine visibility over a duration of time from selected onshore key observation points, as determined by BOEM and the developer.	Although this mitigation measure would not reduce the visual impact of the Project, monitoring and documenting the meteorological influences on wind turbine visibility over time will advance the science of accurately simulating and evaluating visual impacts from offshore wind.

Measure	Description	Effect
	In addition, the plan should include ADLS monitoring and documentation of effectiveness. The developer needs to monitor the ADLS operations documenting when (dates, times) the aviation warning lights are in the on position and the duration. Details for monitoring and reporting procedures are to be included in the plan.	

3.6.9.9 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F on seascape character, open ocean character, landscape character, and viewer experience from accidental releases, lighting, presence of structures, and vessel traffic would be similar to those of the Proposed Action, ranging from **negligible** to **major** adverse related to the IPFs for accidental releases, lighting, presence of structures, and vessel traffic.

This page intentionally left blank.

Chapter 4

Other Required Impact Analyses

4.1 Unavoidable Adverse Impacts of the Proposed Action

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(2)) require that an EIS evaluate the potential unavoidable adverse impacts associated with a Proposed Action. Adverse impacts that can be reduced by mitigation measures but not eliminated are considered unavoidable. Table 4.1-1 provides a listing of such impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction and installation phase and would be temporary. Chapter 3, *Affected Environment and Environmental Consequences,* provides additional information on the potential impacts listed in the table.

All impacts from planned activities are still expected to occur as described in the No Action Alternative analysis in this Draft EIS, regardless of whether the Proposed Action is approved.

Table 4.1-1. Potential unavoidable adverse impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Physical Resources	
Air Quality	• Emissions from engines associated with vessel traffic, construction activities, and equipment operation
Water Quality	• Increase in suspended sediments due to seafloor disturbance during construction and installation, O&M, and decommissioning activities • Potential for accidental releases during construction
Biological Resources	
Bats	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic • Individual mortality due to collisions with operating WTGs
Benthic Resources	• Suspension and re-settling of sediments due to seafloor disturbance • Conversion of soft-bottom habitat to new hard-bottom habitat • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor alterations • Disturbance, displacement, and avoidance behavior due to habitat loss or alteration, equipment activity and noise, and vessel traffic • Individual mortality due to construction activities • Possible temporary loss of seagrass resources within Chelsea Harbor and Great Thoroughfares due to cable emplacement
Birds	• Displacement and avoidance behavior due to habitat loss or alteration, equipment noise, and vessel traffic • Individual mortality due to collisions with operating WTGs
Coastal Habitat and Fauna	• Habitat alteration and removal of vegetation, including trees • Temporary avoidance behavior by fauna during construction activity and noise-producing activities • Individual fauna mortality due to collisions with vehicles or equipment during clearing and grading activities, particularly species with limited mobility

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Finfish, Invertebrates, and Essential Fish Habitat	• Temporary loss of seagrass resources within Chelsea Harbor and Great Thoroughfares due to cable emplacement • Suspension and re-settling of sediments due to seafloor disturbance during construction • Displacement, disturbance, and avoidance behavior due to construction-related impacts, including noise, vessel traffic, increased turbidity, sediment deposition, EMF, and habitat changes • Individual mortality due to construction activities • Changes in habitat and community structure from conversion of soft-bottom habitat to new hard-bottom habitat
Marine Mammals	• Increased risk of injury (TTS or PTS) to individuals due to underwater noise from pile-driving activities during construction • Disturbance (behavioral effects) and acoustic masking due to underwater noise from pile driving, vessel traffic, aircraft, geophysical surveys (HRG surveys) and geotechnical drilling surveys, WTG operation, and dredging during construction and operations • Increased risk of individual injury and mortality due to vessel strikes during construction and installation, O&M, and decommissioning • Increased risk of individual injury and mortality associated with fisheries gear
Sea Turtles	• Increased risk for individual injury and mortality due to vessel strikes during construction and installation, O&M, and decommissioning • Disturbance, displacement, and avoidance behavior due to habitat disturbance and underwater noise during construction • Potential, but minor, EMF effects on migration
Wetlands	• Wetland and surface water alterations, including increased sedimentation deposition and removal of vegetation
Socioeconomic Conditions and Cultural Resources	
Commercial Fisheries and For-Hire Recreational Fishing	• Restriction in harvesting activities during construction of Offshore Project elements and during operations of offshore wind facility • Changes in vessel transit and fishing operation patterns • Changes in risk of gear entanglement, navigational hazards, and space-use conflicts associated with the presence of structures • Changes in the availability of target species because of habitat loss and conversion associated with the presence of structures
Cultural Resources	• Destruction of or damage to ancient submerged landforms • Although unlikely, unanticipated removal or disturbance of previously unidentified marine or terrestrial archaeological resources • Changes to the integrity of aboveground historic resources or visual disruptions to the historic or aesthetic settings from which these resources derive their significance
Demographics, Employment, and Economics	• Disruption of onshore and marine recreational businesses during onshore and offshore construction and cable installation • Potential changes to Ocean Economy sectors due to the long-term presence of the offshore wind facility, including commercial fishing, tourism, and recreation.

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Environmental Justice	• Compounded health issues of local environmental justice communities near ports as a result of air quality impacts from engine emissions associated with vessel traffic, construction activities, and equipment operation • Loss of employment or income due to disruption to commercial fishing, for-hire recreational fishing, or marine recreation businesses • Hindrances to subsistence fishing due to offshore construction and operation of the offshore wind facility
Land Use and Coastal Infrastructure	• Conversion of undeveloped areas for cable maintenance or replacement • Land use disturbance due to construction as well as effects due to noise and travel delays • Potential for accidental releases during construction
Navigation and Vessel Traffic	• Congestion in port channels • Increased navigational complexity, vessel congestion, and allision risk within the WTA • Potential for disruption to marine radar on smaller vessels operating within or in the vicinity of the Project, increasing navigational complexity • Hindrances to SAR missions within the WTA
Other Uses	• Disruption to offshore scientific research and surveys and species monitoring and assessment • Increased navigational complexity for military or national security vessels operating within the WTA through decreased effectiveness of individual radar systems • Changes to aviation and air traffic navigational patterns
Recreation and Tourism	• Disruption of coastal recreation activities during onshore construction, such as beach access • Viewshed effects from the WTGs altering enjoyment of marine and coastal recreation and tourism activities • Disruption to access or temporary restriction of in-water recreational activities from construction of Offshore Project elements • Temporary disruption to the marine environment and marine species important to fishing and sightseeing due to turbidity and noise • Hindrances to some types of recreational fishing, sailing, and boating within the area occupied by WTGs during operation
Scenic and Visual Resources	• Alterations to the ocean, seascape, landscape character units' character, and effects on viewer experience by the wind farm, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations, converter stations or both, and electrical connections with the power grid

This page was intentionally left blank.

4.2 Irreversible and Irretrievable Commitment of Resources

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(4)) require that an EIS review the potential impacts on irreversible or irretrievable commitments of resources resulting from implementation of a Proposed Action. CEQ considers a commitment of a resource irreversible when the primary or secondary impacts from its use limit the future options for its use. Irreversible commitment of resources typically applies to impacts on nonrenewable resources such as marine minerals or cultural resources. The irreversible commitment of resources occurs due to the use or destruction of a specific resource. An irretrievable commitment refers to the use, loss, or consumption of a resource, particularly a renewable resource, for a period of time.

Table 4.2-1 provides a listing of potential irreversible and irretrievable impacts by resource area. Chapter 3, *Affected Environment and Environmental Consequences*, provides additional information on the impacts summarized below.

Table 4.2-1. Irreversible and irretrievable commitment of resources by resource area for the Proposed Action

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Physical Resources			
Air Quality	No	No	BOEM expects air pollutant emissions to comply with permits regulating compliance with air quality standards. Emissions would be temporary during construction activities. To the extent that the Proposed Action displaces fossil-fuel energy generation, overall improvement of air quality would be expected.
Water Quality	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands. Turbidity impacts in marine and coastal environments would be short term.
Biological Resources			
Bats	Yes	No	Irreversible impacts on bats could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce the potential for such impacts. Decommissioning of the Project would reverse the impacts of bat displacement from foraging habitat.
Benthic Resources	No	No	Although local mortality of benthic fauna and habitat alteration is likely to occur, and seagrass resource losses may occur, BOEM does not anticipate population-level impacts on benthic organisms; habitat could recover after decommissioning activities.
Birds	Yes	No	Irreversible impacts on birds could occur if one or more individuals were injured or killed; however, implementation

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
			of mitigation measures developed in consultation with USFWS would reduce the potential for such impacts. Decommissioning of the Project would reverse the impacts of bird displacement from foraging habitat.
Coastal Habitat and Fauna	No	No	Although limited removal of habitat associated with clearing and grading for construction of the onshore cable and substations, converter stations, or both are likely to occur, BOEM does not anticipate population-level impacts on flora or fauna; coastal habitat could recover after construction in some areas, and after decommissioning activities in other areas.
Finfish, Invertebrates, and Essential Fish Habitat	No	No	Although local mortality of finfish and invertebrates, and habitat alteration and temporary loss of seagrass resources could occur, BOEM does not anticipate population-level impacts on finfish, invertebrates, and essential fish habitat. It is expected that the aquatic habitat for finfish and invertebrates would recover following decommissioning activities.
Marine Mammals	No	Yes	Irreversible impacts on marine mammal populations could occur if one or more individuals of an ESA-listed species were injured or killed or if those populations experienced behavioral effects with severe consequences. With implementation of mitigation measures, developed in consultation with NMFS (e.g., timing windows, vessel speed restrictions, safety zones), the potential for an ESA-listed species to experience behavioral effects with severe consequences or be injured or killed would be reduced. No irreversible high-severity behavioral effects from Project activities are anticipated; however, due to the uncertainties from lack of information that are outlined in Appendix E, *Analysis of Incomplete and Unavailable Information*, these effects are still possible. Irretrievable impacts could occur if growth of individuals or populations is retarded as a result of displacement from the Project area.
Sea Turtles	No	Yes	Irreversible impacts on sea turtles could occur if one or more individuals of species listed under the ESA were injured or killed; however, the implementation of mitigation measures, developed in consultation with NMFS, would reduce potential impacts on listed species. Irretrievable impacts could occur if growth of individuals or populations is retarded as a result of injury or mortality due to vessel strikes or entanglement with fisheries gear caught on the structures, or due to displacement from the Project area.
Wetlands	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Socioeconomic Conditions and Cultural Resources			
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and installation and O&M activities, BOEM does not anticipate irreversible impacts on commercial fisheries. The Project could alter habitat during construction and installation and O&M, limit access to fishing areas during construction and installation, or reduce vessel maneuverability during O&M. However, the conceptual decommissioning of the Project would reverse those impacts. Irretrievable impacts (lost revenue) could occur due to the loss of use of fishing areas at an individual level.
Cultural Resources	Yes	Yes	Impacts on ancient submerged landforms could result in irreversible and irretrievable impacts. Although unlikely, unanticipated removal or disturbance of previously unidentified marine or terrestrial archaeological resources could result in irreversible and irretrievable impacts.
Demographics, Employment, and Economics	No	Yes	Construction activities could temporarily increase contractor needs, housing needs, supply requirements, and demand for local businesses, leading to an irretrievable loss of workers for other projects. These factors could lead to increased housing and supply costs.
Environmental Justice	No	Yes	Impacts on environmental justice communities could occur due to loss of income or employment for low-income workers in marine industries; this could be reversed by Project decommissioning or by other employment, but income lost during Project O&M would be irretrievable.
Land Use and Coastal Infrastructure	Yes	Yes	Land use required for construction and installation and O&M activities could result in a minor irreversible impact. Construction and installation activities could result in a minor irretrievable impact due to the temporary loss of use of the land for otherwise typical activities. Onshore facilities may or may not be decommissioned. Depending largely on future consultations with state and municipal agencies, onshore facilities (e.g., onshore substations and converter stations and buried duct banks) will either be retired in place or reused for other purposes.
Navigation and Vessel Traffic	No	Yes	Based on the anticipated duration of construction and installation and O&M activities, BOEM does not anticipate impacts on vessel traffic to result in irreversible impacts. Irretrievable impacts could occur due to changes in transit routes, which could be less efficient during the life of the Project.
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during proposed Project construction and installation,

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
			O&M, and decommissioning activities, constituting irretrievable impacts.
Recreation and Tourism	No	No	Construction and installation activities near the shore could result in a minor, temporary loss of use of the land for recreation and tourism purposes.
Scenic and Visual Resources	No	No	Long-term (until post-decommissioning) seascape unit, open ocean unit, and landscape units' character alterations, and effects on viewer experience, by the wind farm, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations, converter stations or both, and electrical connections with the power grid would occur.

4.3 Relationship Between the Short-term Use of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

CEQ's NEPA-implementation regulations (40 CFR 1502.16(a)(3)) require that an EIS address the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur as a result of a reduction in the flexibility to pursue other options in the future, or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether the short-term environmental effects of the action will result in detrimental effects on long-term productivity of the affected areas or resources.

As assessed in Chapter 3, *Affected Environment and Environmental Consequences*, BOEM anticipates that the majority of the potential adverse effects associated with the Proposed Action would occur during construction and installation activities and would be short term in nature and minor to moderate in severity/intensity. These effects would cease after decommissioning activities. In assessing the relationships between short-term use of the environment and the maintenance and enhancement of long-term productivity, it is important to consider the long-term benefits of the Proposed Action, which include:

- Promotion of clean and safe development of domestic energy sources and clean energy job creation;
- Promotion of renewable energy to help ensure geopolitical security, reduce GHG emissions to combat climate change, and provide electricity that is affordable, reliable, safe, secure, and clean;
- Delivery of electric power to the New Jersey electrical grid to contribute to the state's renewable energy requirements; and
- Increased habitat for certain fish species.

Based on the anticipated potential impacts evaluated in this Draft EIS that could occur during Proposed Action construction and installation, O&M, and decommissioning, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment. Removal or disturbance of habitat associated with onshore activities could create long-term irreversible impacts. For purposes of this analysis, BOEM assumes that the irreversible impacts presented in Table 4.2-1 would be long term. After completion of the Proposed Action's O&M and decommissioning phases, however, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.

This page was intentionally left blank.

U.S. Department of the Interior (DOI)
The DOI 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)
BOEM's mission is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

BOEM
Bureau of Ocean Energy Management