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Bureau of Ocean Energy Management
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ENVIRONMENTAL IMPACT STATEMENT FOR THE COASTAL VIRGINIA OFFSHORE WIND COMMERCIAL PROJECT

DRAFT ( ) FINAL (X)

Lead Agency:	U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs
Cooperating Federal Agencies:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service U.S. Department of Defense U.S. Department of Defense, U.S. Army Corps of Engineers U.S. Department of Homeland Security, U.S. Coast Guard U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement U.S. Department of the Interior, U.S. Fish and Wildlife Service U.S. Environmental Protection Agency
Participating Federal Agencies:	Advisory Council on Historic Preservation U.S. Department of Defense, U.S. Navy U.S. Department of the Interior, National Park Service
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Area:	Renewable Energy Lease No. OCS-A-0483

Abstract:

This Final Environmental Impact Statement (EIS) assesses the reasonably foreseeable 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 the Coastal Virginia Offshore Wind Commercial Project (Project), as proposed by Dominion Energy in its Construction and Operations Plan (COP). The proposed Project described in the COP and this Final EIS would be up-to 3,000-megawatt (MW) in scale and sited 27 miles east of Virginia Beach, Virginia, within the area of Renewable Energy Lease Number OCS-A-0483 (Lease Area). This Final EIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 United States Code 4321–4370f) and implementing regulations of the Council on Environmental Quality and the Department of the Interior. This Final EIS will inform the Bureau of Ocean Energy Management's decision on whether to approve, approve with modifications, or disapprove the Project's COP.

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Acronyms and Abbreviations

μg/L	micrograms per liter
AAQS	ambient air quality standards
AC	alternating current
ACPARS	Atlantic Coast Port Access Route Study
ADLS	Aircraft Detection Lighting System
AIS	Automatic Identification System
AMOC	Atlantic meridional overturning circulation
AMSL	above mean sea level
APE	area of potential effect
APM	applicant-proposed measure
ASLF	ancient submerged landform feature
ASMFC	Atlantic States Marine Fisheries Commission
AWEA	American Wind Energy Association
BA	Biological Assessment
BBC	big bubble curtain
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BRCS	Benthic Resource Characterization Survey
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHIRP	compressed high-intensity radiated pulse
CO	carbon monoxide
CO_2	carbon dioxide
COBRA	CO-Benefits Risk Assessment
COP	Construction and Operations Plan
CSA	CSA Ocean Sciences Inc.
CVOW-C or Project	Coastal Virginia Offshore Wind Commercial Project
CWA	Clean Water Act
dB re 1 μPa	decibel referenced to 1 micropascal
dB	decibels
DC	direct current
DIN	dissolved inorganic nitrogen
DIP	dissolved inorganic phosphorous
DO	dissolved oxygen
DOAv	Virginia Department of Aviation
DOI	U.S. Department of the Interior
Dominion Energy, the lessee	Dominion Virginia Power
DP	dynamic positioning
DPS	distinct population segment

DPST	direct steerable pipe thrusting
DWR	deep-water route
EA	Environmental Assessment
EC	Engineer Circular
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electromagnetic fields
EMFs	electromagnetic forces
ESA	Endangered Species Act
ESC	Erosion and Sediment Control
FAA	Federal Aviation Administration
Fish Haven	Triangle Reef Fish Haven
FLM	federal land managers
FONSI	finding of no significant impact
FOV	field of view
FTE	full-time equivalent
G&G	geological and geophysical
GARFO	Greater Atlantic Regional Office
GW	gigawatts
HAP	hazardous air pollutant
HAPC	habitat areas of particular concern
hazmat	hazardous materials
HF	high frequency
HFC	high-frequency cetacean
HLV	heavy lift vessel
HMS	Office of Highly Migratory Species
HRG	high-resolution geophysical
HUC	Hydrologic Unit Code
HVDC	high-voltage direct-current
IPF	impact-producing factor
JEBLCFS	Joint Expeditionary Base Little Creek–Fort Story
KOP	Key Observation Point
kV	kilovolt
Lease Area	Lease Area OCS-A 0498
LFC	low-frequency cetaceans
LME	Large Marine Ecosystem
LNTMs	local notices to mariners
LP	sound pressure level
Lpk	peak sound pressure level
LPS	Large Pelagics Survey
LWB	Local Wetland Board
MAB	Mid-Atlantic Bight
MAFMC	Mid-Atlantic Fishery Management Council

MCL	maximum contaminant level
MEC	munitions and explosives of concern
MFC	mid-frequency cetaceans
mg/L	milligrams per liter
mL	milliliter
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSA	Metropolitan Statistical Area
MVA	Minimum Vectoring Altitude
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NALFF	Naval Auxiliary Landing Field Fentress
NARWs	North Atlantic right whales
NAS Oceana	Naval Air Station Oceana
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOA	notice of availability
NOAA	National Oceanic and Atmospheric Administration
NOI	notice of intent
NO_X	nitrogen oxides
NP	National Park
NPS	National Park Service
NSRA	Navigation Safety Risk Assessment
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OECC	offshore export cable corridor
OSS	offshore service stations
OW	otariid pinnipeds in water
PAM	passive acoustic monitoring
PDC	Project Design Criteria
PDE	Project Design Envelope
PJD	Preliminary Jurisdictional Delineation
PJM	Pennsylvania-New Jersey–Maryland interconnection
PM10	particulate matter smaller than 10 microns in diameter
PM2.5	particulate matter smaller than 2.5 microns in diameter
PMT	Portsmouth Marine Terminal

POI	Point of Interconnection
PPW	phocid pinnipeds in water
PSD	Prevention of Significant Deterioration
PSO	protected species observer
PSU	Practical Salinity Unity
PTS	permanent threshold shift
RAP	Research Activities Plan
RHA	Rivers and Harbors Act of 1899
ROD	Record of Decision
RODA	Responsible Offshore Development Alliance
RSZ	rotor swept zone
SAB	South Atlantic Bight
SAFMC	South Atlantic Fishery Management Council
SAR	search and rescue
SAR	stock assessment report
SCADA	supervisory control and data acquisition
SCC	State Corporation Commission
SEAMAP-SA	Southeast Monitoring and Assessment Program-South Atlantic
SEL_{cum}	sound exposure level over 24 hours
SFV	sound field verification
SHPO	state historic preservation office
SLIA	seascape, open ocean, and landscape impact assessment
SMR	State Military Reservation
SO_2	sulfur dioxide
SPL	sound pressure level
SPLRMS	root mean-square sound pressure level
T&E	Threatened and Endangered
TCP	traditional cultural property
TMDL	total maximum daily load
TSS	total suspended solids
TTS	temporary threshold shift
UME	unexplained mortality event
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDCR-DNH	Virginia Department of Conservation and Recreation Division of Natural Heritage
VDEQ	Virginia Department of Environmental Quality
VDHR	Virginia Department of Historic Resources
VDMA-VaARNG	Virginia Department of Military Affairs-Virginia Army National Guard
VIA	Visual Impact Assessment
VIMS	Virginia Institute of Marine Science

VMRC	Virginia Marine Resources Commission
VMS	Vessel Monitoring System
VOC	volatile organic compounds
WDA	wind development area
WEA	wind energy area
WNS	white-nose syndrome
WTG	wind turbine generator

ES. Executive Summary

ES.1. Introduction

This Final Environmental Impact Statement (EIS) assesses the reasonably foreseeable 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 a commercial-scale offshore wind energy facility and transmission cable to shore known as the Coastal Virginia Offshore Wind Commercial Project (CVOW-C or Project). The Bureau of Ocean Energy Management (BOEM) has prepared the Final EIS under the National Environmental Policy Act (NEPA) (42 U.S. Code [U.S.C.] 4321–4370f). This Final EIS will inform BOEM's decision on whether to approve, approve with modifications, or disapprove the Project's Construction and Operations Plan (COP).

Cooperating agencies may rely on this Final EIS to support their decision-making. In conjunction with submitting its COP, Virginia Electric and Power Company doing business as Dominion Virginia Power (Dominion Energy, the lessee) applied to the National Marine Fisheries Service (NMFS) for an incidental take authorization in the form of a Letter of Authorization for Incidental Take Regulations under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. 1361 et seq.), for incidental take of marine mammals during Project construction. Under the MMPA, NMFS is required to review applications and, if appropriate, issue an incidental take authorization. NMFS intends to adopt the Final EIS if, after independent review and analysis, the agency determines the Final EIS to be sufficient to support its separate proposed action and decision to issue the authorization, if appropriate. The U.S. Army Corps of Engineers (USACE) similarly intends to adopt the EIS to meet its responsibilities under Section 404 of the Clean Water Act (CWA) and Section 10 and Section 14 of the Rivers and Harbors Act of 1899 (RHA).

ES.2. Purpose and Need for the Proposed Action

In Executive Order 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."

Through a competitive leasing process under 30 Code of Federal Regulations (CFR) 585.211, Dominion Energy was awarded commercial Renewable Energy Lease OCS-A-0483. Dominion Energy has the exclusive right to submit a COP for activities in the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of an offshore wind energy facility in the Lease Area (the Project) (Figure S-1).

Dominion Energy's goal is to develop a commercial-scale offshore wind energy facility in the Lease Area; to provide between 2,500 and 3,000 megawatts (MW) of energy, making landfall in Virginia Beach, Virginia; and to use the offshore wind power generated from the proposed Project to supply its own customers (COP, Section 1.3; Dominion Energy 2023). Dominion Energy's goal of "not less than 2,500 and not more than 3,000 MW" of offshore wind energy in service by 2028 is mandated for Dominion Energy under the 2020 Virginia Clean Economy Act.[1]

[1] https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526.

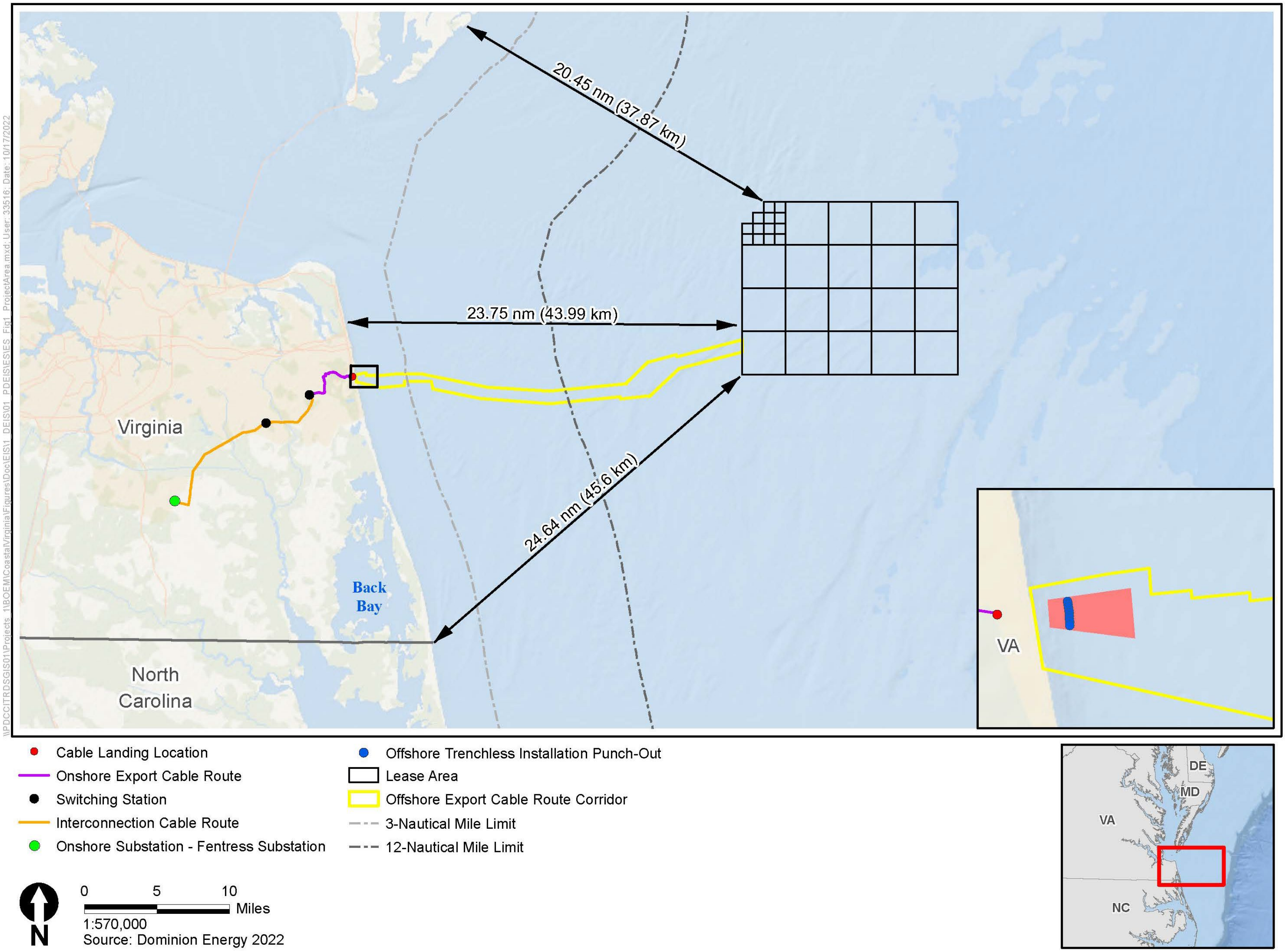


Figure S-1 Coastal Virginia Offshore Wind Commercial Project

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the Outer Continental Shelf, Executive Order 14008, the shared goals of the federal agencies to deploy 30 gigawatts (GW) of offshore wind in the United States by 2030, while protecting biodiversity and promoting ocean co-use,[2] and in consideration of Dominion Energy's goals, the purpose of BOEM's action is to determine whether to approve, approve with modifications or disapprove Dominion Energy's COP. BOEM will make this determination after weighing the factors in OCSLA Subsection 8(p)(4) 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 the lessee's plan to construct and operate a commercial-scale offshore wind energy facility in the Lease Area (the Proposed Action).

In addition, NMFS received a request for authorization to take marine mammals incidental to construction activities related to the Project under the MMPA on February 16, 2022. 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 1501.9I(1)). The purpose of the NMFS action—which is a direct outcome of Dominion Energy's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving, site characterization surveys)—is to evaluate Dominion Energy's request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, consider impacts of Dominion Energy's activities on relevant resources, and, if appropriate, issue the authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS' responsibilities under the MMPA (16 U.S.C. 1371(a)(5)(A and D)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS, after independent review, intends to adopt BOEM's EIS to support that decision and fulfill its NEPA requirements.

USACE Norfolk District anticipates a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR 325.8, under Section 10 of the RHA (33 U.S.C. 403) and Section 404 of the CWA (33 U.S.C. 1344). In addition, it is anticipated that a Section 408 permission will be required pursuant to Section 14 of the RHA (33 U.S.C. 408) for any proposed alterations that have the potential to alter, occupy, or use any USACE federally authorized civil works projects. USACE considers issuance of a permit or permissions under these three delegated authorities a major federal action connected to BOEM's Proposed Action (40 CFR 1501.9(e)(1)). The purpose and need for the Project as provided by the lessee in Section 1.3 of the COP and reviewed by USACE for NEPA purposes is to provide a commercially viable offshore wind energy project in the area covered by Lease OCS-A-0483 to help states achieve their renewable energy goals. The basic Project 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 evaluation, as determined by USACE, is the construction and operation of a commercial-scale offshore wind energy project for renewable energy generation and distribution to the PJM Interconnections energy grid. The purpose of the USACE Section 408 action as determined by Engineer Circular 1165-2-220 is to evaluate the lessee's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE 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 or permissions requested under Section 10 of the RHA, Section 404 of the CWA, or Section 14 of the RHA. USACE would adopt the EIS pursuant to 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

[2] Fact Sheet: 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/.

participation as a cooperating agency and its consideration of the Final EIS, USACE would issue a Record of Decision to formally document its decision on the Proposed Action. Additional evaluations required under NEPA for USACE to issue permits under Section 404 of the CWA and Sections 10 or 14 of the RHA will be addressed in USACE's Record of Decision.

ES.3. Public Involvement

On July 2, 2021, BOEM issued a Notice of Intent (NOI) to prepare an EIS, initiating a 30-day public scoping period from July 2 to August 2, 2021 (86 *Federal Register* 35329). 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 U.S.C. 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 COP. BOEM held three virtual public scoping meetings on July 12, July 14, and July 20, 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-2021-0040, via email to a BOEM representative, and through oral testimony at each of the three public scoping meetings. BOEM received a total of 52 comment submissions from federal 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 mitigation and monitoring; commercial fisheries and for-hire recreational fishing; finfish, invertebrates, and essential fish habitat; marine mammals; birds; air quality and climate change; employment and job creation; and wetlands and Waters of the United States, as well as the Project's purpose and need, alternatives, and cumulative impacts. BOEM considered all scoping comments while preparing this Final EIS.

On December 16, 2022, BOEM published a Notice of Availability for the Draft EIS, initiating a 60-day public review and comment period from December 16, 2022 to February 14, 2023 (87 *Federal Register* 77135). BOEM held three virtual public hearings on January 25, January 31, and February 2, 2023. Public comments were received through Regulations.gov on docket number BOEM-2022-0021, via email and mail to a BOEM representative, and through oral testimony at each of the three public hearings. BOEM received a total of 50 comment submissions from federal and state agencies, local governments, non-governmental organizations, and the general public during the comment period. BOEM assessed and considered all of the comments received in preparation of the Final EIS. See Appendix A, *Required Permits*, for additional information on public involvement.

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 Final EIS evaluates the No Action Alternative and four action alternatives (two 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.

- No Action Alternative
- Alternative A—Proposed Action
- Alternative B—Revised Layout to Accommodate the Fish Haven Area and Navigation

- Alternative C—Sand Ridge Impact Minimization Alternative
- Alternative D—Onshore Habitat Impact Minimization Alternative
  - Alternative D-1—Interconnection Cable Route Option 1
  - Alternative D-2—Interconnection Cable Route Option 6 (Hybrid Route)

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 No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP; Project construction and installation, O&M, and 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. However, all other past and ongoing impact-producing activities would continue. Under the No Action Alternative impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the applicant.

The current resource condition, trends, and impacts from ongoing activities under the No Action Alternative serve as the existing baseline against which the direct and indirect impacts of 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 would be implemented, 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 F, *Planned Activities Scenario*, without the Proposed Action serves as the baseline for the evaluation of cumulative impacts of all alternatives.

ES.4.2 Alternative A—Proposed Action

The Proposed Action would construct, operate, maintain, and eventually decommission an up-to 3,000-MW wind energy facility on the OCS offshore Virginia and associated onshore power distribution facilities within the range of design parameters described in Chapters 1 through 3 of the COP (Dominion Energy 2023) and summarized in Table S-1 and Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Under the Proposed Action, the wind energy facility would consist of up to 202 WTGs ranging from 14 MW to 16 MW each and would include up to three offshore substations (OSSs) within the rows of the gridded WTG layout.

Since publication of the Draft EIS, Dominion Energy adjusted a portion of the overhead alignment for the proposed interconnection cable route located south of the Princess Anne Athletic Complex in the City of Virginia Beach, Virginia to accommodate landowner concerns. The alignment for this 2,365.77-foot (721.1-meter) segment of the interconnection cable route has been rerouted approximately 200 feet to the north and onto land primarily consisting of developed open space associated with the Princess Anne Athletic Complex.[3] BOEM has updated the analysis contained in this Final EIS to address this change to the Proposed Action. Refer to Chapter 2 of the COP (Dominion Energy 2023) for additional details on Project design.

[3] The realignment for this 2,365.77-foot (721.1-meter) segment of the interconnection cable route applies to the shared overhead segment of Interconnection Cable Route Option 1 (Proposed Action, and Alternatives B, C, and D-1) and Interconnection Cable Route Option 6 (Hybrid Route) (Alternative D-2).

Table S-1 Summary of Project Design Envelope Parameters

Project Parameter Details
General (Layout and Project Size)
• 176 to 202 WTGs • Anticipated to begin offshore construction in 2023 (scour protection, offshore cables) and 2025 (WTGs) • Construction of the Project is expected to be complete within approximately 3 years
WTGs and Foundations
• Siemens Gamesa Renewable Energy SG 14-222 DD WTG with power-boost technology • 14- to 16-MW WTGs characterized as "minimum" and "maximum" capacity • Rotor diameter ranging from 725 to 761 feet (221 to 232 meters) • Hub height from MSL ranging from 446 to 489 feet (136 to 149 meters) • Turbine tip height from MSL ranging from 804 to 869 feet (245 to 265 meters) • Installation of monopiles through pile driving • Scour protection proposed to be installed around WTG monopile foundations • Installation vessels to include jack-up, platform supply, crew transfer, tugs, barges, heavy-lift vessels, fall pipe vessels, walk-to-work, and other support vessel types as necessary
Inter-Array Cables
• Up to 66-kV cables buried 3.3 to 9.8 feet (1 to 3 meters) beneath the seabed • Up to 300 miles (484 kilometers) total length of inter-array cables (average inter-array cable length of 5,868 feet [1,789 meters] between turbines) • Installation by jet trenching, chain cutting, trench former, or other available technologies • Installation vessels to include deep-draft cable lay, walk-to-work, crew transfer, trenching support, burial tool, survey, multipurpose support vessels, and other support vessel types as necessary
Offshore Export Cables
• Up to nine 230-kV offshore export cables buried 3.3 to 16.4 feet (1 to 5 meters) beneath the seabed; with additional cover in some sections; total burial depth may be up to 24.6 feet (7.5 meters) • Nine offshore export cables (in a single corridor) • Up to 337.9 miles (543.7 kilometers) total length of offshore export cable • Installation by jet trenching, plowing, chain cutting, trench former, or other available technologies • Installation vessels to include pull-in support barge, tug, multipurpose support, survey, shallow-draft cable lay, hydroplow, crew transfer, deep-draft, walk-to-work, trenching support, burial tool vessels, and other support vessel types as necessary • Cable protection at the cable crossings
Offshore Substations
• Three OSSs • OSSs installed atop piled jacket foundations • Scour protection installed at all foundation locations • Installation vessels to include barge, tug, transport, heavy lift, anchor handling, jack-up vessels, platform support, and other support vessel types as necessary

Project Parameter Details
Onshore Facilities
• Landfall of offshore export cable(s) to be completed via Trenchless Installation • Maximum area of temporary disturbance for cable landing location: 2.27 acres (0.92 hectare); maximum temporary workspace at the Nearshore Trenchless Installation Area approximately 8.8 acres (3.6 hectares) • Construction work area for Harpers Switching Station: maximum of approximately 46.5 acres (18.8 hectares); construction work area for the Chicory Switching Station: maximum of approximately 35.5 acres (14.4 hectares) • Construction work area for the upgrades at the onshore substation (existing Dominion Energy Fentress substation): maximum of approximately 20.4 acres (8.3 hectares) • Maximum onshore export cable length of approximately 4.41 miles (7.10 kilometers) • Maximum interconnection cable length of approximately 14.3 miles (22.9 kilometers) • Maximum area of temporary disturbance for onshore export cable route of approximately 26.6 acres (10.8 hectares)[1] • Maximum area of permanent disturbance for onshore export cable route of approximately 1.0 acre (0.4 hectare)[2] • Maximum area of temporary disturbance for Interconnection Cable Route Option 1 of approximately 0 acres (0 hectares)[2] • Maximum area of permanent disturbance for Interconnection Cable Route Option 1 of approximately 1 acre (0.4 hectare)[3] • Maximum area of temporary disturbance for Interconnection Cable Route Option 6 (Hybrid Route) of approximately 29.0 acres (11.7 hectares)[4] • Maximum area of permanent disturbance for Interconnection Cable Route Option 6 (Hybrid Route) of approximately 3.85 acres (1.56 hectares)[5]

Sources: COP Table 1.2-1; Dominion Energy 2023
kV = kilovolt; MSL = mean sea level.
[1] For the purposes of this analysis, the estimated temporary disturbance for the onshore export cable route is associated with the areas of the route that are surface trenched (60-foot-wide [18-meter-wide] trench for ~3.7 miles [6 kilometers]).
[2] For the purposes of this analysis, the estimated permanent disturbance for the onshore export cable route is associated with the permanent structures (i.e., manhole vaults).
[3] For the purposes of this analysis, the total permanent disturbance for Interconnection Cable Route Option 1 is associated with the new permanent structures (i.e., transmission towers) to be installed within the new/proposed right-of-way. For the purposes of this analysis, it is assumed that no other land disturbance will occur within the interconnection cable route.
[4] For the purposes of this analysis, the estimated temporary disturbance for Interconnection Cable Route Option 6 (Hybrid Route) is associated with the area of the underground portion of the route that is surface trenched.
[5] For the purposes of this analysis, the estimated permanent disturbance for Interconnection Cable Route Option 6 (Hybrid Route) is associated with the permanent structures (i.e., manhole vaults for the underground portion of the route and transmission towers for the overhead portion of the route).

ES.4.3 Alternative B—Revised Layout to Accommodate the Fish Haven Area and Navigation

Under Alternative B, the construction, O&M, and eventual decommissioning of a 2,587-MW wind energy facility on the OCS offshore Virginia would occur within the range of the design parameters outlined in the COP, subject to proposed and required mitigation measures. However, the fish haven area along the northern boundary of the Lease Area would be an exclusion zone where eight WTGs and associated inter-array cables and other Project infrastructure would not be sited. Three WTGs and associated inter-array cables would also be excluded from the northwest corner of the Lease Area to avoid conflicts with a proposed vessel traffic fairway. Up to 176 WTGs under Alternative B would each be 14 MW and capable of generating up to 14.7 MW using power-boost capability in a 0.93- by 0.75-nautical-mile (1.72- by 1.39-kilometer) offset grid in an east–west by northwest by southeast gridded layout. The three OSSs would be placed within the rows of the gridded WTG layout to minimize disruptions to surface and aerial navigation through the Wind Turbine Area. This configuration would still allow micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, to avoid sensitive cultural resources and marine habitats. Onshore components would be the same as described under Alternative A.

ES.4.4 Alternative C—Sand Ridge Impact Minimization Alternative

Alternative C was developed through the scoping process for the EIS in response to comments received requesting an alternative to minimize impacts on offshore benthic habitats. Under Alternative C, the construction, O&M, and eventual decommissioning of a wind energy facility would include a similar offshore layout and range of design parameters as described under Alternative B. However, in addition to avoiding the fish haven area and the proposed vessel traffic fairway, Alternative C would avoid and minimize impacts on sand ridge habitat and shipwrecks through a combination of micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, the removal of four WTGs from priority ridge habitat, and the relocation of one WTG to a spare position. Under Alternative C, the removal of four WTGs and relocation of one WTG allows for the reconfiguration of inter-array cabling that would otherwise be developed in priority sand ridge habitats, thus reducing potential seafloor disturbance, including the cross-cutting and trenching of sand ridges. As a result, an up-to 2,528-MW wind energy facility consisting of up to 172 WTGs (inclusive of two spare WTG positions) and three OSSs with associated export cables would be developed under Alternative C. As under Alternative B, Alternative C would use 14 MW WTGs generating up to 14.7 MW each using power-boost capability in a 0.93- by 0.75-nautical-mile (1.72- by 1.38-kilometer) offset grid pattern. Onshore components would be the same as described under the Proposed Action.

ES.4.5 Alternative D—Onshore Habitat Impact Minimization Alternative

Alternative D was developed through the scoping process for the EIS in response to public comments regarding the potential impacts on sensitive onshore habitats, including wetlands. Under Alternative D, the construction, O&M, and eventual decommissioning of a wind energy facility would include the same offshore layout and range of design parameters as Alternative A: an up-to 3,000-MW wind energy facility consisting of up to 202 WTGs ranging from 14 MW to 16 MW each and three OSSs in the Lease Area, with associated export cables. Unlike Alternative A, the construction of onshore interconnection cables under Alternative D would follow either Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6 (Hybrid Route). Therefore, under Alternative D BOEM would consider and potentially approve Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6, whereas only Interconnection Cable Route Option 1 is considered under Alternative A. Each of the following sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

- **Alternative D-1:** Interconnection Cable Route Option 1 would be the same as described under the Proposed Action and would be approximately 14.3 miles (22.9 kilometers) long and installed entirely overhead. From the common location north of Harpers Road, Interconnection Cable Route Option 1 would continue to the onshore substation, and the new Harpers Switching Station would be located at Naval Air Station (NAS) Oceana Parcel, pending Navy approval.
- **Alternative D-2:** Interconnection Cable Route Option 6 (Hybrid Route) would be approximately 14.3 miles (22.9 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. Following Interconnection Cable Route Option 1 as an underground transmission line for approximately

4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, Interconnection Cable Route Option 6 would transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation. The maximum construction and operational corridor for the underground portion of Interconnection Cable Route Option 6 would be 86.5 feet (26 meters); the overhead portion would be 250 feet (76.2 meters), which is equivalent to the corridor width for Interconnection Cable Route Option 1.

Interconnection Cable Route Option 1 would be an entirely overhead route, while Interconnection Cable Route Option 6 (Hybrid Route) would involve installation of the interconnection cable using a hybrid of overhead and underground construction methods. Both interconnection cable route options are intended to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores when compared to the other interconnection cable routes considered by Dominion Energy.

ES.5. Environmental Impacts

This Final EIS uses a four-level classification scheme to characterize the potential beneficial impacts and adverse impacts of alternatives as either **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*. Table S-2 presents the range of impacts resulting from the individual IPFs for each alternative inclusive of the current resource condition, trends, and impacts from ongoing activities, except where noted. Table S-2 also presents the range of impacts for each alternative inclusive of the current resource condition, trends, and impacts from ongoing and reasonably foreseeable future activities, except where noted. 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.

Appendix L, *Other Impacts*, describes potential unavoidable adverse impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. Appendix L also describes irreversible and irretrievable commitment of resources by resource area. The most notable of such commitments could include effects on habitat or individual members of protected species and potential loss of use of commercial fishing areas.

Table S-2 Summary and Comparison of Impacts Among Alternatives with Mitigation Measures

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout	Alternative C Sand Ridge Impact Minimization	Alternative D Onshore Habitat Impact Minimization
3.4 Air Quality					
Alternative Impacts	Moderate	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Alternative Plus Other Foreseeable Impacts	Moderate; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial
3.5 Bats					
Alternative Impacts	Minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
Alternative Plus Other Foreseeable Impacts	Minor	Minor	Minor	Minor	Minor
3.6 Benthic Resources					
Alternative 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
Alternative Plus Other Foreseeable Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.7 Birds					
Alternative Impacts	Moderate	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Alternative Plus Other Foreseeable Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.8 Coastal Habitat and Fauna					
Alternative Impacts	Moderate	Minor	Minor	Minor	Minor

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout	Alternative C Sand Ridge Impact Minimization	Alternative D Onshore Habitat Impact Minimization
Alternative Plus Other Foreseeable Impacts	Negligible	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
3.9 Commercial Fisheries and For-Hire Recreational Fishing					
Alternative Impacts	Negligible to major on commercial fisheries and moderate on for-hire recreational fishing	Negligible to major on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing
Alternative Plus Other Foreseeable Impacts	Negligible to major on commercial fisheries and moderate on for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and moderate on for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and moderate on for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and moderate on for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and moderate on for-hire recreational fishing; minor beneficial on for-hire recreational fishing
3.10 Cultural Resources					
Alternative Impacts	Moderate on individual onshore and offshore cultural resources	Moderate to major on onshore and offshore cultural resources without National Historic Places Act (NHPA) pre-construction requirements	Moderate to major on onshore and offshore cultural resources without NHPA pre-construction requirements	Moderate to major on onshore and offshore cultural resources without NHPA pre-construction requirements	Negligible to major on onshore and offshore cultural resources without NHPA pre-construction requirements

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout	Alternative C Sand Ridge Impact Minimization	Alternative D Onshore Habitat Impact Minimization
Alternative Plus Other Foreseeable Impacts	Moderate on individual onshore and offshore cultural resources	Moderate to major without pre-construction NHPA requirements, considering long-term or permanent and irreversible impacts on cultural resources	Negligible to major assuming implementation of mitigation measures	Negligible to major assuming implementation of mitigation measures	Negligible to major assuming implementation of mitigation measures
3.11 Demographics, Employment, and Economics					
Alternative Impacts	Minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
Alternative Plus Other Foreseeable Impacts	Minor; minor beneficial	Negligible to minor; negligible to moderate beneficial	Negligible to minor; negligible to moderate beneficial	Negligible to minor; negligible to moderate beneficial	Negligible to minor; negligible to moderate beneficial
3.12 Environmental Justice					
Alternative Impacts	Minor to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Alternative Plus Other Foreseeable Impacts	Minor; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
3.13 Finfish, Invertebrates, and Essential Fish Habitat					
Alternative Impacts	Minor to moderate	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Alternative Plus Other Foreseeable Impacts	Minor to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
3.14 Land Use and Coastal Infrastructure					
Alternative Impacts	Minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout	Alternative C Sand Ridge Impact Minimization	Alternative D Onshore Habitat Impact Minimization
Alternative Plus Other Foreseeable Impacts	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
3.15 Marine Mammals					
Alternative Impacts (without Baseline)[1]	No Impact	Minor for NARWs; moderate for mysticetes (other than NARW), harbor porpoise, and pinnipeds, and minor for odontocetes (other than harbor porpoise)	Minor for NARWs; moderate for mysticetes (other than NARW), harbor porpoise, and pinnipeds, and minor for odontocetes (other than harbor porpoise)	Minor for NARWs; moderate for mysticetes (other than NARW), harbor porpoise, and pinnipeds, and minor for odontocetes (other than harbor porpoise)	Minor for NARWs; moderate for mysticetes (other than NARW), harbor porpoise, and pinnipeds, and minor for odontocetes (other than harbor porpoise)
Alternative Impacts (with Baseline)[2]	Moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for delphinids and pinnipeds[4]	Negligible to moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for delphinids and pinnipeds	Negligible to moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for delphinids and pinnipeds	Negligible to moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for delphinids and pinnipeds	Negligible to moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for delphinids and pinnipeds
	Major for NARW[5]	Negligible to major for NARW	Negligible to major for NARW	Negligible to major for NARW	Negligible to major for NARW
Alternative (with Baseline) Plus Other Foreseeable Impacts[3]	Negligible to moderate for mysticetes (other than NARW), odontocetes and pinnipeds; minor beneficial for delphinids and pinnipeds	Negligible to moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for small odontocetes and pinnipeds	Negligible to moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for odontocetes and pinnipeds	Negligible to moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for odontocetes and pinnipeds	Negligible to moderate for mysticetes (other than NARW), odontocetes, and pinnipeds; minor beneficial for delphinids and pinnipeds
	Negligible to major for NARW	Negligible to major for NARW	Negligible to major for NARW	Negligible to major for NARW	Negligible to major for NARW

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout	Alternative C Sand Ridge Impact Minimization	Alternative D Onshore Habitat Impact Minimization
3.16 Navigation and Vessel Traffic					
Alternative Impacts	Moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
Alternative Plus Other Foreseeable Impacts	Minor to moderate	Minor to major	Minor to major	Minor to major	Minor to major
3.17 Other Uses					
Alternative Impacts	Negligible on Marine Mineral extraction, marine and national security uses, aviation and air traffic, cables and pipelines, and radar systems; major on scientific research and surveys	Negligible on aviation and air traffic, and cables and pipelines; minor on marine mineral extraction and radar systems; moderate on military and national security uses; major on scientific research and surveys	Negligible on aviation and air traffic, and cables and pipelines; minor on marine mineral extraction and radar systems; moderate on military and national security uses; major on scientific research and surveys	Negligible on aviation and air traffic, and cables and pipelines; minor on marine mineral extraction and radar systems; moderate on military and national security uses; major on scientific research and surveys	Negligible on aviation and air traffic, and cables and pipelines; minor on marine mineral extraction and radar systems; moderate on military and national security uses; major on scientific research and surveys
Alternative Plus Other Foreseeable Impacts	Negligible on aviation and air traffic, cables and pipelines, and radar systems; minor on marine mineral extraction and national security and military uses; major on scientific research and surveys	Negligible on aviation and air traffic, cables and pipelines, and radar systems; minor on marine mineral extraction; moderate on national security and military uses; major on scientific research and surveys	Negligible on aviation and air traffic, cables and pipelines, and radar systems; minor on marine mineral extraction; moderate on national security and military uses; major on scientific research and surveys	Negligible on aviation and air traffic, cables and pipelines, and radar systems; minor on marine mineral extraction; moderate on national security and military uses; major on scientific research and surveys	Negligible on aviation and air traffic, cables and pipelines, and radar systems; minor on marine mineral extraction; moderate on national security and military uses; major on scientific research and surveys

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B Revised Layout	Alternative C Sand Ridge Impact Minimization	Alternative D Onshore Habitat Impact Minimization
3.18 Recreation and Tourism					
Alternative Impacts	Minor	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial
Alternative Plus Other Foreseeable Impacts	Minor; minor beneficial	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial	Negligible to minor; negligible to minor beneficial
3.19 Sea Turtles					
Alternative Impacts	Minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
Alternative Plus Other Foreseeable Impacts	Minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
3.20 Scenic and Visual Resources					
Alternative Impacts	Minor	Moderate	Moderate	Moderate	Moderate
Alternative Plus Other Foreseeable Impacts	Moderate to major	Moderate	Moderate	Moderate	Moderate
3.21 Water Quality					
Alternative Impacts	Minor	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
Alternative Plus Other Foreseeable Impacts	Minor	Minor	Minor	Minor	Minor
3.22 Wetlands					
Alternative Impacts	Moderate	Moderate to major	Moderate to major	Moderate to major	Moderate to major
Alternative Plus Other Foreseeable Impacts	Moderate	Moderate to major	Moderate to major	Moderate to major	Moderate to major

Impact rating colors are as follows: orange = major; yellow = moderate; green = minor, negligible, no impact, 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.

[1] BOEM assessed the impacts of the No Action Alternative and action alternatives without the environmental baseline to support determinations under the Marine Mammal Protection Act.

[2] BOEM provides the range of impacts for the individual IPFs evaluated by species groups for the assessment of impacts of the No Action Alternative and action alternatives with the baseline.
[3] BOEM provides the range of impacts for the individual IPFs evaluated by species groups for the assessment of the impacts of the No Action Alternative and action alternatives with the baseline in combination with ongoing and other foreseeable future activities. The individual rating includes all IPFs combined.
[4] Individual IPFs were not evaluated for the No Action Alternative; therefore, impact conclusions are presented as a single determination by species group.
[5] Major impacts are identified here rather than a range because individual IPFs were not evaluated for the No Action Alternative. Based on the status and current population of the North Atlantic right whale, the loss of a single North Atlantic right whale would affect the population.
NRHP = National Register of Historic Places.

1. Introduction

This Final Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, operations and maintenance (O&M), and conceptual decommissioning of the Coastal Virginia Offshore Wind Commercial Project (CVOW-C or Project) proposed by Virginia Electric and Power Company doing business as Dominion Virginia Power (Dominion Energy or lessee), in its Construction and Operations Plan (COP; Dominion Energy 2023).[1] The proposed Project described in the COP and this Final EIS is a wind farm between 2,500 and 3,000 megawatts (MW) in power capacity that would be sited 27 miles (23.75 nautical miles) off the Virginia Beach, Virginia, coastline within the area covered by Renewable Energy Lease No. OCS-A-0483 (Lease Area). The Project would supply the offshore wind power that it generates to the customers of Dominion Energy. This Final 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).

This Final EIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4321–4370f) and NEPA implementing regulations of the Council on Environmental Quality (CEQ) (40 CFR 1500–1508). CEQ revised these regulations on April 20, 2022, and the current regulations, effective May 20, 2022, contain a presumptive time limit of 2 years for completing EISs and a presumptive page limit of 150 pages or fewer or 300 pages for proposals of unusual scope or complexity. BOEM has followed those limits in preparing this EIS in accordance with the new regulations. Additionally, this Final EIS was prepared consistent with the U.S. Department of the Interior (DOI) NEPA regulations (43 CFR 46), longstanding federal judicial and regulatory interpretations, and administration priorities and policies including the Secretary of the Interior's Order No. 3399 requiring bureaus and offices to not apply any of the provisions of the 2020 changes to CEQ regulations (85 *Federal Register* 43304–43376) "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."

1.1. Background

In 2009, DOI issued final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which was authorized by the Energy Policy Act of 2005. The Energy Policy Act provisions implemented by BOEM provide a framework for issuing renewable energy leases, easements, and rights-of-way for OCS activities (Section 1.3, *Regulatory Framework*). BOEM's renewable energy program has four 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 Virginia is summarized in Table 1-1.

[1] The Dominion Energy COP and all appendices are incorporated by reference into this Final EIS and are publicly available on BOEM's website: https://www.boem.gov/renewable-energy/state-activities/cvow-construction-and-operations-plan.

Table 1-1 History of BOEM Planning and Leasing Offshore Virginia

Year	Milestone
2012	On February 3, 2012, BOEM published a Call for Information and Nominations (Call) for Commercial Leasing for Wind Power on the OCS Offshore Virginia in the *Federal Register*. The public comment period for the Call closed on March 19, 2012. In response, BOEM received eight commercial indications of interest.
2012	On February 3, 2012, BOEM published in the *Federal Register* a notice of availability (NOA) of a final Environmental Assessment (EA) and finding of no significant impact (FONSI) for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia.
2012	On December 3, 2012, BOEM published a Proposed Sale Notice requesting public comments on the proposal to auction one lease offshore Virginia for commercial wind energy development.
2013	On July 23, 2013, BOEM published a Final Sale Notice, which stated that a commercial lease sale would be held September 4, 2013, for the wind energy area (WEA) BOEM had designated offshore Virginia. The Virginia WEA was auctioned as one lease, and Virginia Electric and Power Company (doing business as Dominion Virginia Power) was the winner (Renewable Energy Lease OCS-A-0483.
2016–2017	On March 2, 2016, Dominion Energy submitted a Site Assessment Plan (SAP) for Lease OCS-A-0483. BOEM approved the SAP on October 12, 2017.
2020–2021	On October 28, 2020, Dominion Energy submitted a new SAP for Lease OCS-A-0483. BOEM approved the SAP on October 1, 2021.
2020–2022	On December 17, 2020, Dominion Energy submitted a COP for the construction, operations, and conceptual decommissioning of the Project within the Lease Area. Updated versions of the COP were submitted on June 29, 2021; October 29, 2021; December 3, 2021; May 6, 2022; and February 28, 2023.
2021	On July 2, 2021, BOEM published a notice of intent (NOI) to prepare an EIS for the proposed Project.
2022	On December 16, 2022, BOEM published an NOA of a Draft EIS, initiating a 60-day public comment period for the Draft EIS.
2023	On September 29, 2023, BOEM published a Notice of Availability of a Final EIS initiating a minimum 30-day mandatory waiting period, during which BOEM is required to pause before issuing a Record of Decision.

1.2. Purpose and Need of the Proposed Action

In Executive Order 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."

Through a competitive leasing process under 30 CFR 585.211, Dominion Energy was awarded the Lease Area. Dominion Energy 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 an offshore wind energy facility in the Lease Area (the Project) in accordance with BOEM's COP regulations under 30 CFR 585.626, et seq.

Dominion Energy's goal is to develop a commercial-scale offshore wind energy facility in the Lease Area, provide between 2,500 and 3,000 MW of energy, making landfall in Virginia Beach, Virginia, and use the offshore wind power generated from the proposed Project to supply its own customers (COP, Section 1.3; Dominion Energy 2023). Dominion Energy's goal of "not less than 2,500 and not more than 3,000 MW" of offshore wind energy in service by 2028 is mandated for Dominion Energy under the 2020 Virginia Clean Economy Act.[2]

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the OCS, Executive Order 14008, the shared goals of the federal agencies to deploy 30 gigawatts (GW) of offshore wind in the United States by 2030, while protecting biodiversity and promoting ocean co-use,[3] and in consideration of Dominion Energy's goals, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove Dominion Energy's COP. BOEM will make this determination after weighing the factors in OCSLA Subsection 8(p)(4) 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 the lessee's plan to construct and operate a commercial-scale offshore wind energy facility in the Lease Area (the Proposed Action). The reorganization of the Renewable Energy rules (30 CFR Parts 285, 585, and 586) enacted on January 31, 2023) reassigned existing regulations governing safety and environmental oversight and enforcement of OCS renewable energy activities from BOEM to the Bureau of Safety and Environmental Enforcement (BSEE).

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 construction activities related to the Project under the Marine Mammal Protection Act (MMPA) on February 16, 2022. NMFS' issuance of an MMPA incidental take authorization is a major federal action, and, in relation to BOEM's action, it is considered a connected action (40 CFR 1501.9(e)(1)). The purpose of the NMFS action—which is a direct outcome of Dominion Energy's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate Dominion Energy's request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, consider impacts of the Dominion Energy's activities on relevant resources, and, if appropriate, issue the authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS' responsibilities under the MMPA (16 U.S.C. 1371(a)(5)(A and D)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS, after independent review, intends to adopt BOEM's EIS to support that decision and fulfill its NEPA requirements.

The U.S. Army Corps of Engineers (USACE) Norfolk District anticipates a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR 325.8, under Section 10 of the Rivers and Harbors Act of 1899 (RHA) (33 U.S.C. 403) and Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344). In addition, it is anticipated that a Section 408 permission will be required pursuant to Section 14 of the RHA of 1899 (33 U.S.C. 408) for any proposed alterations that have the potential to alter, occupy, or use any USACE federally authorized Civil Works projects. USACE considers issuance of a permit or permissions under these three delegated authorities a major federal action connected to BOEM's Proposed Action (40 CFR 1501.9(e)(1)). The purpose and need for the Project as provided by the lessee in COP Section 1.3 and reviewed by USACE for NEPA purposes is to provide a commercially

[2] https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526.

[3] Fact Sheet: 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/. Interior, Energy, Commerce, and Transportation Departments Announce New Leasing, Funding, and Development Goals to Accelerate and Deploy Offshore Wind Energy and Jobs.

viable offshore wind energy project within the area covered by the Lease Area to help states achieve their renewable energy goals. The basic Project 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 evaluation, as determined by USACE, is the construction and operation of a commercial-scale offshore wind energy project for renewable energy generation and distribution to the PJM Interconnections energy grid. The purpose of the USACE Section 408 action as determined by Engineer Circular (EC) 1165-2-220 is to evaluate the lessee's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE 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 or permissions requested under Section 10 of the RHA, Section 404 of the CWA, or Section 14 of the RHA. USACE would adopt the EIS pursuant to 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. Additional evaluations required under NEPA for USACE to issue permits under Section 404 of the CWA and Sections 10 or 14 of the RHA will be addressed in USACE's ROD.

1.3. Regulatory Framework

The Energy Policy Act of 2005, Public Law 109-58, added Section 8(p)(1)(c) to OCSLA (43 U.S.C. 1337(p)(1)(c).[4] The new section authorized the Secretary of the Interior to issue leases, easements, and rights-of-way in the OCS for renewable energy development, including wind energy. The Secretary of the Interior delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing the authority for renewable energy leasing under OCSLA (30 CFR 585) were promulgated on April 22, 2009.[5] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove Dominion Energy's COP (30 CFR 585.628).

Consistent with the requirements of OCSLA and applicable regulations, Section 2 of BOEM's lease form provides the lessee with the 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 585. 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 43 U.S.C. 1337(p)(4), or for other reasons provided by BOEM pursuant to 30 CFR 585.613(e)(2) or 585.628(f); BOEM reserves the right to approve a COP with modifications; and BOEM reserves the right to authorize other uses within the Lease Area and Project easement that will not unreasonably interfere with activities described in an approved COP pursuant to the lease.

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 U.S.C. 1531–1544). The analyses in this Final EIS will inform BOEM's decision under 30 CFR 585.628 for the COP that was initially submitted to BOEM in December 2020, and later updated with new information on June 29, 2021; October 29, 2021; December 3, 2021; May 6, 2022; and February 28, 2023.

The Environmental Assessment for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia (BOEM 2012) gives a more

[4] Public Law No. 109-58, § 119 Stat. 594 (2005).
[5] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 (April 29, 2009).

comprehensive description of BOEM's regulatory authority and decision-making process and is incorporated by reference in this Final EIS. BOEM is required to coordinate with tribes, federal agencies, and state and local governments to ensure that renewable energy development occurs in a safe and environmentally responsible manner. Appendix A, *Required Environmental Permits and Consultations*, outlines the federal, state, regional, and local permits and authorizations that are required for the Project and the status of each permit and authorization. Appendix A also describes BOEM's consultation efforts during development of the Final EIS. The reorganization of the Renewable Energy rules (30 CFR Parts 285, 585, and 586) enacted on January 31, 2023 reassigned existing regulations governing safety and environmental oversight and enforcement of OCS renewable energy activities from BOEM to BSEE.

1.4. Relevant Existing NEPA and Consulting Documents

BOEM previously prepared the following NEPA documents, which it used to inform preparation of this Final EIS and they are incorporated in their entirety by reference.

- *Final Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf (BOEM 2007).* 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, (BOEM 2012).* BOEM prepared this Environmental Assessment to determine whether issuance of a lease and approval of a Site Assessment Plan within the wind energy area (WEA) 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 plan for 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

Dominion Energy would implement a Project Design Envelope (PDE) concept. This concept allows Dominion Energy to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as wind turbine generators, foundations, submarine cables, and offshore substations.

This Final EIS assesses the impacts of the PDE that are described in the CVOW-C COP and presented in Appendix E, *Project Design Envelope and Maximum-Case Scenario*, by using the "maximum-case scenario" process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Final EIS evaluates potential impacts of the Proposed Action and each alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource.[6] This Final EIS considers the interrelationship between aspects of the PDE rather than 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 E explains the PDE

[6] 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.

approach in more detail and presents a detailed table outlining the design parameters with the highest potential for impacts by resource area.

1.6. Methodology for Assessing Impacts

This Final EIS assesses past, present (ongoing), and reasonably foreseeable future (planned) actions that could occur during the life of the 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 F, *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.

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 Final EIS includes a description of the baseline conditions of the affected environment. The existing baseline considers past and present activities in the resource-specific geographic analysis area, including those related to offshore wind projects with an approved COP (e.g., CVOW-Pilot Project) 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 acknowledged 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 planned activities may occur over time and that, cumulatively, those activities would affect the 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 Final EIS. The existing baseline condition as influenced by future planned activities evaluated in Appendix F is assessed as cumulative impacts. 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.

2 Alternatives Including the Proposed Action

This chapter (1) describes the alternatives carried forward for detailed analysis in this Final EIS, including the Proposed Action, No Action Alternative, 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 Project; and (3) presents a summary and comparison of impacts by alternative and resource affected.[1]

CEQ NEPA implementing regulations require the identification of a preferred alternative in the Final EIS. BOEM has identified Alternative B in combination with Alternative D-1 as the preferred alternative. The preferred alternative is identified to let the public know which alternative BOEM, as the lead agency, is leaning toward before an alternative is selected for action when a ROD is issued. No final agency action is being taken by the identification of the preferred alternative in the Final EIS, and BOEM is not obligated to select the preferred alternative. The preferred alternative is depicted on Figure 2-4 and Figure 2-6.

2.1 Alternatives Analyzed in Detail

BOEM considered a range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. To be carried forward for analysis, alternatives were required to meet the screening criteria identified in BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act (NEPA)* (BOEM 2022). The alternatives carried forward for detailed analysis in this Final EIS are described in this subsection and summarized in Table 2-1. Section 2.1.6, *Alternatives Considered but not Analyzed in Further Detail*, describes the alternatives considered but dismissed from detailed analysis and the rationale for their dismissal. The alternatives listed in Table 2-1 are not mutually exclusive. BOEM may "mix and match" the EIS alternatives to develop the preferred alternative provided that the design parameters are compatible, and the preferred alternative would still meet the purpose of and need for the Proposed Action.

BOEM considers those measures that Dominion Energy has committed to in its COP to be part of the Proposed Action and action alternatives (COP, Executive Summary, Table ES-1; Dominion Energy 2023). The alternatives listed in Table 2-1 do not include additional mitigation measures that are analyzed separately in this Final EIS (Appendix H, *Mitigation and Monitoring*). BOEM, in consultation with cooperating agencies, may select any of the mitigation measures identified in Appendix H in addition to its preferred alternative, as long as the design parameters are compatible, and the preferred alternative and mitigation measures would still meet the purpose and need. Additionally, compliance with applicable laws and regulations by Dominion Energy and BOEM may require additional measures or changes to the measures described in this Final EIS. The completion of consultations under the MMPA, Section 7 of the Endangered Species Act (ESA), the Magnuson-Stevens Fishery Conservation and Management Act, and Section 106 of the National Historic Preservation Act (NHPA) may result in additional measures or changes to the measures described in this Final EIS.

NMFS and USACE are serving as cooperating agencies. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support its separate proposed action and decision to issue the authorization, if appropriate. USACE similarly intends to adopt

[1] *Decommissioning* as described in this analysis is considered conceptual because the lessee would submit a second application for formal review and approval at the end of the project life.

the EIS if it is determined to be sufficient after independent review to meet its responsibilities under Section 404 of the CWA and Section 10 of the RHA. Under the Proposed Action and other action alternatives, NMFS' action alternative is to issue the requested Letter of Authorization to the Applicant to authorize incidental take for the activities specified in the Applicant's application, which are being analyzed by BOEM in the reasonable range of alternatives described herein. USACE is required to analyze alternatives to the proposed Project that are reasonable and practicable pursuant to NEPA and the CWA 404(b)(1) guidelines. The range of alternatives analyzed in the Final EIS, including alternatives considered but dismissed, represents a reasonable range of alternatives for this analysis. Additional evaluations required under NEPA for USACE to issue permits under Section 404 of the CWA and Sections 10 or 14 of the RHA will be addressed in USACE's ROD.

BOEM decided to use the NEPA substitution process for NHPA Section 106 purposes, pursuant to 36 CFR 800.8(c), during its review of the Project. Section 106 of the NHPA regulations, "Protection of Historic Properties" (36 CFR 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. Please note that the substitution process does not lessen compliance with the fundamental policies of Section 106; it is designed to allow greater procedural efficiency without lessening substantive requirements. Avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties are presented in Appendix H, *Mitigation and Monitoring*. Ongoing consultation with consulting parties and government-to-government consultation with tribal nations may result in additional measures or changes to these measures.

All elements of the Proposed Action are included in BOEM's analysis in this Final EIS; however, BOEM's authority under the OCSLA only extends to the activities on the OCS. The reorganization of the Renewable Energy rules (30 CFR Parts 285, 585, and 586) enacted on January 31, 2023) reassigned existing regulations governing safety and environmental oversight and enforcement of OCS renewable energy activities from BOEM to BSEE.

Table 2-1 Alternatives Considered for Analysis

Alternative	Description
Alternative A — Proposed Action	Under **Alternative A**, the Proposed Action, the construction, operation, maintenance, and eventual decommissioning of an up-to 3,000 MW wind energy facility consisting of up to 202 WTGs ranging from 14 MW to 16 MW each and three OSSs in the Lease Area and associated export cables would occur offshore Virginia and within the range of the design parameters outlined in the COP (Dominion Energy 2023), subject to applicable mitigation measures (Figure 2-1). Dominion would space WTGs in a 0.93- by 0.75-nautical-mile offset grid pattern (east–west by northwest by southeast gridded layout). The three OSSs would be placed within the rows of the gridded WTG layout. This configuration would still allow micrositing of WTGs (up to 500 feet) to avoid sensitive cultural resources and marine habitats. Onshore components include a cable landing location in Virginia Beach, Virginia.[2] Onshore export cables would transfer electricity from the cable landing location to a switching station constructed north of Harpers Road in Virginia Beach, Virginia. An overhead interconnection cable route would then connect the new Harpers Switching Station to the Fentress Substation located in Chesapeake, Virginia.

[2] The cable landing location would be adjacent to the existing CVOW-Pilot Project landing location and at a proposed parking lot west of the State Military Reservation (SMR) firing range (formerly known as Camp Pendleton). This is the only cable landing location carried forward in the Project Design Envelope (PDE) and would be the same under all alternatives (COP, Section 2.1.2.1; Dominion Energy 2023).

Alternative	Description
Alternative B — Revised Layout to Accommodate the Fish Haven and Navigation **(Preferred Alternative)**	Under **Alternative B**, the Revised Layout to Accommodate the Fish Haven[3] and Navigation Alternative, the construction, operation, maintenance, and eventual decommissioning of a 2,587 MW wind energy facility consisting of 176 WTGs (inclusive of seven spare WTG positions) and three OSSs in the Lease Area and associated export cables would occur offshore Virginia within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Dominion Energy would use only 14 MW WTGs, each capable of generating up to 14.7 MW using power boost capability, to avoid impacts due to construction and operation of WTGs. Similar to the Proposed Action, Dominion would utilize WTGs in a 0.93- by 0.75-nautical-mile offset grid pattern (east–west by northwest by southeast gridded layout). However, under Alternative B, the Fish Haven area located along the northern boundary of the Lease Area would be an exclusion zone (e.g., eight WTGs and associated infrastructure would not be developed or placed in the Fish Haven area). Additionally, three WTGs and associated inter-array cables would be excluded from the northwest corner of the Lease Area to avoid a proposed vessel traffic fairway (Figure 2-4). As under the Proposed Action, the three OSSs would be placed within the rows of the gridded WTG layout. This configuration would still allow micrositing of WTGs (up to 500 feet) to avoid sensitive cultural resources and marine habitats. Onshore components are the same as under the Proposed Action.
Alternative C — Sand Ridge Impact Minimization Alternative	Under **Alternative C**, the Sand Ridge Impact Minimization Alternative, the construction, operation, maintenance, and eventual decommissioning of a wind energy facility would include a similar offshore layout of Project components as Alternative B. However, in addition to avoiding the Fish Haven area and proposed vessel traffic fairway, Alternative C would also avoid sand ridge habitat by a combination of: micrositing WTGs, inter-array cables or OSSs (or both) (up to 500 feet); the removal of four WTGs within priority sand ridge habitat, and the relocation of one WTG. The removal and relocation of these WTGs would allow for a reconfiguration of inter-array cabling to minimize potential linear seafloor impacts and the potential cross-cutting impacts to priority sand ridge habitat. As a result, an up-to 2,528 MW wind energy facility consisting of up to 172 WTGs (inclusive of two spare WTG positions), and three OSSs and associated export cables would be developed under Alternative C (Figure 2-5). The generation capacity under Alternative C would allow Dominion Energy to meet its minimum 2,500-MW need for the project under the 2020 Virginia Clean Economy Act. As under Alternative B, Alternative C would utilize 14 MW WTGs generating up to 14.7 MW each using power boost capability in a 0.93- by 0.75-nautical mile offset grid pattern. Onshore components are the same as under the Proposed Action.
Alternative D — Onshore Habitat Impact Minimization Alternative	Under **Alternative D**, the Onshore Habitat Impact Minimization Alternative, the construction, operation, maintenance, and eventual decommissioning of a wind energy facility would include the same offshore layout of Project components as described under the Proposed Action: an up-to 3,000 MW wind energy facility consisting of up to 202 WTGs ranging from 14 MW to 16 MW each and three OSSs in the Lease Area and associated export cables. Unlike Alternatives A, B, and C, the construction of interconnection cables under Alternative D would follow either Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6 (Hybrid Route), as described in the COP

[3] The Fish Haven area is an area of documented recreational fisheries uses within the northern border of the Lease Area known as the *Triangle Wrecks* and *Triangle Reef*. The area consists of several large, scuttled World War II-era ships, tires, cable spools, and other materials deposited since the 1970s to facilitate an artificial reef development (COP Sections 2.1.1.1 and 4.2.4.2; Dominion Energy 2023).

Alternative	Description
	(Dominion Energy 2023). For purposes of comparative analyses, Interconnection Cable Route Option 1 will be evaluated in all action alternatives. However, under Alternative D, BOEM would approve either Interconnection Cable Route Option 1 or 6 (Hybrid Route) to minimize impacts of the proposed Project on onshore sensitive habitats (Figure 2-6). Interconnection Cable Route Option 1 would be an entirely overhead route, while Interconnection Cable Route Option 6 (Hybrid Route) would involve installation of the Interconnection Cable using a hybrid of overhead and underground construction methods. Both interconnection cable route options are intended to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. Each of the following sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the Project's purpose and need. **Alternative D-1 (Preferred Alternative) (**Figure 2-7**):** Interconnection Cable Route Option 1 would be approximately 14.3 miles (23.0 kilometers) long and installed entirely overhead. From the common location north of Harpers Road, Interconnection Cable Route Option 1 would continue to the onshore substation and the new Harpers Switching Station would be located at Naval Air Station (NAS) Oceana Parcel. This route has been approved by the Virginia State Corporation Commission (SCC). **Alternative D-2 (**Figure 2-8**):** Interconnection Cable Route Option 6 (Hybrid Route) would be approximately 14.3 miles (23.0 kilometers) long and would mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. Following Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, Interconnection Cable Route Option 6 would transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be bult at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation.
Alternative E — No Action Alternative	Under **Alternative E,** the No Action Alternative, BOEM would not approve the COP, and the Project construction and installation, O&M, and conceptual 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. However, all other existing or other reasonably foreseeable future impact-producing activities would continue. The impact of the No Action Alternative serves as the baseline against which all action alternatives are evaluated.

Note: Components of alternatives may be individually selected and combined with any or all other alternatives, subject to the combination meeting the purpose and need.

2.1.1 No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP. Project construction and installation, O&M, and 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. However, all other past and ongoing impact-producing activities would continue. Under the No Action Alternative impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the Applicant. The current resource condition and effects from ongoing activities under the No Action Alternative serve as the existing baseline against which all direct and indirect impacts from alternatives are evaluated.

Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities would be implemented, 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 F, *Planned Activities Scenario,* without the Proposed Action serves as the future baseline for the evaluation of cumulative impacts.

2.1.2 Alternative A—Proposed Action

The Proposed Action would construct, operate, maintain, and eventually decommission an up-to 3,000 MW wind energy facility on the OCS offshore Virginia and associated onshore power distribution facilities (Figure 2-1). The boundary of the Lease Area is 20.45 nautical miles (37.87 kilometers) from the northwest corner to the Eastern Shore Peninsula and 23.75 nautical miles (43.99 kilometers) from Virginia Beach, Virginia. Water depths in the Lease Area range from 57 feet (18 meters) to 139 feet (42 meters). The Proposed Action is based on Dominion Energy's maximum-case design parameters, which is described in the COP and summarized in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. This subsection describes the construction and installation, O&M, and decommissioning activities to be undertaken for the Proposed Action; COP Sections 1, 2, and 3 (Dominion Energy 2023) provide additional details on Project design.

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 would begin in 2023 and be completed in 2027. Dominion Energy anticipates beginning land-based construction (onshore export and interconnection cable installation, switching station construction, and existing onshore substation upgrades) in the third quarter of 2023 and finishing in 2025. Construction of the offshore components would begin in the fourth quarter of 2023 with scour protection pre-installation (ending in 2024), offshore export cable installation (ending in 2025), and monopile and transition piece transport and onshore staging (ending in 2026). Monopile installation and offshore substation installation would occur from May 2024 through October 2025. Transition piece installation and scour protection post-installation would occur in 2024 through the first quarter of 2026. Inter-array cable installation and WTG pre-assembly and installation are planned to start in 2025 and end in 2026 and 2027, respectively. Commissioning is planned for 2025 through 2027. As per Dominion Energy's commitment to seasonal restrictions from November through April, no WTG or OSS foundation installation activities are planned for winter. Monopile and OSS pin pile installation is planned for part of spring (May), summer (June, July, and August), and part of fall (September through October) annually. Dominion Energy anticipates that all WTG and OSS foundations would be installed by October 31, 2025. However, as a contingency to account for the potential for delays due to weather and other anticipated events, Dominion Energy has proposed installation of up to 15 foundations in 2026. If required to accommodate delays in the installation schedule, the 15 installations would occur between May 1 and September 30, 2026. Inter-array and offshore export cable emplacement associated with construction of the WTGs and OSSs would occur during two separate construction seasons in the Lease Area, which would provide a recovery period for sand ridge habitats between the installation of the inter-array and offshore export cables. Additionally, there would be an approximate 1- to 2.5-month period between the installation of offshore export cable, with the potential for a longer period depending on weather conditions and operational needs for cable resupply. There would be several months of seafloor rest following the completion of offshore export cable installation at one OSS prior to commencement of inter-array cable emplacement associated with the next OSS (COP, Section 3.4.1.2; Dominion Energy 2023). An indicative Project schedule is included in COP Section 1, Table 1.1-2 (Dominion Energy 2023).

2.1.2.1.1 Onshore Activities and Facilities

Proposed Onshore Project elements include the cable landing location, the onshore export cable route, the switching station, the onshore interconnection cable route(s), and expansions/upgrades to the onshore substation that connects to the existing grid (these elements collectively compose the Onshore Project area). Interconnection Cable Route Option 1 would be the selected onshore interconnection cable route for the Project (Figure 2-1). Appendix E describes the PDE for onshore activities and facilities, and COP Section 3 (Dominion Energy 2023) provides additional details on construction and installation methods.

Since publication of the Draft EIS, Dominion Energy adjusted a portion of the overhead alignment for the proposed interconnection cable route located south of the Princess Anne Athletic Complex in the City of Virginia Beach, Virginia to accommodate landowner concerns. The alignment for this 2,365.77-foot (721.09-meter) segment of the interconnection cable route has been rerouted approximately 200 feet (61 meters) to the north and onto land primarily consisting of developed open space associated with the Princess Anne Athletic Complex[4] (Figure 2-2). BOEM has updated the following Chapter 3 sections in this Final EIS to address this change in the Proposed Action, specifically the alignment shift of the interconnection cable route.

- Section 3.5, *Bats*
- Section 3.7, *Birds*
- Section 3.8, *Coastal Habitat and Fauna*
- Section 3.10, *Cultural Resources*
- Section 3.21, *Water Quality*
- Section 3.22, *Wetlands*

The proposed Project would include a cable landing location in Virginia Beach, Virginia, as shown in COP Section 3, Figure 3.3-14 (Dominion Energy 2023). Negotiations regarding the easement agreement for the proposed parking lot west of the firing range at SMR would be determined prior to BOEM's COP authorization. The cable landing would be located at the proposed parking lot west of the firing range at SMR. Dominion Energy plans to use trenchless installation—direct steerable pipe thrusting (DSPT)—to install the offshore export cables under the beach and dune and bring them to shore through a series of high-density polyethylene casings. DSPT involves using a direct steerable tunnel boring machine (DSTBM) to excavate ground along the design alignment while simultaneously pushing steel casing pipes behind the DSTBM using a pipe thrusting machine. The pipe thrusting machine is situated on the ground surface or (typically) in a shallow pit and uses pipe clamps to grip the outside circumference of the pipe and thrust the steel casing pipe behind the DSTBM in compression. This provides the force required to progress the DSTBM forward, which excavates the ground at the leading edge of the casing pipe. Upon exiting the casings, the nine 230-kilovolt (kV) offshore export cables would be spliced to a series of nine separate single circuit transition joint bays and would transition to the onshore export cables to be installed via horizontal directional drilling (HDD) vaults laid in a single right-of-way and transition to the onshore export cables at the cable landing location.

[4] The realignment for this 2,365.77-foot (721.09-meter) segment of the interconnection cable route applies to the shared overhead segment of Interconnection Cable Route Option 1 (Proposed Action and Alternatives B, C, and D-1) and Alternative D-2 Interconnection Cable Route Option 6 (Hybrid Route).

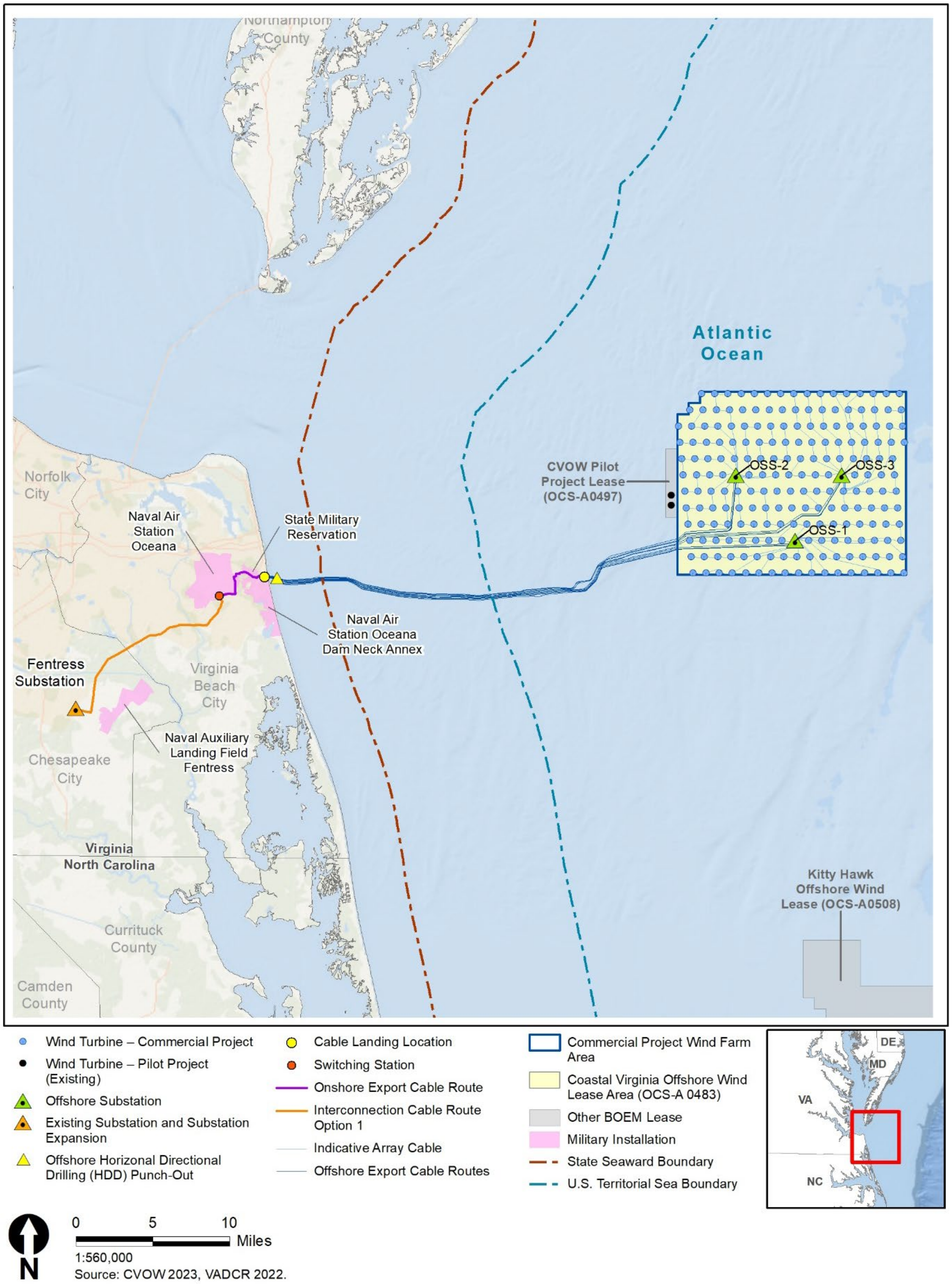


Figure 2-1 Alternative A: Proposed Action

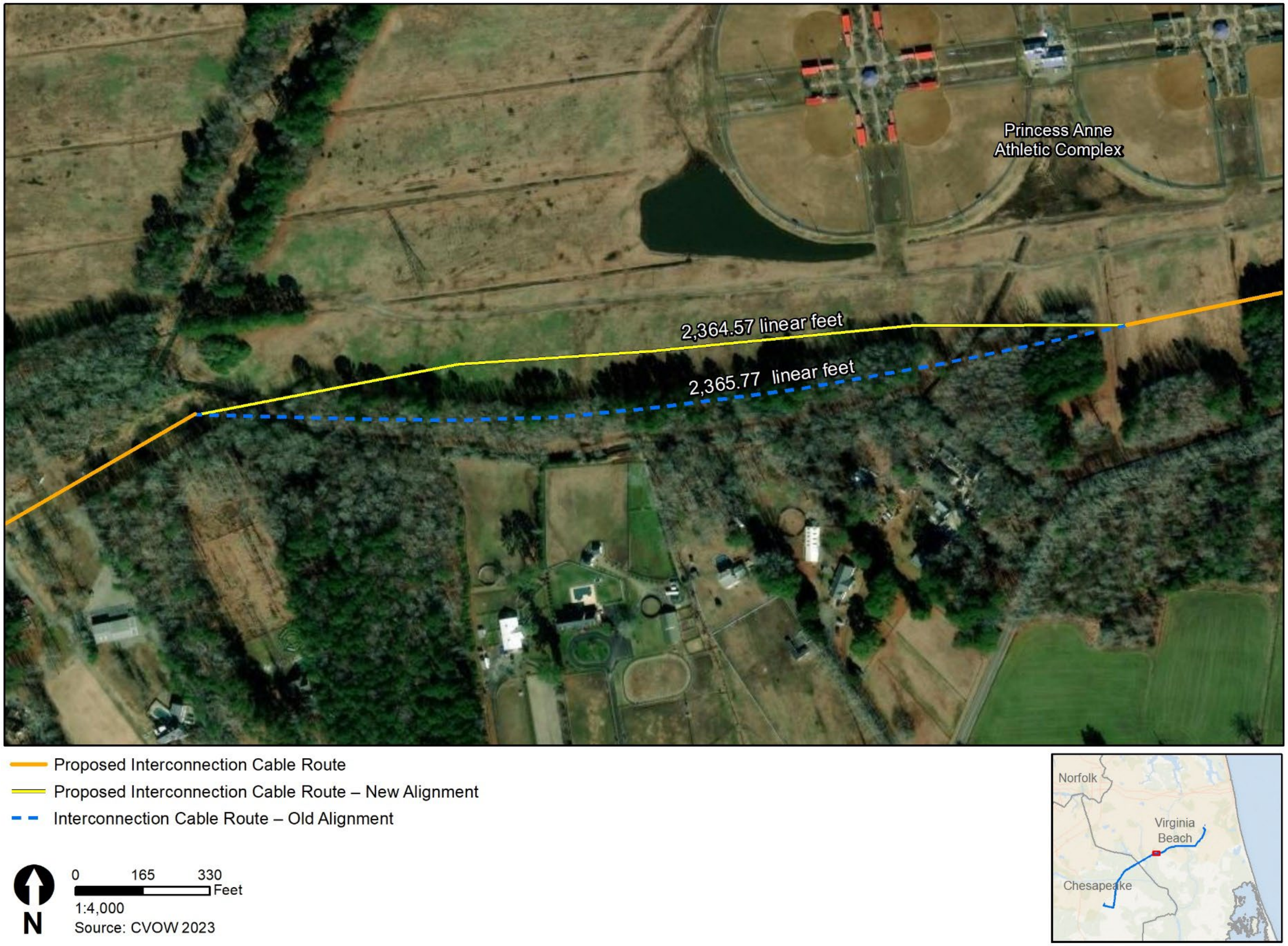


Figure 2-2 Interconnection Cable Route Shift

COP Section 3 (Dominion Energy 2023) shows a total area of 8.8 acres (3.6 hectares) for temporary disturbance associated with the nearshore trenchless installation area of the offshore export cable. Within this footprint, the COP notes anticipated cofferdam dimensions of approximately 20 feet by 50 feet (6.1 meters by 15 meters) for each of the nine cofferdams. However, further constructability analysis conducted by Dominion Energy in August 2023 indicated that use of a controlled flow excavation (CFE) tool to excavate targeted areas to expose each direct pipe conduit of the offshore export cable pull-ins would be preferable in comparison to the cofferdam installation method. Disturbance associated with the CFE method would still occur within the 8.8-acre (3.6-hectare) area identified in the COP (and analyzed in this EIS) for temporary disturbance associated with the nearshore trenchless installation area. However, using the CFE methodology would result in an estimated total disturbed area of less than 1.0 acre (0.4 hectare) for the nine punch-out installations, which represents a 1.25-acre (0.5-hectare) reduction in disturbance compared to the cofferdam methodology. The total acreage of the cable landing location footprint is 11.1 acres (4.5 hectares); however, the permanent construction footprint for the cable landing location is anticipated to be 2.27 acres (0.92 hectare).

Onshore export cables would transfer the electricity from the cable landing location to a common location north of Harpers Road and would comprise 27 single-phase 230-kV onshore export cables installed underground within the onshore export cable route corridor. For the majority of the underground onshore export cable route, cables would travel within three duct banks with nine cables per duct bank (Jabs pers. comm.). The proposed Project currently includes a single onshore export cable route that plans to use HDD below Lake Christine. HDD would create a pilot bore along the cable corridor, expand the bore to a diameter 1.5 times that of the cable being installed, then pull the cables into the prepared borehole. The cables would be divided into five HDD casings (four casings would include six cables, and one would include three cables) (Jabs pers. comm.). The onshore export cable route (COP, Section 3, Figure 3.3-15; Dominion Energy 2023) would be 4.41 miles (7.10 kilometers) long, with 3.5 miles of rights-of-way on NAS Oceana property, and the operational corridor would be approximately 49 acres (20 hectares).

The switching station would be constructed north of Harpers Road (Harpers Switching Station) in Virginia Beach, Virginia (COP, Section 3, Figure 3.3-16; Dominion Energy 2023). The switching station would collect power and convert an underground cable configuration to an overhead configuration. The power would then be transmitted to the existing onshore substation for distribution to the grid. The switching station would be an aboveground, fenced facility and would generally have the appearance of a typical larger Dominion Energy substation. The switching station would serve as a transition point where the power transmitted through twenty-seven 230-kV onshore export cables would be collected to three 230-kV interconnection cables.

The Harpers Switching Station would be constructed on a NAS Oceana parcel, pending Navy approval. Demolition of an existing Navy golf maintenance facility would occur at the same location as the construction of the switching station and construction of a new golf maintenance facility would occur on-site at NAS Oceana northwest of the Harpers Switching Station. During demolition and construction of a new golf maintenance facility, temporary maintenance operations and storage would be located at existing areas on-site at NAS Oceana. In addition to the construction of the switching station itself, installation of stormwater management facilities, realignment of two existing golf fairways, and relocation of existing NAS Oceana fencing and Dewey Road would occur. The total limits of disturbance for construction of the Harpers Switching Station and associated activities on NAS Oceana property (described below) would be 46.48 acres (18.8 hectares). The operational footprint of the Harpers Switching Station would be approximately 31.4 acres (12.7 hectares) with an additional 5.52 acres (2.2 hectares) for stormwater management facilities, 6.11 acres (2.5 hectares) for relocation of fairways and the NAS Oceana maintenance building, and 0.93 acre (0.4 hectare) for relocation of Dewey Drive. Details of the proposed Harpers Switching Station footprint and associated activities on NAS Oceana property are depicted on

Figure 2-3. The total length of onshore export cable and Interconnection Cable routes on NAS Oceana property would be 3.5 miles (5.6 kilometers).

Dominion Energy evaluated one overhead interconnection cable route option and one hybrid interconnection cable route option from Harpers Road to the onshore substation (COP, Section 3, Figure 3.3-16; Dominion Energy 2023). For both interconnection cable route options considered, a maximum construction and operational corridor width of 250 feet (76.2 meters) would be needed for overhead cables. Existing rights-of-way would be used to the extent practical. The interconnection cable route corridor within existing rights-of-way would be approximately 121.4 acres (49.1 hectares) and the operational corridor within new rights-of-way would be approximately 132.1 acres (53.5 hectares). The height of the overhead interconnection cable would vary from 75 feet (22.9 meters) to 170 feet (51.8 meters), depending on the terrain within the route.

Dominion Energy selected Interconnection Cable Route Option 1 (overhead) as their preferred cable route, and on August 5, 2022, the Virginia State Corporation Commission (VA SCC) approved, by issuance of a certificate of public convenience and need (CPCN), Interconnection Cable Route Option 1. The approved CPCN includes all of the transmission interconnection lines and stations starting 3 miles (4.8 kilometers) offshore, the single proposed underground lines and route from the SMR to the Harpers Switching Station, and Interconnection Cable Route Option 1 for the overhead lines from Harpers Switching Station to Fentress Substation. As a result, the Proposed Action includes only Interconnection Cable Route Option 1 and associated transmission interconnection lines and stations. On October 7, 2022, Dominion Energy requested that BOEM remove from consideration overhead Interconnection Cable Route Options 2, 3, 4, and 5 that were included in Dominion Energy's COP at the time BOEM issued the Notice of Intent to Prepare an Environmental Impact Statement; Interconnection Cable Route Option 6 (Hybrid Route) is considered under Alternative D.

The existing onshore substation (Fentress Substation) that would be expanded and upgraded to accommodate the electricity from the Project is located in Chesapeake, Virginia. The Fentress Substation would serve as the final Point of Interconnection (POI) for power distribution to the Pennsylvania–New Jersey–Maryland interconnection (PJM) grid. The current footprint of the onshore substation is approximately 11.7 acres (4.7 hectares). The expansion/upgrades to the onshore substation footprint are anticipated to require approximately an additional 15.2 acres (6.2 hectares), for a total of 26.9 acres (10.9 hectares). Stormwater management facilities associated with the onshore substation are anticipated to require an additional 6.2 acres (2.5 hectares). The onshore substation expansions/upgrades would serve as the POI for the three 230/500-kV auto-transformers for connection into the grid. The existing equipment at the onshore substation affected by this Project would include one 500-kV transmission line, two 230/500-kV transformer banks, and a security fence. The onshore substation expansion/upgrades would include the addition of three 230/500-kV transformer banks, a 500-kV gas-insulated switchgear building, static poles, and other ancillary equipment. The facility is planned to be surrounded by a security fence approximately 20 feet (6.1 meters) high.

As a public utility, in order to construct and operate electric utility facilities within the Commonwealth, Dominion Energy is required to obtain a CPCN under Virginia Code Section 56-265.2 A.1, as well as approval under Virginia Code Section 56-46.1, from the VA SCC. For purposes of the CVOW-C Project, these approvals are needed for the portion of the offshore export cable from 3 miles offshore landward, as well as all of the Onshore Project components. The VA SCC makes a determination on the location of onshore infrastructure including interconnection cable routes.

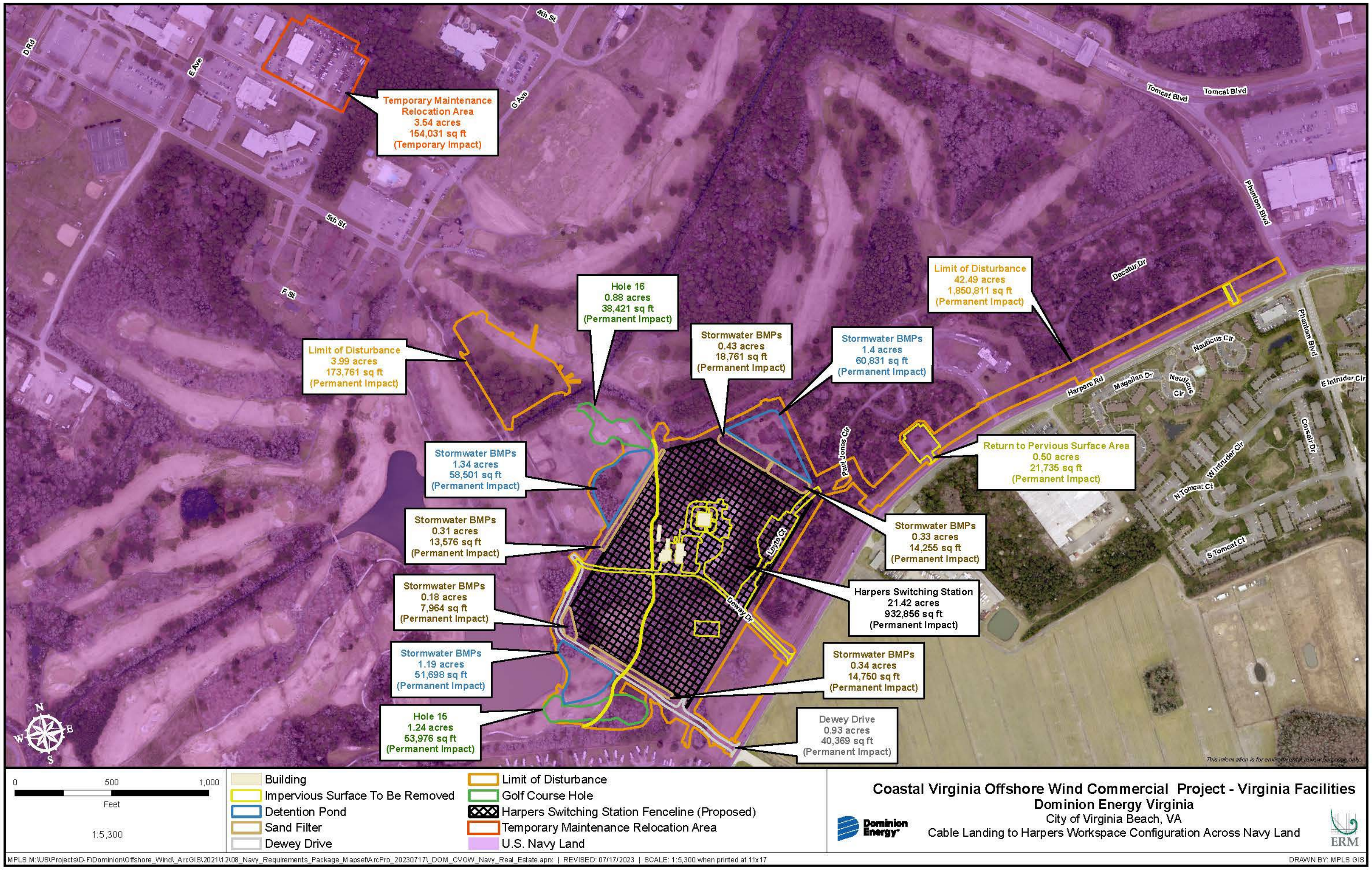


Figure 2-3 Proposed Harpers Switching Station and Associated Activities on NAS Oceana Property

2.1.2.1.2 Offshore Activities and Facilities

Proposed Offshore Project components include WTGs and their foundations, OSSs and their foundations, scour protection for foundations, inter-array cables, and offshore export cables (these elements collectively compose the Offshore Project area). The proposed Offshore Project elements would be on the OCS as defined in the OCSLA, with the exception of a portion of the offshore export cables, which would be within state waters (COP, Executive Summary, Figure ES-1; Dominion Energy 2023). Appendix E describes the PDE for offshore activities and facilities, and COP Section 3 provides additional details on construction and installation methods.

Dominion Energy proposes the installation of 202 14 MW to 16 MW WTGs (COP, Section 3, Figure 3.3-4; Dominion Energy 2023). Dominion Energy's preferred WTG layout would be arranged in a grid pattern oriented at 35 degrees to minimize wake losses within the Wind Turbine Area (COP, Section 3, Figure 3.3-4; Dominion Energy 2023). WTGs would be spaced approximately 0.75 nautical mile (1.39 kilometers) in an east–west direction and 0.93 nautical mile (1.72 kilometers) in a north–south direction. However, the distances between some turbines in the final WTG layout may be slightly larger or smaller, subject to micrositing; some WTG foundation installation locations may shift up to 500 feet (152 meters) to avoid obstructions, and sensitive cultural and natural resources, and due to local site condition variations. Turbine tip height as measured from mean sea level would be between 804 feet (245 meters) and 869 feet (265 meters). The distance from the bottom of the turbine tip to the highest astronomical tide would be between 82 feet (25 meters) and 115 feet (35 meters). Dominion Energy would mount the WTGs on monopile foundations consisting of two parts: a lower foundation pile (monopile) driven into the seabed and an upper transition piece mounted on top of the monopile (together referred to as the WTG foundation). Monopiles would be installed to the target penetration depth via impact and vibratory pile driving. Dominion Energy proposes using secondary noise mitigation systems such as the Hydro Sound Damper, the Noise Mitigation Sleeve, the AdBm Noise Mitigation System, or double big bubble curtains, to reflect and dampen underwater sound waves. The WTG foundations would have scour protection installed around the base of the monopile.

Dominion Energy proposes to construct three OSSs within the rows of the gridded WTG layout (COP, Section 3, Figure 3.3-5; Dominion Energy 2023).The offshore substation would comprise two main components: a foundation attached to the seafloor and a topside to contain the decks holding the main electrical and support equipment. Dominion Energy is also considering adding a helideck to support monitoring and maintenance to each of the OSSs for normal and emergency access by helicopters. Dominion Energy is proposing to use pre- or post-installed, piled, jacket foundations to support the OSSs. The OSS foundations are foreseen to have scour protection installed around the base of the piled jackets. The need, type, and method for installing scour protection for the WTG foundations and the OSS foundations would be determined in consultation and coordination with relevant jurisdictional agencies prior to construction and installation. Dominion Energy believes that it is possible to design and install the size and type of piled jacket foundations included in the PDE to the desired target penetration depth of 229.7 feet (70 meters) to 269 feet (82 meters). The distance of the OSS topside substructure base above the highest astronomical tide would be between 56 feet (17 meters) and 151 feet (46 meters).

The inter-array cable system would be composed of a series of cable "strings" that interconnect a small grouping of WTGs to the OSSs. The inter-array cables would consist of strings of three-core copper and/or aluminum conductor, with a rated voltage of 72.5 kV and an operating voltage of 66 kV, connecting up to six WTGs per string. The WTG strings would be connected to each other via link/switch, and each offshore substation would be tied to a WTG string. Dominion Energy anticipates approximately 12 WTG strings would be connected to each offshore substation, for a total of 36 WTG strings (COP, Section 3, Figure 3.3-7; Dominion Energy 2023). However, the number of WTGs per string and/or the number of WTG strings connecting to each offshore substation may be modified given the final layout of WTGs.

The offshore export cables would transfer the electricity from the offshore substation to the cable landing location in Virginia Beach, Virginia (COP, Section 3, Figure 3.3-12; Dominion Energy 2023). Electricity would be transferred from each of the three offshore substations to the cable landing location via three 3-core copper and/or aluminum-conductor 230-kV subsea cables, for a total of nine offshore export cables. The offshore export cable route corridor width associated with the three cables originating from each OSS would be 1,280 feet (390 meters). Upon exiting the Lease Area, the three offshore export cable route corridors originating at the offshore substation would merge to become one overall offshore export cable route corridor containing all nine offshore export cables. The offshore export cable route corridor between the western edge of the Lease Area and the cable landing location would range in width from 1,970 feet (600 meters) to 9,400 feet (2,865 meters). Variability in the offshore export cable route corridor width would be driven by several external constraints, including existing telecommunications cable and transmission cable crossings; the U.S. Department of Defense exclusion area to the south; the vessel traffic lane and proposed Atlantic Coast Port Access Study safety fairway to the north; the Dam Neck Ocean Disposal Site (DNODS); obstructions, exclusion areas, and seabed conditions identified from existing data and ongoing surveys; potential risks due to the use of the area by third parties; and the approach to the HDD at the cable landing location. Within the offshore export cable route corridor, the nine offshore export cables would generally be spaced approximately 164 to 2,716 feet (50 to 828 meters) apart and constrained at times to be spaced 164 to 328 feet (50 to 100 meters) apart.

Dominion Energy evaluated the following burial tools as potential installation methodologies for the offshore export cable, which are included in the PDE: trenching remotely operated underwater vehicles (cutting, jetting, or hybrid modes), vertical injector, chain cutting, hydroplow, mechanical plowing (simultaneous lay and burial), pre-trenching (both simultaneous and separate lay and burial), and mechanical trenching (simultaneous lay and burial). However, Dominion Energy’s preferred installation method would use a jetting sledge, trenching remotely operated vehicle, and/or vertical injector. While chain cutting, hydroplow, mechanical plowing, pre-trenching, and mechanical trenching are not currently anticipated as a means of offshore export cable installation for the Project, Dominion Energy maintains their inclusion in this list to be comprehensive and operationally flexible if needed.

Inter-array cables would be buried to a depth of between 3.9 feet (1.2 meters) and 9.8 feet (3 meters); however, the exact depth would be dependent on the substrate encountered along the route. The offshore export cables would be buried to a target depth of between 3.3 feet (1 meter) and 16.4 feet (5 meters); for the portion of the offshore export cable that crosses the DNODS, 14.8 feet (4.5 meters) of cover may be added to a target burial depth of 9.8 feet (3 meters) for a total maximum burial depth of 24.6 feet (7.5 meters). Dominion Energy’s preferred installation method would use a jet trencher by means of post-lay trenching. Chain cutting, trench forming, pre-trenching, and mechanical trenching are not currently anticipated as a means of inter-array cable installation for the Project.

Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance, and pre-grapnel runs. A pre-grapnel run may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the siting corridor. Additionally, pre-sweeping may be required in areas of the submarine export cable corridor with sand waves. Pre-sweeping involves smoothing the seafloor by removing ridges and edges using a controlled flow excavator from a construction vessel to remove the excess sediment. In surveys conducted for CVOW-C and the CVOW-Pilot project, no boulders that would need to be moved (i.e., were larger than 1.6 feet (0.5 meter) were identified. However, in the event that such boulders were encountered, they would be removed from the offshore export cable corridor through use of a Hydroplow (COP, Section 3.4.1.4; Dominion Energy 2023). Boulders would be relocated to areas as close as feasible to their original position.

There is the potential for munitions and explosives of concern (MEC), including anti-aircraft munitions, from the VACAPES and associated firing ranges. Prior to the installation of inter-array cables Dominion Energy would complete route clearance, including MEC mitigation, to identify and remove as appropriate any obstructions within the cable installation corridors. MEC identification surveys would be completed in a 164-foot (50-meter) corridor around the inter-array cable corridor and offshore export cable route corridor to allow for re-routing of the cable as necessary to avoid identified features where clearance is not possible. Wider corridors would be used in higher risk areas, including the DNODS and crossings of telecommunications cables. MEC identification surveys began in spring 2023 and would be completed prior to construction activities beginning in 2024, at which point all needed mitigation would occur. MEC mitigation would entail relocation of MEC that could not be avoided by micrositing. Relocation of MEC would be done by using a suction pump to uncover and reconfirm classification of the MEC, then lifting and shifting the MEC the minimum distance needed to clear the activity-specific exclusion zone. The seabed disturbance footprint for each MEC mitigation would be 161.5 square feet (15 square meters). MEC would be relocated 16.4 to 164.0 feet (5 to 50 meters) outside construction activity areas and would remain within the export cable corridor or lease area to a location that would not disturb surveyed historical and archaeological resources. MEC lift and shift activities would fall under Section 10 of the RHA.

Dominion Energy has identified three in-service telecommunications cables within the offshore export cable route corridor that would be crossed by the offshore export cables. At cable crossings, both the existing infrastructure and the offshore export cables must be protected. The protection and crossing method would be determined on a case-by-case basis. At a minimum, it is expected that each asset crossing would include two layers of cable protection installed prior to and following offshore export cable installation, and a potential third layer of protection if stabilization and scour protection is deemed necessary. Dominion Energy anticipates using a combination of dump rocks, geotextile sand containers, and/or concrete mattresses depending on technical requirements (COP, Section 3.4.1.4; Dominion Energy 2023). Target burial depths at specific locations along the offshore export cable route corridor may be refined following the results of the ongoing geophysical survey data analysis, additional sediment mobility studies, and coordination with USACE and other stakeholders, and will be formalized in the *Facility Design Report/Fabrication Installation Report*, to be submitted to BOEM prior to installation.

The construction and installation phase of the proposed Project would make use of both construction and support vessels to complete tasks in the Offshore Project area. Construction vessels would travel between the Offshore Project area and the third-party port facility where equipment and materials would be staged. Dominion and the Port of Virginia have executed a lease agreement for a portion of the existing Portsmouth Marine Terminal (PMT) facility in the city of Portsmouth, Virginia, to serve as a construction port. The port would support the staging of components and construction vessels for the Project.

2.1.2.2 Operations and Maintenance

The proposed Project is anticipated to have an operating period of 33 years.[5] Dominion Energy intends to lease an existing O&M facility, with the location at Lambert's Point, located on a brownfield site in Norfolk, Virginia. Dominion Energy is also evaluating leasing options in Virginia Port Authority's Portsmouth Marine Terminal and Newport News Marine Terminal near Hampton Roads, Virginia. The

[5] Dominion Energy's lease with BOEM (Lease OCS-A 0483) has an operations term of 25 years that commences on the date of COP approval. See https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/Commercial%20Lease%20OCS-A%200483.pdf; see also 30 CFR 585.235(a)(3).) Dominion Energy would need to request an extension of its operations term from BOEM to operate the proposed Project for 33 years. For the purposes of maximum-case scenario and to ensure NEPA coverage if BOEM grants such an extension, the Final EIS analyzes a 33-year operations term.

O&M facility would monitor operations and would include office space, a control room, 16,000 square foot (4,877-square-meter) warehouse, shop, and pier space.

The proposed Project would include a comprehensive maintenance program and planned and unplanned inspections, including preventive maintenance based on statutory requirements, original equipment manufacturers' guidelines, and industry best practices. Dominion Energy would maintain an Oil Spill Response Plan and Safety Management System that would be developed and implemented prior to construction and installation activities in coordination with BOEM and BSEE (COP, Appendices A and Q; Dominion Energy 2023).

2.1.2.2.1 Onshore Activities and Facilities

The switching station and onshore substation would be equipped with monitoring equipment and would be regularly inspected during the operational lifespan. Onshore maintenance activities could include routine maintenance, including the replacement or upgrade of electrical components and equipment. The onshore export cables and interconnection cables would require periodic testing; however, maintenance should not be required outside of occasional repair activities as a result of damage due to unanticipated events. Overhead lines would be inspected prior to being energized and routinely inspected by vegetation management crews every 3 years for woody vegetation and hazard trees, with additional inspections following localized storm events.

2.1.2.2.2 Offshore Activities and Facilities

Routine inspection and maintenance are expected for WTGs, foundations, and the OSSs. Offshore O&M activities would include inspections of Offshore Project components for signs of corrosion and wear on WTG components, inspection of electrical components associated with the WTGs and OSSs, surveys of cables to confirm they have not become exposed or that any cable protection measures have not worn away, replacement of consumable items such as filters and hydraulic oils, repairs or replacement of worn or defective components, and disposal of waste materials and parts. Crew transfer vessels and service operation vessels would be used to support O&M activities offshore. Helicopters are also being considered to support the Project's O&M activities.

The WTGs would be monitored through a supervisory control and data acquisition (SCADA) system, and offshore export cables and inter-array cables would be monitored through distributed temperature sensing equipment to provide real-time detection of possible faults. In the event of a fault or failure of an Offshore Project component, Dominion Energy would repair and replace it in a timely manner. Should an offshore export cable or inter-array cable fault, the failed or damaged portion of the cable would be spliced and replaced with a new, working segment. This would require the use of various cable installation equipment, as described in Section 2.1.2.1.2, *Offshore Activities and Facilities*.

The WTGs and OSSs would be lit and marked in accordance with Federal Aviation Administration (FAA), United States Coast Guard (USCG), and BOEM guidance to aid safe navigation. Other appropriate safety systems would be included on all WTGs, including fire detection and an audible and visible warning system, and lightning protection.

2.1.2.3 Decommissioning

In accordance with 30 CFR Part 285 and other BOEM requirements, Dominion Energy would be required to remove or decommission all Project infrastructure and clear the seabed of all obstructions following the end of the Project's operational activities and the lease. All foundations would need to be removed to 15 feet (4.6 meters) below the mudline (30 CFR 285.910(a)). Offshore export cables and inter-array cables would be retired in place or removed in accordance with the decommissioning plan. Unless otherwise authorized by BOEM, Dominion Energy 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. See COP Section 3, Table 3.6-1 (Dominion Energy 2023) for additional details on removal methods and assumptions that would likely be applicable based on present-day understanding of available decommissioning approaches. Although the proposed Project is anticipated to have a lifespan of 33 years, some installations and components may remain fit for continued service after this time. Dominion Energy would have to apply for an extension to operate the proposed Project for more than the operations term.

BOEM would require Dominion Energy 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 (30 CFR 285.905). Upon completion of the technical and environmental reviews, BOEM 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. Dominion Energy would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the proposed 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, Dominion Energy would have to submit a bond that would be held by the U.S. government to cover the cost of decommissioning the entire facility if Dominion Energy would not otherwise be able to decommission the facility.

2.1.2.3.1 Onshore Activities and Facilities

At the time of decommissioning, some components of the onshore electrical infrastructure may still have substantial life expectancies. Dominion Energy anticipates removing the onshore substation buildings and equipment unless it is suitable for future use. Materials would be recycled as appropriate. Removal of the onshore export cable and interconnection cable is assumed by Dominion Energy to be limited to disconnecting and cutting at the fence line below ground level at both sides. The termination points would be removed, the cable would be cut 3 feet (0.9 meter) below ground level, and remaining cable would be capped off and earthed.

2.1.2.3.2 Offshore Activities and Facilities

The decommissioning process for the WTGs and OSSs is anticipated to be the reverse of construction and installation, with turbine components or the offshore substation topside structure removed prior to foundation removal. Decommissioning of the topside structures for WTGs and OSSs is assumed by Dominion Energy to include removal of all WTG components including removal of the rotor, nacelle, blades, and tower, and removal of the offshore substation topside structure. Materials would be brought onshore for recycling and disposal. WTG monopile foundations and the OSSs piled jacket foundations would be removed by cutting below the mud line and lifting the foundation off by a heavy lift vessel (HLV) to a barge. The steel used in the foundations and towers would be recycled. The scour protection placed around the base of each foundation, if used, would be removed unless leaving in place is deemed appropriate through consultation with appropriate authorities. The offshore export cables and inter-array cables would be lifted out and cut into pieces or reeled in, and the cable would be recycled as appropriate.

2.1.3 Alternative B—Revised Layout to Accommodate the Fish Haven and Navigation (Preferred Alternative)

Alternative B was developed through the scoping process for the EIS in response to comments that the original proposed siting of the three OSSs would disrupt the common grid pattern of the Project layout and produce potential impacts on a known Fish Haven area. Under Alternative B (Figure 2-4), the construction, O&M, and eventual decommissioning of a 2,587 MW wind energy facility consisting of

176 WTGs and three OSSs in the Lease Area, and associated export cables would occur within the range of design parameters outlined in the COP subject to applicable mitigation measures. Dominion Energy would use only 14 MW WTGs, each capable of generating up to 14.7 MW using power boost capability, to avoid impacts due to construction and operation of WTGs. Similar to the Proposed Action, Dominion Energy would use WTGs in a 0.93- by 0.75-nautical-mile (1.72- by 1.39-kilometer) offset grid in an east–west by northwest by southeast gridded layout. However, under Alternative B, the Fish Haven area located along the northern boundary of the Lease Area would be an exclusion zone where eight WTGs and associated inter-array cables and other Project infrastructure would not be sited. Three WTGs and associated inter-array cables would also be excluded from the northwest corner of the Lease Area to avoid conflicts with a proposed vessel traffic fairway. The three OSSs would be placed within the rows of the gridded WTG layout to minimize disruptions to surface and aerial navigation through the Wind Turbine Area. This configuration would still allow micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, to avoid sensitive cultural resources and marine habitats. Onshore components would be the same as described under the Proposed Action.

2.1.4 Alternative C—Sand Ridge Impact Minimization Alternative

Alternative C was developed through the scoping process for the EIS in response to comments received requesting an alternative to minimize impacts on offshore benthic habitats. Under Alternative C (Figure 2-5), the construction, O&M, and eventual decommissioning of a wind energy facility would include a similar offshore layout and range of design parameters as described under Alternative B. However, in addition to avoiding the Fish Haven area and the proposed vessel traffic fairway, Alternative C would avoid and minimize impacts on sand ridge habitat and shipwrecks through a combination of micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, the removal of four WTGs from priority sand ridge habitat, and the relocation of one WTG to a spare position. Under Alternative C, the removal of four WTGs and relocation of one WTG allows for the reconfiguration of inter-array cabling that would otherwise be developed within priority sand ridge habitats, thus reducing potential seafloor disturbance, including the cross-cutting and trenching of sand ridges. As a result, an up-to 2,528 MW wind energy facility consisting of up to 172 WTGs (inclusive of two spare WTG positions) and three OSSs with associated export cables would be developed under Alternative C. As under Alternative B, Alternative C would use 14 MW WTGs generating up to 14.7 MW each using power boost capability in a 0.93- by 0.75-nautical-mile (1.72- by 1.38-kilometer) offset grid pattern. Onshore components would be the same as described under the Proposed Action.

BOEM requested Dominion Energy's input on the technical and economic feasibility of removing project infrastructure from the 3,212-acre (3,000-hectare) priority sand ridge habitat area. Dominion Energy reported that avoiding the WTGs marked for removal in Alternative C would cause project delays and cost increases due to the need to redesign the offshore inter-array cable and OSS connections to balance the OSS electrical load. Dominion Energy also identified challenges in such a redesign due to the inability for inter-array cables and offshore export cables to cross other cables.

2.1.5 Alternative D—Onshore Habitat Impact Minimization Alternative

Alternative D was developed through the scoping process for the EIS in response to public comments regarding the potential impacts on sensitive onshore habitats, including wetlands. Under Alternative D, the construction, O&M, and eventual decommissioning of a wind energy facility would include the same offshore layout and range of design parameters as the Proposed Action: an up-to 3,000 MW wind energy facility consisting of up to 202 WTGs ranging from 14 MW to 16 MW each and three OSSs in the Lease Area, with associated export cables. Unlike the Proposed Action, the construction of onshore interconnection cables under Alternative D would follow either Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6 (Hybrid Route) (Figure 2-6). Therefore, under Alternative D BOEM would consider and potentially approve Interconnection Cable Route Option 1 or Interconnection

Cable Route Option 6, whereas only Interconnection Cable Route Option 1 is considered under the Proposed Action.[6] Each of the following sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

- **Alternative D-1 (Preferred Alternative) (**Figure 2-7**):** Interconnection Cable Route Option 1 would be the same as described under the Proposed Action and would be approximately 14.3 miles (23.0 kilometers) long and installed entirely overhead (Figure 2-6). From the common location north of Harpers Road, Interconnection Cable Route Option 1 would continue to the onshore substation, and the new Harpers Switching Station would be located at NAS Oceana Parcel, pending Navy approval.[7] Demolition of an existing Navy golf maintenance facility would occur at the same location as the construction of the new Harpers Switching Station. During demolition and construction of a new golf maintenance facility, temporary maintenance operations and storage would be located at existing areas onsite at NAS Oceana.
- **Alternative D-2** (Figure 2-8)**:** Interconnection Cable Route Option 6 (Hybrid Route) would be approximately 14.3 miles (23.0 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station (Figure 2-6). Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. Following Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, Interconnection Cable Route Option 6 would transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation. The maximum construction and operational corridor for the underground portion of Interconnection Cable Route Option 6 would be 86.5 feet (26 meters); the overhead portion would be 250 feet (76.2 meters), which is equivalent to the corridor width for Interconnection Cable Route Option 1.

Interconnection Cable Route 1 would be an entirely overhead route, while Interconnection Cable Route 6 (Hybrid Route) would involve installation of the interconnection cable using a hybrid of overhead and underground construction methods. Both interconnection cable route options are intended to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores.

[6] Dominion Energy's February 2023 submission of the COP only included Interconnection Cable Route Options 1 and 6, although previous versions of the COP also considered Interconnection Cable Route Options 2, 3, 4, and 5. The Final EIS analyzes the two routes (Interconnection Cable Route Options 1 and 6), which are included in Dominion Energy's February and July 2023 COPs.
[7] The Navy decision as to whether to approve Dominion's proposed activities on the NAS Oceana Parcel would be determined prior to BOEM's COP authorization.

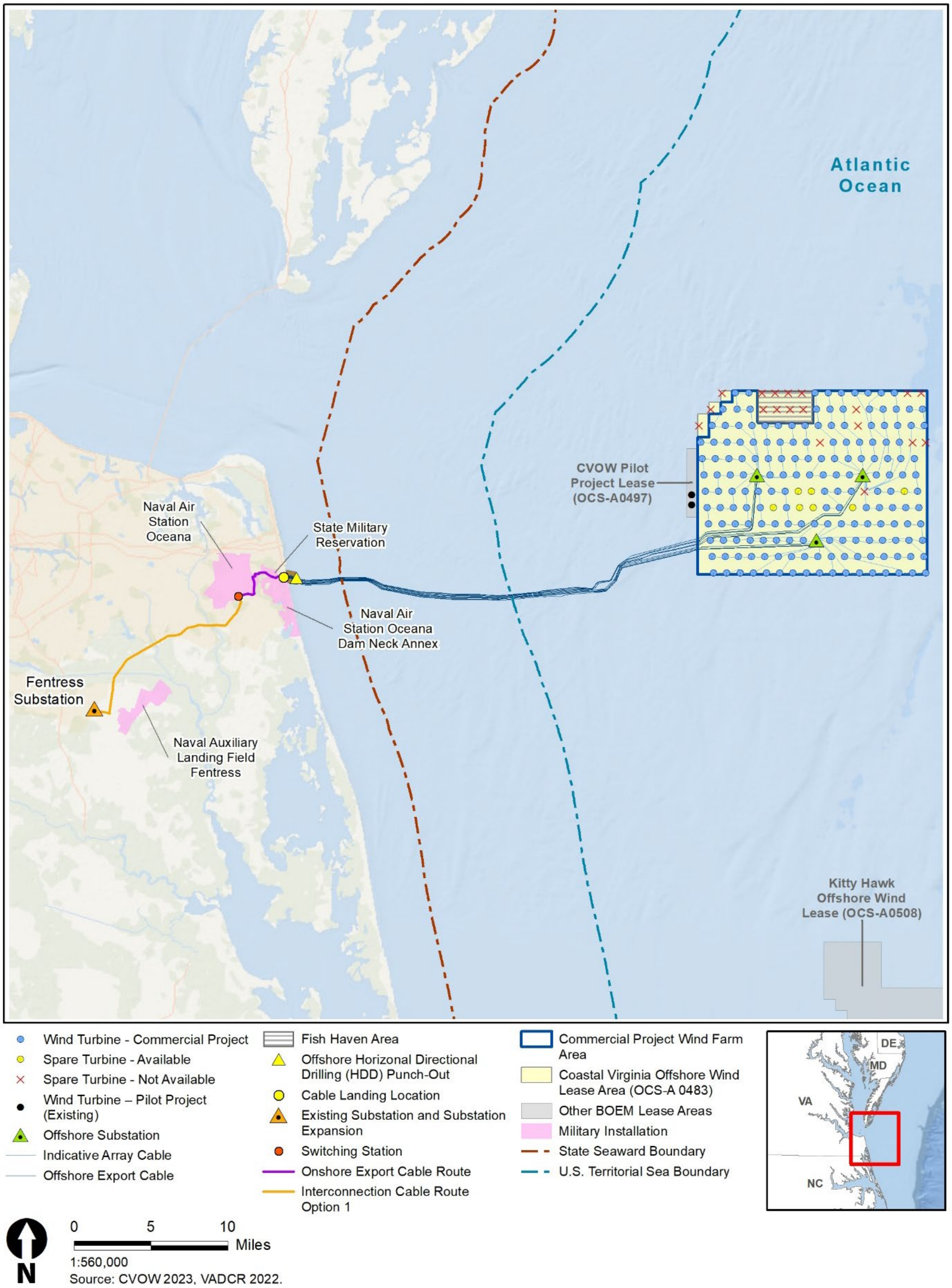


Figure 2-4 Alternative B: Revised Layout to Accommodate the Fish Haven and Navigation (Preferred Alternative)

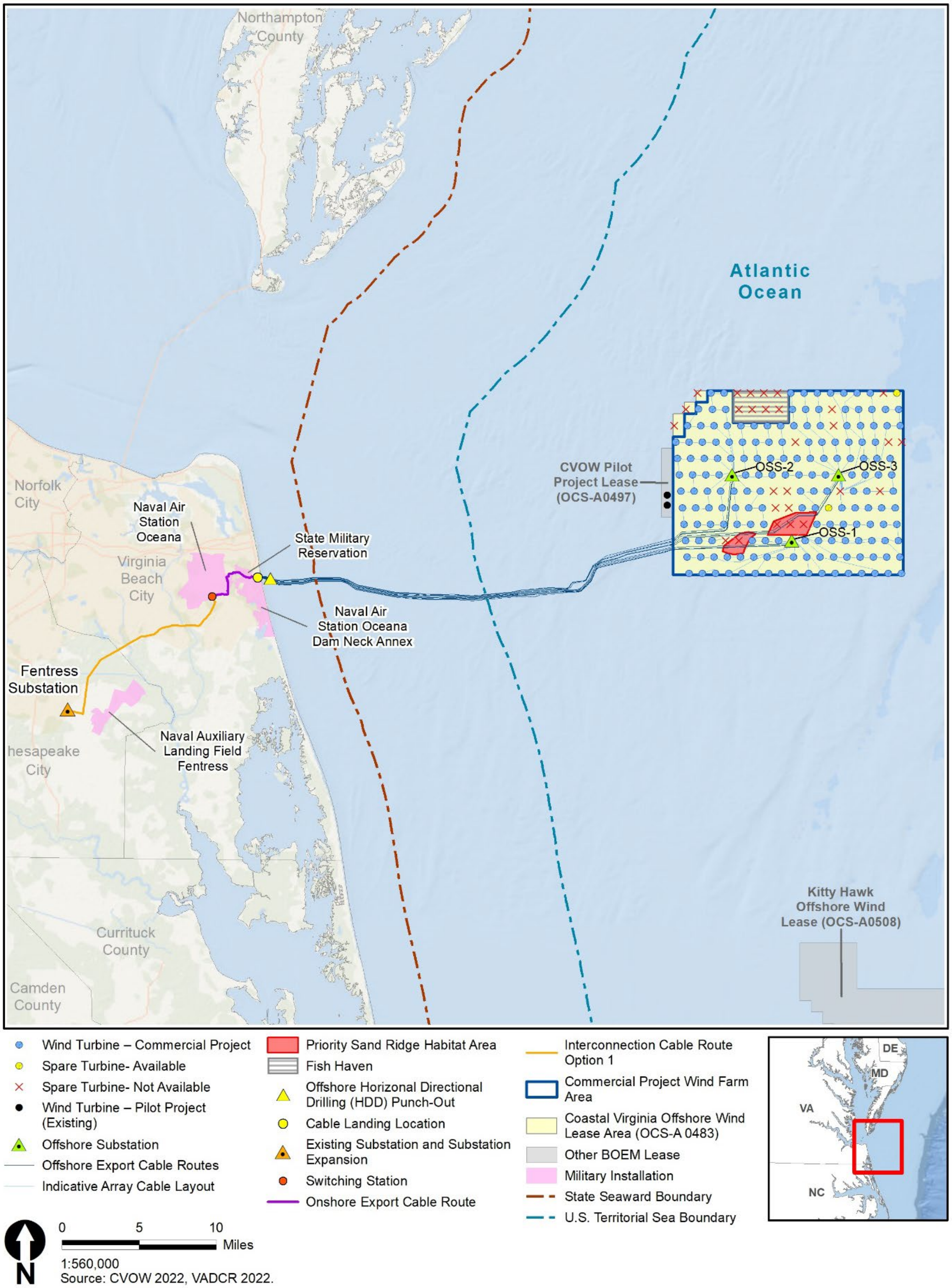


Figure 2-5 Alternative C: Sand Ridge Impact Minimization Alternative

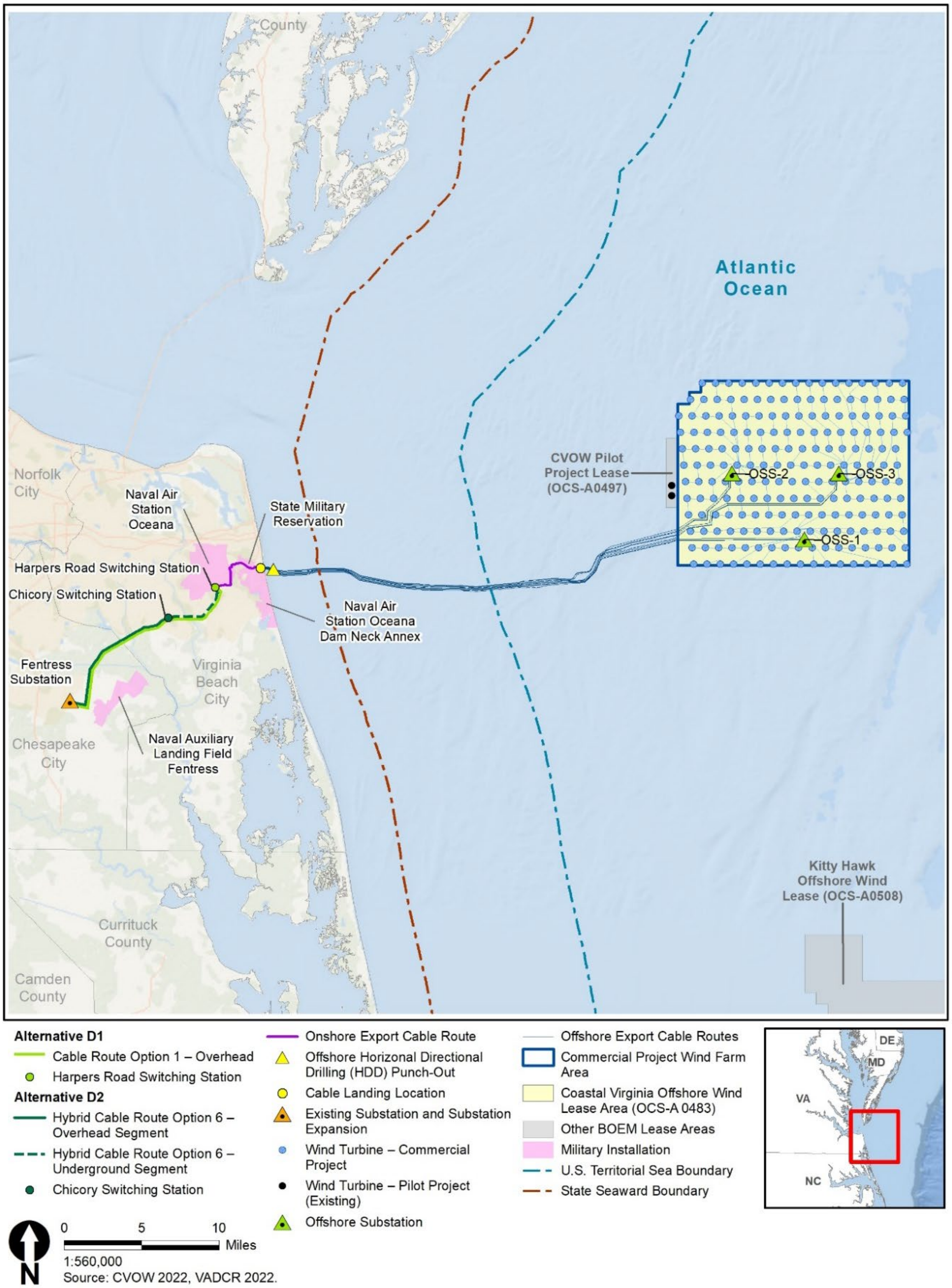


Figure 2-6 Alternative D: Onshore Habitat Impact Minimization Alternative (Alternative D-1: Preferred Alternative)

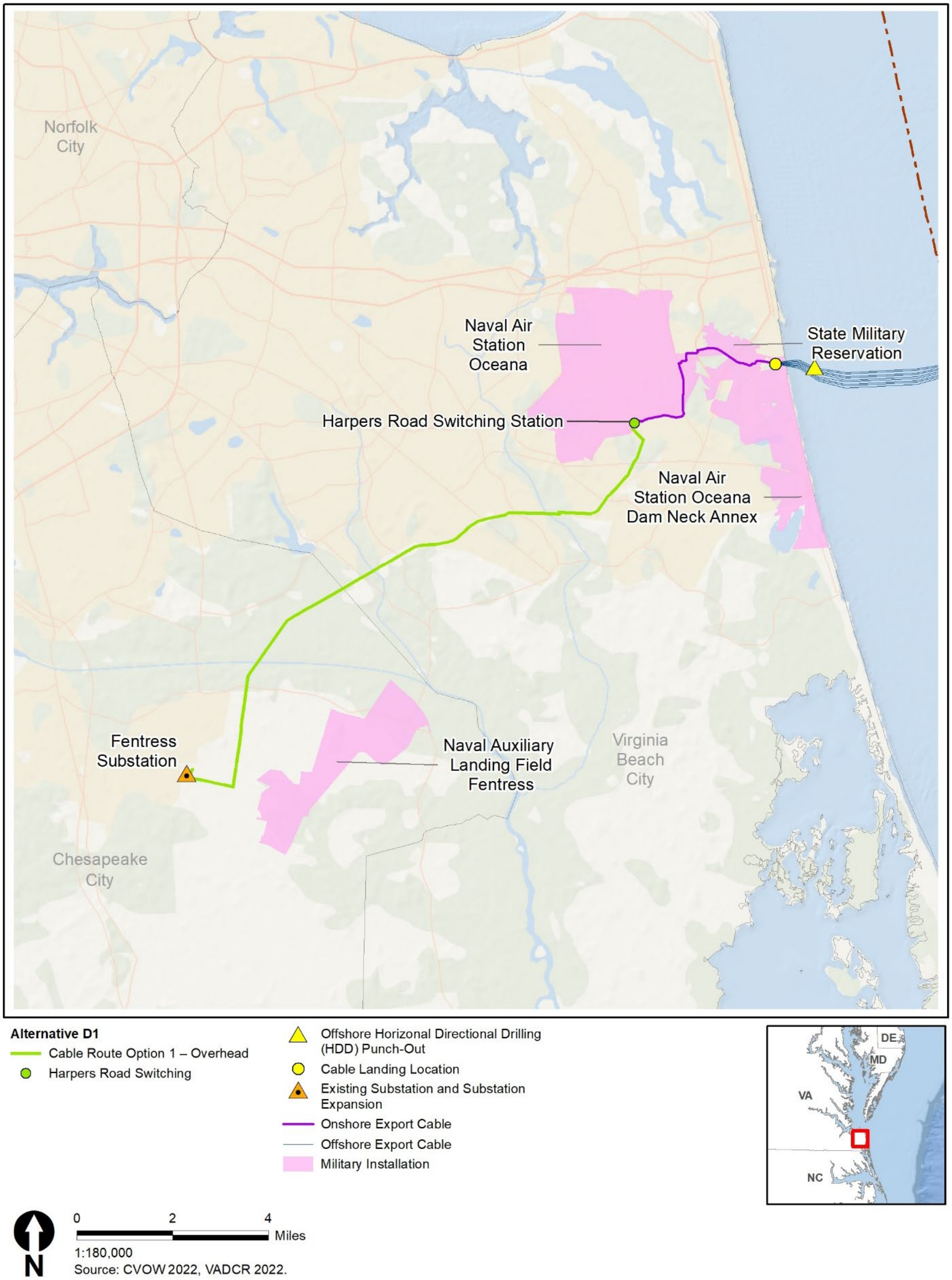


Figure 2-7 Alternative D-1: Onshore Components Detail

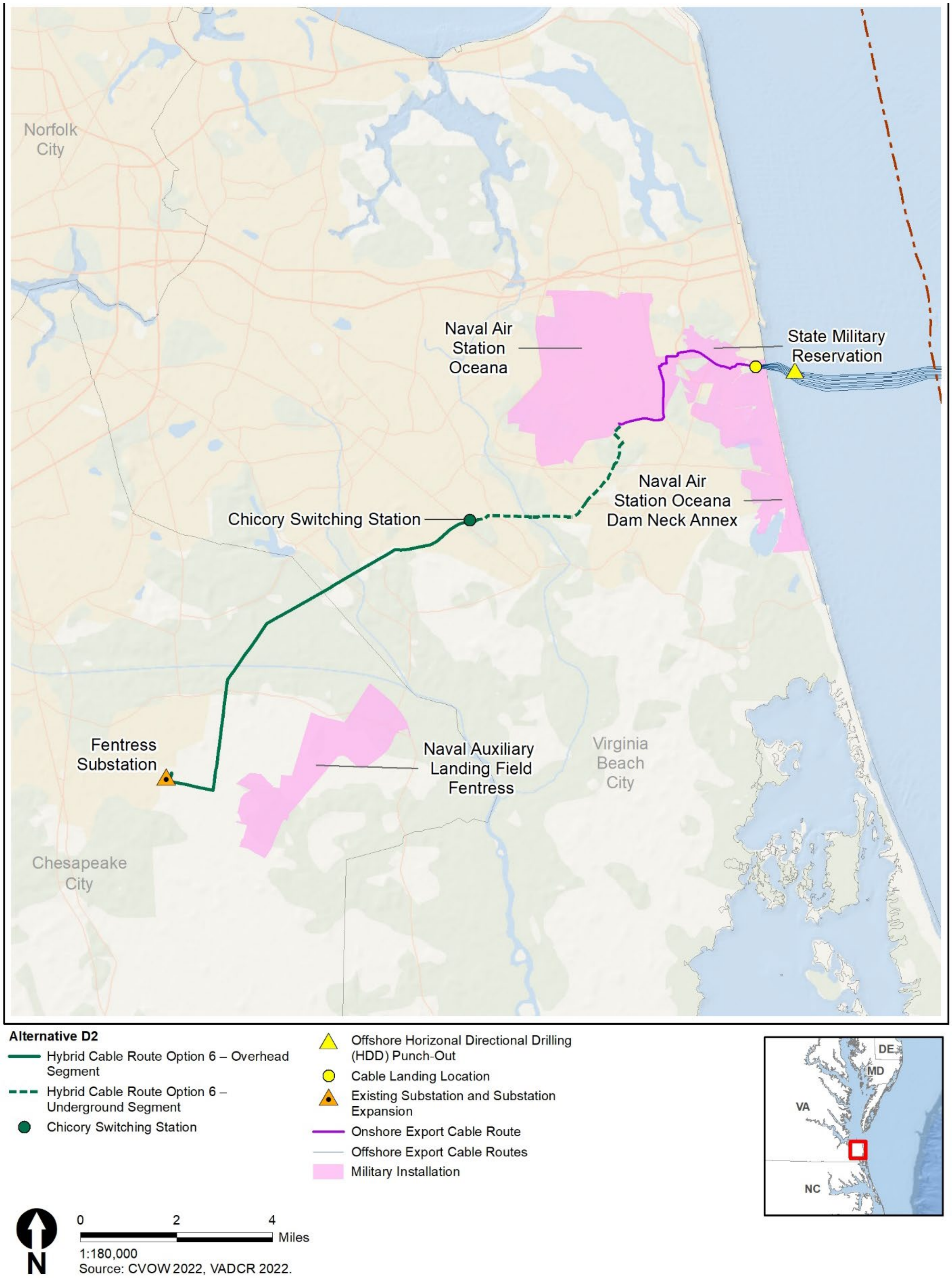


Figure 2-8 Alternative D-2: Onshore Components Detail

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 the Department of the Interior 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] 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, therefore, 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 and dismissed from further consideration alternatives that did not meet the purpose and need, did not meet the screening criteria, or both. The screening criteria are provided in BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act (NEPA)* (BOEM 2022).

Table 2-2 lists the alternatives and the rationale for their dismissal. These alternatives are presented with a brief discussion of the reasons for their elimination as prescribed in CEQ regulations at 40 CFR 1502.14(a) and Department of the Interior regulations at 43 CFR 46.420(b–c).

[8] 43 CFR 46.420(b)
[9] 43 CFR 46.415(b)

Table 2-2 Alternatives Considered but not Analyzed in Detail.

Alternative	Rationale for Dismissal
Offshore Export Cables	
Coordinated offshore export cable route	Commenters recommended that BOEM consider offshore export cable routing alternatives that would have adjacent projects use a shared, common cable corridor. There is no offshore lease area immediately adjacent to CVOW-C; the nearest existing offshore lease area is off the coast of North Carolina. Developing a shared export cable corridor would not be practicable because the CVOW-C Project and the nearest projects have different interconnection points to the electric power grid. At this time, these factors outweigh any potential future decrease in collective seabed disturbance that may result from having multiple projects sharing one cable corridor. Therefore, an alternative with a cable route shared by adjacent projects is not technically or economically practicable, and this alternative has not been carried forward at this time. An offshore routing constraints analysis was conducted by Dominion Energy along the offshore export cable route corridor as well as the adjacent CVOW-Pilot project cable route, dating back to 2013 when the Project was first identified. Constraints analyses are identified in COP Appendix W (Dominion Energy 2023). This constraints analysis identified potential offshore export cable routes; evaluated routing feasibility; and identified other challenges associated with existing cable assets, such as the DNODS, and Navy training and testing locations. The potential challenges and complexities of the offshore export cable routing (e.g., length, seabed features, burial depth, installation hazards, biological/cultural resources, commercial/recreational fishing) were considered as part of the selection criteria for the preferred and alternative cable landing locations. To the extent possible, the most direct route served as the starting point in developing the offshore export cable route corridor. This also is driven by technical constraints and costs, including cable costs, installation time, and limits associated with available and efficient high-voltage alternating-current (HVAC) transmission (as detailed in COP, Appendix W; Dominion Energy 2023). Section 2.1.2.1 of the COP states: A potential landing in the vicinity of Sandbridge Road was investigated at a desktop level for feasibility. Discussions with the Navy's Office of Seafloor Cable Protection resulted in the determination of an exclusion zone for any subsea cable routes approaching from the north of the Sandbridge Road area. This line originates along the shoreline at Dam Neck Annex and extends to the shelf break to the east. This feature, and perhaps others like it, may be the reason the Department of Defense prohibits any cables approaching from the north from crossing the Department of Defense exclusion line and traversing south across the seabed to the Sandbridge area, which eliminated Sandbridge as a potential offshore export cable landing location. As such, a route to land in the area of the Sandbridge community or any points further south is precluded given this fatal flaw. For reasons stated above, this location is not carried forward in the PDE. Further, Section 2.1.1.2 of the COP states: Though the details of the cable are not available to the public, it is inferred that a Navy subsea cable asset was installed approximately 4 nautical miles (7 kilometers) south of the offshore export cable routes. The only evidence of this cable asset that has been located in the public domain is referenced in the Final Environmental Assessment (EA) for the Sandbridge Beach Erosion Control and Hurricane Protection Project on Virginia Beach in 2018. In addition, the offshore export cable route corridor separating the two sand resource area polygons due south of DNODS is another indication that a cable passes through the area.

Alternative	Rationale for Dismissal
	Additionally, Dominion Energy evaluated utilizing the existing CVOW-Pilot corridor for the CVOW-C export cable route; however, the number of cables and required spacing to ensure the ability to microsite the routes, install the cables, and account for potential maintenance and repairs for the CVOW-C export cable route requires a larger footprint than what is available within the CVOW-Pilot export cable corridor. Specifically, the CVOW-C export cable route ROW varies in width from approximately 0.5 mile (0.8 kilometer) to 1.8 miles (2.9 kilometers) and would require a total ROW footprint of approximately 24.8 miles to accommodate the nine-cable layout. The CVOW-Pilot ROW totals approximately 1.0 mile (1.6 kilometers). The CVOW-C export cable corridor has been sited to be adjacent to the CVOW-Pilot cable corridor to the extent practical. The separation between the CVOW-C and CVOW-Pilot ROWs varies from 400 feet (122 meters) apart to approximately 2.0 miles (3.2 kilometers).
Evaluate alternatives for offshore export cable route reviewed by Dominion Energy	Commenters requested that an alternative evaluate the export cable route corridors considered by Dominion Energy and include an explanation of how the final export cable corridor was selected. An offshore routing constraints analysis was conducted along the offshore export cable rote corridor as well as the adjacent CVOW-Pilot project cable route. A summary of Dominion Energy's offshore routing constraints analysis and process for selecting the offshore export cable route is documented in the COP (Section 2.1.1.2; Dominion Energy 2023). Constraints analyses have been conducted and are identified in COP Appendix W (Dominion Energy 2023). Though the most direct route served as the starting point for developing the export cable route corridor, the final export cable route corridor was identified through constraints analysis, technical constraints, and routing feasibility, and reflected other challenges associated with existing constraints, such as the DNODS, Navy training and testing locations, and existing telecom and transmission cables. Additionally, potential challenges and complexities of the route such as length, seabed features, biological/cultural resources, and commercial/recreational fishing, were considered as part of the selection criteria for the preferred and alternative cable landing locations. Dominion Energy's preferred offshore export cable route minimizes route length, and has the least potential impacts on benthic habitat, the DNODS area, sand borrow areas, navigation channels, Department of Defense training and testing areas, and existing submarine cables. As a result, Dominion Energy's preferred offshore export cable route corridor was determined to be the least environmentally damaging practicable alternative. An alternative export cable route corridor would be technically infeasible based on the constraints described above and in the rationale for dismissal for the coordinated offshore export cable route alternative; therefore, a separate alternative to consider other offshore export cable routes is not considered in the EIS.

Alternative	Rationale for Dismissal
Scour Protection	
Scour protection for foundations and offshore cables	Commenters recommended that BOEM consider alternatives that evaluate different possibilities for the composition and material of scour protection used in the Project. Suggestions include removing concrete mattresses as a possible option for scour protection and using layered rocks of different sizes and roughness. Scour protection proposed by Dominion Energy includes dumped rocks, geotextile sand containers, and concrete mattresses. The need, type, and method for installing scour protection has not been finalized and will be determined in consultation and coordination with relevant jurisdictional agencies prior to construction and installation (COP Section 3; Dominion Energy 2023). Dominion Energy would submit the proposed final need, type, and method for installing scour protection as part of the Facility Design Report and Fabrication and Installation Report for BOEM's review. Project impacts associated with scour protection are disclosed in Chapter 3, *Affected Environment and Environmental Consequences,* of this EIS for relevant affected resources. Because, under all alternatives, scour protection is foreseen to be installed around the base of WTG foundations and OSSs foundations, and the type and method of installation would be determined at a later time, a separate alternative is not warranted.
Wind Turbine Array Layout and Spacing	
OSSs placed in offset positions between the gridded WTG layout	The Draft EIS analyzed the maximum PDE for the May 2022 version of Dominion Energy's COP, which included a maximum of 205 WTGs plus 3 OSSs in offset positions between the gridded WTG layout (previous Alternative A). USCG recommended that the OSSs be "aligned with the turbines in straight rows or columns to allow for continuous passage of vessels and SAR helicopters." To address these concerns, Dominion Energy changed the maximum PDE to 202 WTGs with 3 OSSs within the rows of the gridded WTG layout (current Alternative A) and is no longer proposing a Project layout with OSSs in offset positions. Because this layout is no longer being proposed, this alternative is removed from detailed analysis in the Final EIS.
Transit corridor alternative	Commenters suggested that BOEM consider an alternative that would include a 2- to 4-nautical mile (3.7- to 7.4-kilometer)–wide transit corridor that aligns with the line-of-sight transit from Rudee Inlet in Virginia Beach to the Norfolk Canyon. BOEM considered the request for a 2- to 4-nautical mile (3.7- to 7.4-kilometer)–wide transit corridor and determined that an analysis of additional separation widths would not provide the U.S. Secretary of the Interior significantly different information regarding impacts on affected resources when compared to Alternative B, which would site OSSs in alignment with the common grid layout of the WTGs to minimize adverse impacts on surface and aerial navigation through the Project area. In previous BOEM NEPA analyses, BOEM found that eliminating structure locations to create corridors for transit did not meaningfully improve navigational safety in an aligned and regular gridded structure layout, as would exist under all the alternatives. Further, the spacing provided within Dominion Energy's proposed 0.93- by 0.75-nautical mile (1.72- by 1.39-kilometer) offset grid pattern is anticipated to be consistent with the findings expected to be published in the Final USCG Atlantic Coast Port Access Route Study (COP Section 3.3.1.4; Dominion Energy 2023). Therefore, this alternative was not carried forward for detailed analysis.

Alternative	Rationale for Dismissal
Project and inter-array cable oriented to avoid specific benthic features	Commenters suggested that BOEM consider an alternative with WTG spacing and inter-array cable orientation that conforms with benthic features, such as sand ridges, and to create corridors for inter-array cables rather than a gridded layout, to allow for improved movement of whelk species and to minimize possible isolation of sensitive benthic species. BOEM developed Alternative C to minimize impacts on offshore benthic habitats through a combination of: micrositing (up to 500 feet), the removal of 30 WTGs and associated inter-array cables, and the relocation of 1 WTG and associated inter-array cables from within priority sand ridge habitats. The generating capacity under Alternative C would allow Dominion Energy to meet its minimum 2,500-MW need for the project under the 2020 Virginia Clean Economy Act. There is no indication that whelk movement would be hindered by the presence of inter-array cables; however, potential impacts associated with offshore cables and foundations have been reviewed and disclosed in Chapter 3 of this EIS for relevant affected resources. As applicable, BOEM could also choose to implement additional mitigation measures to further reduce or avoid impacts. BOEM considered a variation to Alternative C that would use only 16 MW turbines and requested that Dominion Energy develop an Offshore Project layout avoiding sand ridge habitats and consisting of approximately 156 WTGs. However, a 16-MW turbine design is not currently commercially or technically available and is not likely to be available at the time of BOEM's anticipated Record of Decision (ROD). While the PDE for the Project does include a 16-MW WTG as the maximum capacity to allow for flexibility in the event technological advancements allow for an increase in the generating capacity of the selected turbine, Dominion Energy's preferred WTG design is the Siemens Gamesa Renewable Energy SG 14-22 DD WTG; Dominion Energy has selected and contracted 176 SG 14-22 DD WTGs for the Project. Given the custom nature of WTG orders, their custom site-specific foundations, and the supply chain constraints currently facing the offshore wind market, it is not reasonable nor economically feasible for BOEM to defer selection of a WTG model to the ROD. If a 16-MW WTG becomes available, Dominion Energy would conduct a financial assessment of whether to maintain 176 WTG positions or remove WTG locations. If determined favorable to remove WTG positions, Dominion Energy would consider prioritizing those located within priority sand ridge habitats in the Lease Area. Under this scenario, BOEM would review a 16-MW offshore layout in a future NEPA review, likely as a supplement to this EIS. Lessees prefer to have the WTGs arranged in such a way that the total wake effects for the individual WTG are minimized, which together with a goal to maintain a uniform layout to ease navigation, resulted in an offset grid pattern. As described in COP Section 3.3.1.1 and Section 4 (Dominion Energy 2023), the design of the WTG layout considered all existing uses of the Lease Area and surrounding areas such as vessel traffic patterns, commercial and recreational fishing activities, minimization of impacts on biological and cultural resources, as well as the safety of mariners and Project personnel. Based on these considerations, Dominion Energy designed the WTG layout to include a 397-foot (121-meter) setback (measured from the center point of the WTG) from the edge of the Lease Area to minimize potential impacts on existing uses and resources within and adjacent to the Lease Area. The setback is based on an assumed WTG blade length of 364 feet (111 meters) plus 3.3 feet (1 meter) to account for the rotation axis, with an additional 33-foot (10-meter) buffer to ensure that all WTG components are fully located within the Lease Area. Additionally, a 984-foot (300-meter) buffer was placed

Alternative	Rationale for Dismissal
	around known biological and cultural resources such as artificial reefs or shipwrecks. As a result, rotating the Project layout is infeasible as it would considerably increase impacts on safe navigation of the Project area, thereby obviously and substantially increasing the impacts on the human environment that outweigh potential benefits.
Minimum viable project scenario	Commenters recommended consideration of an alternative describing the minimum necessary components for a viable project. The commenters proposing a "minimum viable project design scenario" did not provide evidence that the alternative would avoid or substantially lessen one or more specific, significant socioeconomic or environmental effects of the Project. The "minimum viable project design scenario" would have substantially similar effects as alternatives that are analyzed in detail to address specific environmental and socioeconomic effects: Alternatives B, C, and D, all of which reduce the footprint of the Project to address specific impacts based on evidence of the sensitivity of resources and/or the need to accommodate other ocean uses, such as safe navigation. The generation capacity under Alternatives B, C, and D would allow Dominion Energy to meet its minimum 2,500-MW need for the Project under the 2020 Virginia Clean Economy Act.
Wind Turbine Technology	
Foundation type alternative	Commenters recommended that BOEM analyze an alternative that includes the use of non–pile-driven foundations. Dominion Energy considered multiple design alternatives for turbine foundations that were ultimately not selected for inclusion in the PDE for the COP. Alternative, non–pile-driven foundations considered but not carried forward include suction buckets, gravity-based structures, and floating foundations. Dominion Energy determined that these foundation types were not suitable for the CVOW-C Project due to site conditions including soil sediment composition and water depth. See COP Volume 1, Section 2.2.2 (Dominion Energy 2023) for additional information on alternative foundation types considered. Because non–pile-driven foundations are technically infeasible for the CVOW-C Project area, they were eliminated from detailed analysis.
Mitigation	
Alternatives specific to each phase on the Project	A commenter encouraged BOEM to include alternatives specific to each phase of the Project to ensure environmental effects of the Project are avoided, mitigated, or minimized. Alternatives that only consider specific phases of the Project would not meet the purpose and need for Dominion Energy to construct and operate a commercial-scale offshore wind energy facility that would generate 2,500–3,000 MW. For each alternative evaluated in detail in the EIS, impacts at each stage of the Project have been analyzed. If the COP is approved or approved with modifications, BOEM could "mix and match" the EIS alternatives to develop a new preferred alternative, provided the design parameters are compatible and the alternative would still meet the purpose and need of the Proposed Action. For all alternatives evaluated in the EIS, BOEM could choose to implement additional mitigation measures to further reduce or avoid impacts, as appropriate. Refer to Appendix H, *Mitigation and Monitoring*, for BOEM's recommended measures to avoid or minimize impacts during the construction and operation of the Project.

Alternative	Rationale for Dismissal
	Because impacts from alternatives have been analyzed in detail for each phase of the Project and options for mitigation and minimization at each phase of the Project are already being evaluated as part of BOEM's review of the Proposed Action and alternatives, analyzing additional alternatives specific to each phase of the Project would not provide significantly different analysis; thus, this alternative was not carried forward for separate evaluation.

2.3 Non-Routine Activities and 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, 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. Dominion Energy would stock spare parts and have sufficient workforce available to conduct corrective maintenance activities, if required.
- **Collisions and allisions:** These events 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 requirement for lighting on vessels.
    - USCG requirement for aids to navigation, such as channel markers, safety signage, and buoys.
    - NOAA vessel speed restrictions.
    - The proposed spacing of WTGs and OSSs.
    - The lighting and marking plan that would be implemented, as described in Section 2.1.2.2.2, *Offshore Activities and Facilities.*
    - 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 Dominion Energy. However, such incidents are unlikely to occur because the proposed Project area would be indicated on navigational charts and the cable would be buried at least 3.3 feet (1 meter) below the seabed.
- **Chemical spills or releases:**
    - **Offshore:** For offshore activities, these include inadvertent releases from refueling vessels, spills from routine maintenance activities, and any more significant spills resulting from 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. Dominion Energy would be expected to comply with USCG and BSEE regulations relating to prevention and control of oil spills through the implementation of an Oil Spill Response Plan (COP, Appendix Q; Dominion Energy 2023).

- **Onshore:** Onshore, releases could occur from construction equipment or HDD activities; however, impacts would be minimized through the implementation of a Spill Prevention, Control, and Countermeasures Plan. For HDD in particular, Dominion Energy would implement an Inadvertent Return Plan to minimize the likelihood of drilling fluid escaping from the drilling shaft and being deposited in unwanted areas around the drill path.

- **Severe weather and natural events:** Dominion Energy designed the proposed Project to withstand severe weather events.
  - **Offshore:** The WTGs are designed to withstand hurricane force winds expected in the Lease Area. The cut out wind speed of the WTG is anticipated to be 62.6 miles per hour (28.2 meters per second). If severe weather caused a spill or release offshore, the actions outlined previously would help reduce potential impacts. Severe flooding or coastal erosion could require repairs to Onshore Project components, 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) due to severe weather would result in temporary hazards to navigation for all vessels, similar to the construction and installation impacts described in Chapter 3.
  - **Onshore**: Onshore components are designed to withstand similar severe weather events to the offshore components, including hurricane force winds, flooding, severe precipitation events, and freezing precipitation. Severe weather-related events and the conditions and forces imposed as a result are included in the load cases needed for the subject geographic area based on the standards established by the National Electric Safety Code (NESC) which is used for the design of all onshore systems, structures, and components (Dominion Energy 2023).
- **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. Therefore, terrorist attacks are not analyzed further.

2.4 Summary and Comparison of Impacts by Alternative

Table 2-3 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. Chapter 3 provides definitions for **negligible**, **minor**, **moderate**, and **major** impacts.

Table 2-3 Summary and Comparison of Impacts among Alternatives with Mitigation Measures[1]

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
3.4 Air Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse 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 (VOCs), hazardous air pollutants (HAPs), and greenhouse gases (GHGs), mostly released during construction and decommissioning, and **moderate beneficial** impacts on regional air quality after offshore wind projects are operational.	The Proposed Action would have **minor** adverse impacts attributable to air pollutant and 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. The Proposed Action would contribute a noticeable increment to the **minor** adverse and **moderate beneficial** impacts on air quality from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C could have slightly less impacts on air quality compared to the Proposed Action due to a reduced number of WTGs. Alternatives B and C could have lesser **minor** adverse impacts on air quality compared to the Proposed Action, to the extent that Alternatives B and C would reduce the number of WTGs. Alternatives B and C would have lesser **minor beneficial** impacts on air quality in the long term due to reduced emissions from fossil-fueled power plants, considering the reduced number of WTGs. The overall impact level for Alternatives B and C would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. Alternatives D-1 and D-2 would have the same number of WTGs as the Proposed Action and, therefore, the same anticipated offshore emissions and impact levels. Under Alternatives D-1 and D-2, the onshore interconnection cables could differ in length and construction techniques from those of the Proposed Action, and thus their construction emissions and impacts could differ from those of the Proposed Action. However, the impact levels would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
			and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **minor** adverse and **moderate beneficial**.
3.5 Bats	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** 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 **minor** impacts because bat presence on the OCS is anticipated to be limited and onshore bat habitat impacts are expected to be minimal.	The Proposed Action would have **negligible** to **minor** adverse impacts on bats, especially if tree clearing is conducted outside of the active season. The primary risks to bats would be from potential onshore removal of roosting and/or foraging habitat and operation of offshore WTGs; however, occurrence of bats offshore is low and mortality is anticipated to be rare in the onshore or offshore environment. The Proposed Action would contribute an undetectable increment to the overall impact on bats. The overall impacts are expected to be **minor** adverse impacts on bats from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C may result in slightly less, but not materially different, **negligible** to **minor** adverse impacts on bats than those described under the Proposed Action due to a reduced number of WTGs. Alternatives D-1 and D-2 would have the same Offshore Project components as the Proposed Action and, therefore, would have similar impacts on bats offshore. Onshore, Alternatives D-1 and D-2 would limit the onshore interconnection cable route to either Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. These route options are analyzed as part of the Proposed Action and so impacts on bats would be the same as for the Proposed Action. Therefore, the impact levels of Alternatives B, C, D-1, and D-2 would be the same as for the Proposed Action: **negligible** to **minor** adverse. The impacts associated with Alternatives B, C, D-1, and D-2, when each combined with the impacts of ongoing and planned activities (including offshore wind activities), would be the same as for the Proposed Action: **minor** adverse.

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
3.6 Benthic Resources	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** adverse impacts, with the potential for **moderate beneficial** impacts on benthic resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative, when combined with all planned activities (including other offshore wind activities), would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts resulting from emplacement of structures (habitat conversion).	The Proposed Action would have **negligible** to **moderate** adverse impacts on benthic resources resulting from offshore construction and **moderate beneficial** impacts on benthic resources resulting from emplacement of structures (habitat conversion). Adverse impacts would primarily result from new cable emplacement, pile-driving noise, anchoring, and the presence of structures. Beneficial impacts would result from the presence of new structures. The Proposed Action would contribute an undetectable to noticeable increment to the **moderate** adverse and **moderate beneficial** impacts on benthic resources from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities). The overall benthic impact would be **moderate** adverse.	Alternatives B and C would reduce the number of WTGs compared to the Proposed Action by 29 and 33 WTGs, respectively, so the impacts would be slightly reduced compared to the Proposed Action, though not substantively different. There would be fewer foundations and fewer inter-array cables, which would reduce impacts associated with the presence of structures and conversion of habitat from soft-bottom to scour protection. However, the reduction in impacts would not be substantial enough to reduce the impact level, so these alternatives would have the same impact levels as the Proposed Action: **negligible** to **moderate** adverse and **moderate beneficial**. Alternatives D-1, and D-2 differ from the Proposed Action only in respect to the routing of the onshore interconnection cable and therefore would be the same as for the Proposed Action, **negligible** to **moderate** adverse to **moderate beneficial**, with an overall benthic impact of **moderate** adverse.
3.7 Birds	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on birds. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including offshore wind activities) would have	The Proposed Action would have **negligible** to **moderate** adverse impacts on birds, primarily associated with habitat loss and collision-induced mortality from rotating WTGs and permanent habitat loss and conversion from onshore construction. **Moderate beneficial** impacts would result from increased foraging opportunities for marine birds.	Alternatives B and C would reduce the number of WTGs compared to the Proposed Action, which would result in slightly less impacts on species with high collision sensitivity and high displacement sensitivity but would not change the impact level: **negligible** to **moderate** adverse impacts with **minor beneficial** impacts.

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	a **moderate** adverse impact on birds but could include **moderate beneficial** impacts because of the presence of offshore structures.	The Proposed Action would contribute an undetectable increment to the **moderate** adverse and **moderate beneficial** impacts on birds from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives D-1 and D-2 would have the same Offshore Project components as the Proposed Action and, therefore, would have similar impacts on birds offshore as the Proposed Action. Onshore, Alternatives D-1 and D-2 would limit the interconnection cable route to either Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. These route options are analyzed as part of the Proposed Action and so impacts on birds from Alternatives D-1 and D-2 would be the same as for the Proposed Action. Therefore, the impact levels of Alternatives B, C, D-1, and D-2 would be the same as for the Proposed Action: **negligible** to **moderate** adverse impacts with **minor beneficial** impacts on birds. The overall impacts associated with Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse and **moderate beneficial**.
3.8 Coastal Habitat and Fauna	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on	The Proposed Action would have **negligible** to **moderate** adverse impacts on coastal habitat and fauna because habitat impacts would be limited, and coastal construction would predominantly	Because Alternatives B and C involve modifications only to offshore components, impacts on coastal habitat and fauna from those alternatives would be **negligible** to **moderate** adverse.

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	coastal habitat and fauna. Currently, there are no other offshore wind activities proposed in the geographic analysis area. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including offshore wind activities) would be **negligible**.	occur in already developed areas where wildlife is habituated to human activity and noise. The Proposed Action would contribute an undetectable increment to the **negligible** to **moderate** adverse impacts on coastal habitat and fauna from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Onshore, Alternatives D-1 and D-2 would limit the interconnection cable route to either Interconnection Cable Route Option 6 (Alternative D-1) or Interconnection Cable Route Option 1 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. These route options are analyzed as part of the Proposed Action and so impacts on coastal habitat and fauna would be the same. Therefore, the impact levels of Alternatives D-1 and D-2 would be **negligible** to **moderate** adverse on coastal habitat and fauna.
3.9 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 **negligible** to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on 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 a **negligible** to **major** adverse impact on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing due primarily to the presence of structures (e.g., through gear loss, navigational hazards, space use conflicts, and potential impacts on	The Proposed Action would have **negligible** to **major** adverse impacts on commercial fisheries and for-hire recreational fishing. The impacts of the Proposed Action could also include long-term **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. The Proposed Action would have **negligible** to **major** adverse impacts on commercial fisheries and for-hire recreational fishing in the analysis area, driven largely by the presence of structures from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities). The presence of structures may also induce a **minor** beneficial impact on for-hire recreational fishing	Alternatives B and C could lead to **negligible** to **major** adverse impacts on commercial fisheries and for-hire recreational fishing and **minor beneficial** impacts on for-hire recreational fishing due to the increase in structures provided by WTGs, OSSs, and associated scour pads. Both adverse and beneficial impacts would be slightly less than for the Proposed Action considering the lower number of WTGs for Alternatives B and C. Alternative D differs from the Proposed Action only with respect to onshore routing of the interconnection cable. Alternative D would result in the same level of impacts as under the Proposed Action: **negligible** to **major** adverse on commercial fisheries and for-hire recreational fishing

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	fisheries surveys), new cable emplacement and pile-driving noise. The presence of structures may also induce a **minor** beneficial impact on for-hire recreational fishing.		The impacts of Alternatives B, C, D-1, and D-2, when each combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action on commercial fisheries and for-hire recreational fishing: **negligible** to **major** adverse. The presence of structures may also induce a **minor** beneficial impact on for-hire recreational fishing
3.10 Cultural Resources	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in overall **moderate** adverse impacts on cultural resources, primarily as a result of dredging, cable emplacement, and activities that disturb the seafloor. *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 on cultural resources.	The Proposed Action would have **moderate** to **major** adverse impacts on cultural resources primarily from the introduction of intrusive visual elements, which alter character-defining ocean views of historic properties onshore that contribute to the resource's eligibility for the NRHP; and dredging, cable emplacement, and activities that disturb the seafloor, which result in damage to or destruction of submerged archaeological sites or other underwater cultural resources (e.g., shipwreck, debris fields, ancient submerged landforms) from offshore bottom-disturbing activities. The Proposed Action would have **moderate** to **major** adverse impacts on cultural resources from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C would have similar **moderate** to **major** adverse impacts on individual cultural resources as the Proposed Action assuming implementation of mitigation measures. Impacts would be slightly less than for the Proposed Action considering the lower number of WTGs for Alternatives B and C. Alternatives D-1 and D-2 would have the same impacts offshore as for the Proposed Action, as the offshore components of Alternatives D-1 and D-2 are the same as for the Proposed Action. Alternatives D-1 and D-2 would have similar **moderate** to **major** adverse impacts on individual cultural resources onshore as the Proposed Action assuming implementation of mitigation measures. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **moderate** to **major** adverse.

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
3.11 Demographics Employment, and Economics	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics. *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 and **minor beneficial** impacts on demographics, employment, and economics.	The Proposed Action would have **negligible** to **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics. The combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would result in **negligible** to **minor** adverse and **negligible** to **moderate beneficial** impacts on demographics, employment, and economics from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B and C would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action because of the reduced number of WTGs, but the overall impact would be the same: **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts. Alternatives D-1 and D-2 would not change the number of WTGs and therefore the impacts are anticipated to be the same as those of the Proposed Action: **negligible** to **minor** adverse and **negligible** to **minor beneficial**. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **negligible** to **minor** adverse and **negligible** to **moderate beneficial**.
3.12 Environmental Justice	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** adverse and **minor beneficial** impacts on environmental justice populations. *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 due to	The Proposed Action would have a range of impacts on environmental justice populations, such as **negligible** adverse impacts due to air emissions, light, noise, port utilization, and vessel traffic, **minor** adverse impacts as a result of disruption of marine activities during construction, and **minor** to **moderate** adverse impacts due to the long-term presence of structures in the offshore environment. Potential **minor beneficial** impacts would result from port utilization and the enhanced employment opportunities.	Impacts of Alternatives B, C, D-1, and D-2 would be the same as those of the Proposed Action for environmental justice populations and would range from **negligible** to **moderate** adverse and **minor beneficial**. These action alternatives would not result in disproportionately "high and adverse" impacts on environmental justice populations. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	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. The combination of the Proposed Action and other ongoing and planned activities **minor beneficial** impacts on environmental justice populations.	Overall, BOEM expects that the Proposed Action would result in **negligible** to **moderate** adverse impacts and **minor beneficial** impacts on environmental justice populations. These action alternatives would not result in disproportionately “high and adverse” impacts on environmental justice populations. The combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would result in **negligible** to **moderate** adverse impacts and **minor beneficial** impacts on environmental justice populations.	activities (including other offshore wind activities) would be the same as for the Proposed Action: **negligible** to **moderate** adverse impacts and **minor beneficial** impacts.
3.13 Finfish, Invertebrates, and Essential Fish Habitat	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** adverse impacts on finfish, invertebrates, and essential fish habitat (EFH). *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** adverse impacts on finfish, invertebrates, and EFH. It is anticipated that the greatest impact on finfish and invertebrates would be caused by ongoing regulated fishing activity and climate change.	The Proposed Action would result in **negligible** to **moderate** adverse impacts for finfish, invertebrates, and EFH. The primary adverse impacts on finfish would be from noise during construction and operation of the proposed Project. Long-term adverse impacts on EFH from construction and installation of the Proposed Action would be **minor**, as the resources would likely recover naturally over time. The Proposed Action would have **negligible** to **moderate** adverse impacts on invertebrates through temporary disturbance and displacement, habitat conversion, and behavioral changes, injury, and mortality of sedentary fauna. The presence of structures may have a **minor beneficial** impact on invertebrates through an “artificial reef effect.” Despite invertebrate mortality and varying extents	Alternatives B and C would reduce the number of WTGs by 29 and 33 WTGs, respectively and would slightly reduce adverse impacts on finfish, invertebrates, and EFH compared to the Proposed Action, given that there would be fewer foundations developed and, therefore, less permanent loss of habitat and lower noise impacts during associated pile driving; however, the impact level would be the same as for the Proposed Action: **negligible to moderate** adverse. The presence of structures may have a **minor beneficial** impact on invertebrates through an “artificial reef effect.” Despite invertebrate mortality and varying extents of habitat alteration, BOEM expects the long-term impact on invertebrates from construction and installation of the Proposed Action to be minor, as the

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
		of habitat alteration, BOEM expects the long-term impact on invertebrates from construction and installation of the Proposed Action to be minor, as the resources would likely recover naturally over time. The combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would contribute a noticeable increment to the **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH and may have a **minor beneficial** impact on invertebrates through an "artificial reef effect."	resources would likely recover naturally over time. Alternatives D-1 and D-2 differ from the Proposed Action only in relation to the onshore routing of the interconnection cable and therefore impacts on finfish, invertebrates, and EFH would be the same as for the Proposed Action, with an overall Finfish, invertebrate and EFH impact of **moderate** adverse. The presence of structures may have a **minor beneficial** impact on invertebrates through an "artificial reef effect." Despite invertebrate mortality and varying extents of habitat alteration, BOEM expects the long-term impact on invertebrates from construction and installation of the Proposed Action to be minor, as the resources would likely recover naturally over time. The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **negligible** to **moderate** adverse and **minor beneficial**.
3.14 Land Use and Coastal Infrastructure	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse impacts and **minor beneficial** impacts on land use and coastal infrastructure**.** *Cumulative Impacts of the No Action Alternative:* The No Action	The Proposed Action would result in **negligible** to **minor** adverse impacts and **minor beneficial** impacts on land use and coastal infrastructure. Beneficial impacts would result from port utilization. Adverse impacts would primarily result from land disturbance during onshore installation of the cable route and	Alternatives B and C would reduce the number of WTGs, resulting in slightly decreased visual impacts of WTGs on coastal communities compared to the Proposed Action, but would not change the impact levels. Alternatives B and C therefore would have the same levels of impacts on land use and coastal infrastructure as the those of Proposed

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts and **minor beneficial** impacts.	substation, accidental spills, and construction noise and traffic. The Proposed Action would have **minor** adverse impacts and **minor beneficial** impacts from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Action—**negligible** to **minor** adverse impacts and **minor beneficial** impacts. Alternatives D-1 and D-2 would have similar impacts on land use and coastal infrastructure as those of Proposed Action: **negligible** to **minor** adverse impacts and **minor beneficial** impacts. Alternatives D-1 and D-2 impacts, when combined with ongoing and planned activities would be the same as the Proposed Action: long-term **minor** adverse impacts and **minor beneficial** impacts. The impacts of Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**.
3.15 Marine Mammals	*No Action Alternative (without Baseline)*[2]*:* Not approving the COP would have no additional incremental effect on marine mammals (i.e., no effect). *No Action Alternative (with Baseline)*[3]: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on mysticetes (other than NARW), odontocetes, and pinnipeds, as impacts would be detectable and measurable, but populations would be expected to recover sufficiently. The presence	*Proposed Action (without Baseline):* The incremental impact of the Proposed Action when compared to the No Action Alternative would be **minor** adverse for NARWs. The incremental impact of the Proposed Action when compared to the No Action Alternative would be **moderate** adverse for other mysticetes, harbor porpoise, and pinnipeds; and **minor** for all other odontocetes. *Proposed Action (with Baseline):* BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **moderate** adverse for the mysticetes, (other than NARW), odontocetes, and pinnipeds and could	*Alternative (without Baseline):* Alternatives B and C would result in similar impacts on marine mammals as for the Proposed Action, with some impacts being minimally decreased in duration and geographic extent considering the reduction in the number of WTGs for Alternatives B and C. The incremental impacts resulting from the Alternatives B and C individually would be similar to those of the Proposed Action and would be **moderate** for mysticetes (other than NARW), harbor porpoise, and pinnipeds and would be **minor** for NARW and other odontocetes

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	of structures could potentially result in **minor beneficial** impacts for pinnipeds and delphinids. Adverse impacts on mysticetes, odontocetes, and pinnipeds would be primarily due to underwater noise, vessel activity (vessel collisions), commercial and recreational fishing gear interactions, and ongoing climate change. For the NARW, continuation of existing environmental trends and activities under the No Action Alternative would result in **major**[4] adverse impacts due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. *Cumulative Impacts of the No Action Alternative:*[5] The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** adverse impacts on mysticetes, odontocetes, and pinnipeds, except for the NARW, on which impacts range from **negligible** to **major** adverse due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. Adverse impacts would be primarily due to underwater	include **minor beneficial** impacts for odontocetes and pinnipeds. Impacts on NARW would range from **negligible** to **major** adverse. Adverse impacts, which would be detectable and measurable, are expected to result mainly from pile-driving noise, increased vessel traffic, and fishing gear entanglement. Populations are expected to recover fully from these individual IPFs. Beneficial impacts are expected to result from the presence of structures as related to the artificial reef effect. *Proposed Action (with Baseline) Plus Other Foreseeable Impacts:* The incremental impacts contributed by the Proposed Action to the overall impact on marine mammals considering other ongoing and planned activities (including offshore wind activities) would range from undetectable to measurable and appreciable. The impact on mysticetes (other than NARW), odontocetes, and pinnipeds from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would range from **negligible** to **major** adverse for NARW, and **negligible** to **moderate** adverse for all other mysticetes (except NARW), odontocetes, and pinnipeds, depending on the IPF. The main drivers for these adverse impact levels are underwater noise, vessel activity (vessel strikes) and entanglement risk. There may potentially be **minor beneficial** impacts for delphinids and pinnipeds.	and could include **minor beneficial** impacts on odontocetes and pinnipeds. Alternatives D-1 and D-2 would have the same offshore components as for the Proposed Action; impacts of Alternatives D-1 and D-2 would therefore be the same as for the Proposed Action. *Proposed Action (with Baseline):* Alternatives B and C when considering the environmental trends and activities would result in impacts ranging from **negligible** to **moderate** adverse for mysticetes (other than NARW), odontocetes, and pinnipeds and would be **negligible** to **major** adverse for NARW and could include **minor beneficial** impacts on delphinids and pinnipeds. Alternatives D-1 and D-2 would have the same offshore components as for the Proposed Action; impacts of Alternatives D-1 and D-2 would therefore be the same as for the Proposed Action. *Alternative (with Baseline) Plus Other Foreseeable Impacts:* The impacts of Alternatives B, C, D-1, and D-2 when each combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the similar to or the same as for the Proposed Action and would range from **negligible** to **major** adverse on NARW and **negligible** to **moderate** adverse for mysticetes (other than NARW), delphinids and pinnipeds and could include **minor beneficial** impacts for delphinids and pinnipeds.

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	noise, vessel activity (vessel collisions), fishing entanglement, and climate change.		
3.16 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 offshore wind activities) would result in **minor** to **moderate** adverse impacts primarily due to the presence of structures and increased vessel traffic, leading to congestion at affected ports, an increased likelihood of collisions and allisions, and increased risk of accidental releases.	The Proposed Action would result in **minor** to **moderate** adverse impacts on navigation and vessel traffic. Adverse impacts would include changes in navigation routes due to the presence of structures and cable emplacement, delays in ports, degraded communication and radar signals, and increased difficulty of offshore search and rescue or surveillance missions within the Wind Turbine Area. Some commercial fishing, recreational, and other vessels would choose to avoid the Wind Turbine Area, leading to potential congestion of vessels along the Wind Turbine Area borders. 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. The Proposed Action would have **minor** to **major** adverse impacts on navigation and vessel traffic from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	Alternatives B and C may slightly reduce impacts on navigation and vessel traffic due to the reduction in WTG positions and alignment of OSSs within the rows of the WTGs, but would not change the impact levels. Alternatives B and C therefore would have the same levels of impacts on navigation and vessel traffic as that of the Proposed Action, **minor** to **moderate** adverse impacts. Alternatives D-1 and D-2 would have the same impact as those under the Proposed Action and range from **minor** to **moderate** adverse**.** The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **minor** to **major** adverse impacts.
3.17 Other Uses	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** adverse impacts for marine mineral extraction, marine and national security uses, aviation	The Proposed Action would result in **negligible** adverse impacts for aviation and air traffic and cables and pipelines; **minor** adverse impacts for marine mineral extraction, radar systems; **moderate** adverse impacts for military and national security uses; and **major**	Impacts of Alternatives B and C 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, with the overall impact ratings of **negligible** to **major**

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	and air traffic, cables and pipelines, and radar systems and **major** adverse impacts on 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** adverse impacts for aviation and air traffic, cables and pipelines, and radar systems; **minor** adverse impacts for marine mineral extraction and national security and military uses; and **major** adverse impacts for scientific research and surveys.	adverse impacts for NOAA's scientific research and surveys. The installation of WTGs in the Project area would result in increased navigational complexity and increased allision risk for vessel traffic and low-flying aircraft and would result in line-of-sight interference for radar systems. Additionally, 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 affect survey gear performance, efficiency, and availability for NOAA surveys supporting commercial fisheries and protected-species research programs. The Proposed Action would contribute to the impacts of ongoing and planned a noticeable increment to the **negligible** to **minor** adverse impacts for aviation and air traffic, cables and pipelines, marine mineral extraction and radar systems; **moderate** adverse impacts for military and national security uses; and **major** adverse impacts for NOAA's scientific research and surveys.	adverse. Alternatives B and C may slightly reduce impacts on other uses due to the reduction in WTG positions and alignment of OSSs within the rows of the WTGs, but would not change the impact levels. Alternatives B and C could potentially decrease impacts on radar systems by removing the WTGs closest to the shore, which would possibly reduce line-of-sight impacts. Alternatives D-1 and D-2 would have the same offshore components as for the Proposed Action and therefore offshore impacts of Alternatives D-1 and D-2 would be the same as for the Proposed Action. Impacts of Alternatives D-1 and D-2 would be the same as or similar to those of the Proposed Action for cables and pipelines, marine mineral extraction, military and national security uses, radar, and aviation and air traffic, with the overall impact ratings of **negligible** to **major** adverse. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same impact levels as for the Proposed Action: **negligible** to **minor** adverse impacts for aviation and air traffic, cables and pipelines, marine mineral extraction and radar systems; **moderate** adverse impacts for military and national security uses; and **major** adverse impacts for NOAA's scientific research and surveys.

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
3.18 Recreation and Tourism	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse 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 and **minor beneficial** impacts on recreation and tourism.	The Proposed Action would result in **negligible** to **minor** adverse and **negligible** to **minor beneficial** impacts on recreation and tourism. Impacts would result from short-term impacts during construction: noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs; and the long-term presence of scour protection and structures in the Wind Turbine Area during operations, with resulting impacts on recreational vessel navigation and visual quality. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures. The Proposed Action in combination with other ongoing activities (including offshore wind activities) would contribute an undetectable to noticeable increment to the **negligible** to **minor** adverse, and **negligible** to **minor beneficial** impacts on recreation and tourism.	Impacts of Alternatives B and C would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. Construction of Alternatives B and C would install fewer WTGs and associated inter-array cables, which would slightly reduce the construction footprint and installation period. The impact levels are anticipated to remain the same as for the Proposed Action: **negligible** to **minor** adverse and **negligible** to **minor beneficial**. Alternatives D-1 and D-2 would differ from the Proposed Action only with respect to the onshore interconnection cable routes, and Alternatives D-1 and D-2 would not result in a discernable difference in impacts on recreation and tourism compared to the Proposed Action. Alternatives D-1 and D-2 would result in the same **negligible** to **minor** adverse and **negligible** to **minor beneficial** impacts. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **negligible** to **minor** adverse and **negligible** to **minor beneficial**.
3.19 Sea Turtles	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action	The Proposed Action would result in overall **negligible** to **minor** adverse impacts on sea turtles, as well as **minor beneficial** impacts throughout the life of	Alternatives B and C would have similar impacts on sea turtles as described for the Proposed Action and would be **negligible** to **minor** adverse**.** Alternatives

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	Alternative would result in **minor** adverse 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 **minor** adverse and **minor** beneficial impacts on sea turtles. Potential impacts on sea turtles from multiple construction activities within the same calendar year could affect migration, feeding, breeding, and individual fitness. The foundations from WTG and OSS may provide foraging and sheltering opportunities.	the projects due to 'reef effect' associated with the presence of the structures. The combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would have an overall **negligible** to **minor** adverse impact on sea turtles. The main drivers are pile-driving noise, the presence of structures, ongoing climate change, and ongoing vessel traffic posing a risk of collision. There would also be **minor beneficial** impacts throughout the life of the projects due to 'reef effect' associated with the presence of the structures.	B and C would install fewer WTGs and associated inter-array cables, which would slightly reduce the construction footprint and installation period but would not change the impact levels. Alternatives D-1 and D-2 would differ from the Proposed Action only with respect to the onshore interconnection cable routes, and therefore Alternatives D-1 and D-2 would have the same impact on sea turtles as the Proposed Action: **negligible** to **minor** adverse. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **negligible** to **minor** adverse. There would also be **minor beneficial** impacts throughout the life of the projects due to 'reef effect' associated with the presence of the structures.
3.20 Scenic and Visual Resources	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on scenic and visual resources. *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** to **major** adverse impacts on visual and scenic resources due to addition of new	Impacts of the Proposed Action on scenic and visual resources would range from **minor** to **moderate** adverse**.** The main drivers for this impact rating are the adverse impacts associated with the presence of structures, lighting, and vessel traffic. The Proposed Action would contribute substantially to the **moderate** adverse impact on scenic and visual resources from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	Alternatives B and C would reduce the number of WTGs visible from the seascape and landscape compared to the Proposed Action. However, because of the eliminated WTGs offshore distance and location, these alternatives impacts on scenic and visual resources and would not change the overall impact level of **minor** to **major** adverse. The impacts of Alternatives B and C on scenic and visual resources would be similar to the impacts of the Proposed Action: **minor** to **moderate** adverse.

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	structures, nighttime lighting, onshore construction, and increased vessel traffic.		Onshore, Alternatives D-1 and D-2 would limit the interconnection cable route to either Interconnection Cable Route Option 6 (Alternative D-1) or Interconnection Cable Route Option 1 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. Although the Chicory Switching Station would be visible to some residences, Interconnection Cable Route Option 6 (Alternative D-1) would reduce the overall visual impacts on suburban residential character compared to the other routes from major to moderate. The overall impact level of Alternatives D-1 and D-2 would be the same as the Proposed Action: **moderate** adverse. The impacts associated with Alternatives B, C, D-1, and D-2 when each is combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse.
3.21 Water Quality	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse 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	The Proposed Action would result in **negligible** to **minor** adverse impacts on water quality primarily due to sediment resuspension and potential accidental releases. The impacts are likely to be temporary or small in proportion to the geographic analysis area and the resource would recover completely after decommissioning. A larger offshore spill, although unlikely to occur based on	Alternatives B and C may result in slightly less, but not materially different impacts on water quality due to relocated or a reduced number of WTGs that would be constructed, operated, and maintained. Alternatives B and C would install fewer WTGs and associated inter-array cables, which would slightly reduce the construction footprint and installation

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
	in **minor** adverse impacts because any potential detectable impacts are not anticipated to exceed water quality standards.	BOEM modeling, could have **minor** to **moderate** adverse impacts on water quality. The Proposed Action when combined with the impacts from ongoing and planned activities (including offshore wind activities) would be **minor** adverse, primarily due to short-term, localized effects from increased turbidity and sedimentation. (BOEM has considered the possibility of a **moderate** adverse impact resulting from potential accidental releases; this level of impact could occur if there was a large-volume release. While it is an impact on water quality that should be considered, it is unlikely to occur based on BOEM's accidental release modeling.)	period, but would not change the impact levels: **negligible** to **moderate** adverse. Alternatives D-1 and D-2 would differ from the Proposed Action only with respect to the onshore interconnection cable routes, and therefore offshore impacts on water quality for Alternatives D-1 and D-2 would be the same as for the Proposed Action: **negligible** to **moderate** adverse. Alternatives D-1 and D-2 could have slightly less potential for onshore water quality impacts compared to the Proposed Action, but water quality regulatory requirements and Dominion Energy's proposed mitigation measures would be the same as for the Proposed Action. Therefore, onshore water quality impacts under Alternatives B, C, D-1, and D-2 would be the same as those of the Proposed Action: **minor** adverse. Similar to the Proposed Action, a large-volume spill offshore, although unlikely to occur based on BOEM modeling, could have **minor** to **moderate** adverse impacts on water quality under any of the alternatives. The impacts of Alternatives B, C, D-1, and D-2 when each combined with impacts from ongoing and planned activities (including offshore wind activities) would be the same as those of the Proposed Action: **minor** adverse. (BOEM has considered the possibility of a **moderate** adverse impact resulting from accidental releases offshore from

Resource	No Action Alternative	Proposed Action	Differences Among Action Alternatives
			offshore wind development; however, it is unlikely to occur based on BOEM modeling.)
3.22 Wetlands	*No Action Alternative*: Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on wetlands. *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 wetlands, primarily through land disturbance.	The Proposed Action may result in impacts on wetlands through short-term or permanent disturbance 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 have **moderate** to **major** adverse impacts on wetlands. The Proposed Action would have **moderate** to **major** adverse impacts on wetlands from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	Because Alternatives B and C involve modifications only to offshore components, and offshore components would not contribute to impacts on wetlands, impacts on wetlands from those alternatives would be the same as those under the Proposed Action: **moderate** to **major** adverse. Onshore, Alternatives D-1 and D-2 would limit the interconnection cable route to either Interconnection Cable Route Option 6 (Alternative D-1) or Interconnection Cable Route Option 1 (Alternative D-2) to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores. These interconnection cable route options are analyzed as part of the Proposed Action and so impacts on wetlands from Alternatives D-1 and D-2 would be the same as for the Proposed Action. The impacts from Alternatives B, C, D-1, and D-2 when each combined with impacts from ongoing and planned activities (including offshore wind activities) would be the same as those of the Proposed Action: **moderate** to **major** adverse.

[1] BOEM has identified Alternative B in combination with Alternative D-1 as the preferred alternative. The preferred alternative is identified to let the public know which alternative BOEM, as the lead agency, is leaning toward before an alternative is selected for action when a ROD is issued. No final agency action is being taken by the identification of the preferred alternative in the Final EIS, and BOEM is not obligated to select the preferred alternative. The preferred alternative is depicted on Figure 2-4 and Figure 2-6.

[2] BOEM assessed the impacts of the No Action Alternative and action alternatives without the environmental baseline to support determinations under the Marine Mammal Protection Act.
[3] BOEM provides the range of impacts for the individual IPFs evaluated by species groups for the assessment of impacts of the No Action Alternative and action alternatives with the baseline. Individual IPFs were not evaluated for the No Action Alternative, and so impact conclusions are presented as a single determination by species group.
[4] Major impacts are identified here rather than a range because individual IPFs were not evaluated for the No Action Alternative. Based on the status and current population of the North Atlantic right whale, the loss of a single North Atlantic right whale would affect the population.
[5] BOEM provides the range of impacts for the individual IPFs evaluated by species groups for the assessment of the impacts of the No Action Alternative and action alternatives with the baseline in combination with ongoing and other foreseeable future activities. The individual rating includes all IPFs combined.

3. Affected Environment and Environmental Consequences

This chapter addresses the affected environment for each resource area and the potential environmental consequences to those resources from the alternatives described in Chapter 2, *Alternatives Including the Proposed Action*. In addition, it 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 F, *Planned Activities Scenario*. The planned activities considered in Appendix F include other ongoing and planned actions within the geographic analysis area for each resource that are occurring at the same time as the proposed Project or that could occur later in time but are still reasonably foreseeable.

Where information is incomplete or unavailable for the evaluation of reasonably foreseeable impacts analyzed in this chapter, BOEM identified that information and conducted its analysis in accordance with Section 1502.22 of the CEQ regulations. The findings of this assessment are presented in Appendix D, *Analysis of Incomplete or Unavailable Information*.

3.1. Impact-Producing Factors

BOEM has completed a study of IPFs on the North Atlantic OCS to consider in an offshore wind development planned activities scenario (BOEM 2019). The study, which is incorporated in this document by reference, accomplishes the following:

- Identifies cause-and-effect relationships between renewable energy projects and 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 to be considered in a cumulative impacts scenario.
- Identifies actions and activities that may affect the same physical, biological, economic, or cultural resources as renewable energy projects and states that such actions and activities may have the same IPFs as offshore wind projects.

The BOEM (2019) study identifies the relationships between IPFs associated with specific past, present, and reasonably foreseeable future actions in the North Atlantic OCS. As discussed in the BOEM (2019) study, reasonably foreseeable actions other than offshore wind projects may also affect the same resources as the proposed Project or other offshore wind projects, possibly via the same IPFs or via IPFs through which offshore wind projects do not contribute. BOEM determined the relevance of each IPF to each resource analyzed in this Final EIS. If an IPF was not associated with the proposed Project, it was not included in the analysis. Table 3.1-1 provides a brief description of the primary IPFs involved in this analysis, including examples of sources and activities that result in each IPF. The IPFs cover all phases of the Project, including construction, operations and maintenance, and decommissioning. Each IPF is assessed in relation to ongoing activities, planned activities, and the Proposed Action. Planned activities include planned non-offshore wind activities and future offshore wind activities.

Table 3.1-1 Primary Impact-Producing Factors Addressed in This Analysis

IPF	Sources and/or Activities	Description
Accidental releases	• Mobile sources (e.g., vessels) • Installation, operation, and maintenance of onshore or offshore stationary sources (e.g., renewable energy structures, transmission lines, cables)	Refers to unanticipated release or spills into receiving waters of a fluid or other substance (e.g., fuel, hazardous materials, suspended sediment, trash, or debris). Accidental releases are distinct from routine discharges, the latter typically consisting of authorized operational effluents controlled through treatment and monitoring systems and permit limitations.
Discharges	• Vessels • Structures • Onshore point and non-point sources • Dredged material ocean disposal • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure •	Generally, refers to routine permitted operational effluent discharges to receiving waters. There can be numerous types of vessel and structure discharges (e.g., bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, and seawater cooling system effluent). These discharges are generally restricted to uncontaminated or properly treated effluents that may have best management practice or numeric pollutant concentration limitations imposed through USEPA National Pollutant Discharge Elimination System (NPDES) permits or USCG regulations.
Air emissions	• Internal combustion engines (e.g., generators) aboard stationary sources or structures • Internal combustion engines in mobile sources (e.g., vessels, vehicles, or aircraft)	Refers to the release of gaseous or particulate pollutants 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)	Anchors, anchor chain sweep, mooring, and the installation of bottom-founded structures can alter the seafloor.

IPF	Sources and/or Activities	Description
Electromagnetic Fields (EMFs)	• Substations • Power transmission cables • Inter-array 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.
Land disturbance	• Onshore construction • Onshore land use changes • Erosion and sedimentation • Vegetation clearance • Wetland and waters of the United States impacts	Refers to land disturbances for any onshore construction activities.
Lighting	• Vessels or offshore structures above or under water • Onshore infrastructure	Refers to the presence of light above the water onshore and offshore, as well as underwater associated with offshore wind development and activities that use offshore vessels.
Cable emplacement and maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Mattress and rock placement	Refers to disturbances associated with installing new offshore submarine cables on the seafloor, commonly associated with offshore wind energy.
Noise	• Aircraft • Vessels • Turbines • Geophysical and geotechnical surveys • Operations and maintenance • Pile driving • Dredging and trenching	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.
Port utilization	• Expansion and construction • Maintenance • Use • Revitalization	Refers to effects associated with port activity, upgrades, or maintenance that occur only as a result of the Project. Includes activities related to port expansion and construction from increased economic activity and maintenance dredging or dredging to deepen channels for larger vessels.

IPF	Sources and/or Activities	Description
Presence of structures	• Onshore and offshore structures including towers and transmission cable infrastructure	Refers to effects associated with onshore or offshore structures other than construction-related effects, including the following: • Space-use conflicts • Fish aggregation/dispersion • Bird attraction/displacement • Marine mammal attraction/displacement • Sea turtle attraction/displacement • Scour protection • Allisions • Entanglement • Gear loss/damage • Fishing effort displacement • Habitat alteration (creation and destruction) • Migration disturbances • Navigation hazard • Seabed alterations • Turbine strikes (birds, bats) • Viewshed (physical, light) • Microclimate and circulation effects
Gear utilization	• Monitoring activities	Refers to entanglement and bycatch from gear utilization during fisheries and benthic monitoring surveys.
Traffic	• Aircraft • Vessels • Vehicles	Refers to marine and onshore vessel and vehicle congestion, including vessel strikes of sea turtles and marine mammals, collisions, and allisions.
Energy generation/security	• Wind energy production	Refers to the generation of electricity and its provision of reliable energy sources as compared to other energy sources (energy security). Associated with renewable energy development operations.
Climate change	• Emissions of greenhouse gases	Refers to the effects of climate change, such as warming and sea level rise, and increased storm severity or frequency. Ocean acidification refers to the effects associated with the decreasing pH of seawater from rising levels of atmospheric carbon dioxide.

Source: BOEM 2019.

In addition to adverse effects, beneficial effects could accrue from the development of the proposed Project and renewable energy sources on the OCS in general. The BOEM study *Evaluating Benefits of Offshore Wind Energy Projects in NEPA* (BOEM 2017) examines this in depth. Benefits from the development of offshore wind energy projects, in particular offshore wind projects, can accrue in three primary areas: system benefits, environmental benefits, and socioeconomic benefits, which are further examined throughout this chapter.

3.2. Mitigation Identified for Analysis in the Environmental Impact Statement

During the development of the Final EIS and in coordination with cooperating agencies, BOEM considered potential additional mitigation measures that could further avoid, minimize, or mitigate impacts on the physical, biological, socioeconomic, and cultural resources assessed in this document. These potential additional mitigation measures are described in Appendix H, *Mitigation and Monitoring*, Table H-1, and 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 completion of consultations and authorizations with respect to several environmental statutes such as the MMPA, Section 7 of the ESA, or the Magnuson-Stevens Fishery Conservation and Management Act. Mitigation imposed through consultations is included in this Final EIS. Those additional mitigation measures presented in Appendix H, Table H-2, may not all be within BOEM's statutory and regulatory authority to require; however, other jurisdictional governmental agencies may potentially require them. BOEM may choose to incorporate one or more additional measures in the ROD and adopt those measures as conditions of COP approval. All Applicant-Proposed Measures (APM) listed in Appendix H, Table H-1, are part of the Proposed Action (see Section 2.1, *Alternatives Analyzed in Detail*).

3.3. Definition of Impact Levels

This Final EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. Resource-specific adverse and beneficial impact level definitions are presented in each resource section. When considering duration of impacts this Final EIS uses the following terms.

- **Short-term effects.** Effects that may extend up to 3 years. Construction and conceptual decommissioning activities are anticipated to occur for 2 to 3 years. An example would be clearing of onshore shrubland vegetation during construction; the area would be revegetated when construction is complete, and, after revegetation is successful, this effect would end. Short-term effects may be further defined as being temporary if the effects end as soon as the activity ceases. An example would be road closures or traffic delays during onshore cable installation. Once construction is complete, the effect would end.
- **Long-term effects**. Effects that may extend for more than 3 years and may extend for the life of the Project (37 years). An example would be the loss of habitat where a foundation has been installed.
- **Permanent effects**. Effects that extend beyond the life of the Project. An example would be the conversion of land to support new onshore facilities or the placement of scour protection that is not removed as part of decommissioning.

The following terms are used to describe the incremental impact of the action alternative in relation to the combined impacts from all ongoing and planned activities, including both non-offshore wind and offshore wind activities.

- **Undetectable**. The incremental impact contributed by the action alternative to impacts from all ongoing and planned activities is so small that it is impossible or extremely difficult to discern.
- **Noticeable**. The incremental impact contributed by the action alternative, while evident and

observable, is still relatively small in proportion to the impacts from all ongoing and planned activities.

- **Appreciable**. The incremental impact contributed by the action alternative constitutes a large portion of the impacts from all ongoing and planned activities.

3.4. Air Quality

This section discusses potential impacts on air quality from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for air quality. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.4-1, includes the airshed within 25 miles (40 kilometers) of the Wind Farm Area (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 U.S. Environmental Protection Agency (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 be 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 Description of the Affected Environment for Air Quality

The overall geographic analysis area for air quality covers the Virginia Beach, Virginia, region and the adjacent portions of the Atlantic Ocean, which includes the air above the Wind Farm Area and adjacent OCS area, the offshore and onshore export cable routes, the onshore substations, the construction staging areas, the onshore construction and proposed Project-related sites, and the ports used to support proposed Project activities. In addition, some vessel trips could occur in the Corpus Christi–Victoria, Texas, region. COP, Section 4.1.3 (Dominion Energy 2023a), provides further description of the geographic analysis area.[1] Appendix I, *Environmental and Physical Settings*, 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 USEPA pursuant to the CAA (42 U.S.C. 7409) for several common pollutants, known as criteria pollutants, to protect human health and welfare. The criteria pollutants are carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone, particulate matter smaller than 10 microns in diameter (PM_{10}), particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). Virginia has established ambient air quality standards (AAQS) that are similar to the NAAQS. COP, Table 4.1-12 (Dominion Energy 2023a) shows the NAAQS. 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 EIS. Ozone is not emitted directly but is formed in the atmosphere from precursor chemicals, primarily nitrogen oxides (NO_X) and VOCs, in the presence of sunlight. Potential impacts of a project on ozone levels are evaluated in terms of NO_X and VOC emissions.

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 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 point 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 each nonattainment and maintenance area, which describes the region's program to attain and

[1] The COP and its appendices are available at https://www.boem.gov/renewable-energy/state-activities/CVOW-C.

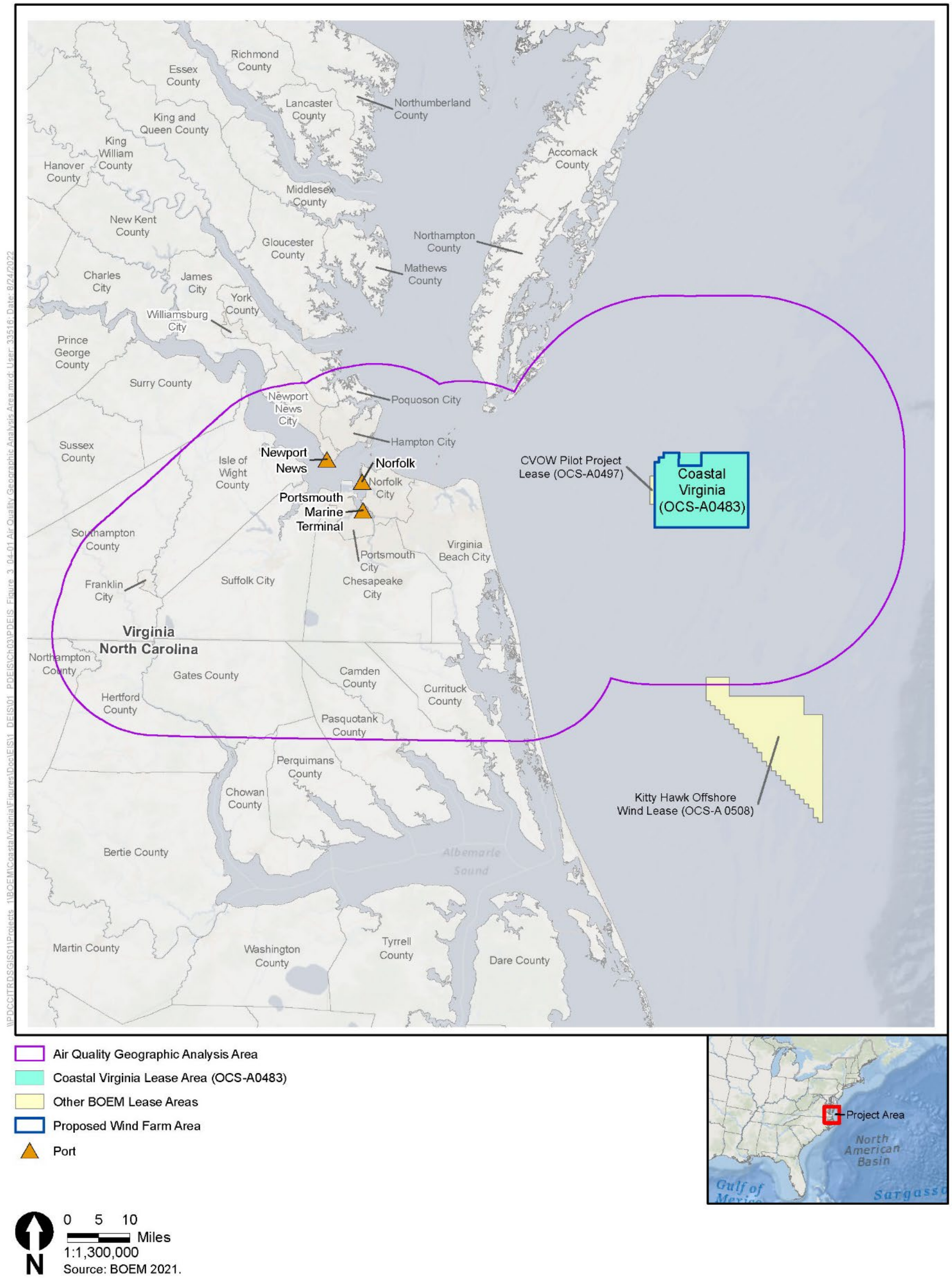
maintain compliance with the NAAQS. The attainment status of an area can be found at 40 CFR 81 and in the USEPA Green Book, which the agency revises from time to time (USEPA 2021a). Attainment status is determined through evaluation of air quality data from a network of monitors.

The nearest onshore areas to the Wind Farm Area are the City of Virginia Beach, Virginia, and the other cities and counties that comprise the Virginia Beach-Norfolk-Newport News metropolitan area. These cities and counties are designated maintenance for ozone. These maintenance areas include facilities that the Project could use in the Hampton Roads area, such as the Portsmouth Marine Terminal. More distant ports that may be used include Corpus Christi, Texas, which is in an area designated attainment for all pollutants. Figure 3.4-1 displays the maintenance areas that intersect the geographic analysis area.

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 and wilderness areas larger than 5,000 acres that were in existence before August 1977. Projects subject to federal permits are required to notify the federal land manager responsible for designated Class I areas within 62 miles (100 kilometers) of the Project. The federal land manager identifies appropriate air quality–related values for the Class I area and evaluates the impact of the Project on air quality–related values. The nearest Class I area to the Project is the Swanquarter Wilderness Area in North Carolina, located about 87 miles (140 kilometers) south of the Project.

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



Note: Corpus Christi, Texas, area is not shown.

Figure 3.4-1 Air Quality of the Geographic Analysis Area

GHGs are gases that trap heat in the atmosphere and contribute to global climate change by retaining heat in the atmosphere. 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]

3.4.2 Environmental Consequences

3.4.2.1 Impact Level Definitions for Air Quality

Definitions of impact levels are provided in Table 3.4-1. 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 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 exceedance 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 could lead to exceedance of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be larger than for minor to moderate impacts.

3.4.3 Impacts of the No Action Alternative 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 activities and ongoing offshore wind activities, on baseline conditions for air 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 F.

3.4.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for air quality described in Section 3.4.1, *Description of the Affected Environment for Air Quality*, 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 onshore impacts, including onshore construction. Onshore

[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.

construction activities and associated impacts are expected to continue at current trends and have the potential to affect air quality through temporary and permanent air emissions. The only ongoing offshore wind activity within the geographic analysis area is the existing CVOW-Pilot Project, which is currently in operation and consists of two 12 MW turbines and approximately 24 miles (44.5 kilometers) of offshore export cable. Operation and maintenance activities for the CVOW-Pilot Project produce emissions but have negligible air quality impacts because only two turbines must be serviced.

In 2019, Virginia Governor Ralph Northam by Executive Order 43 established Virginia's objectives for statewide energy production.

- By 2028, Virginia will achieve 5,500 MW of wind and solar energy. At least 3,000 MW of this target should be under development by 2022.
- By 2030, 30 percent of Virginia's electric system will be powered by renewable energy resources.
- By 2050, 100 percent of Virginia's electricity will be produced from carbon-free sources, such as wind, solar, and nuclear.

The Virginia Clean Economy Act of 2020 was passed to implement Executive Order 43. The law requires new measures to promote energy efficiency, sets a schedule for closing old fossil-fuel power plants, and requires electricity to come from 100 percent renewable sources such as solar or wind. Energy companies must pay penalties for not meeting their targets, and part of that revenue would fund job training and renewable energy programs in historically disadvantaged communities.

Under the Virginia Clean Economy Act, as the Executive Order 43 targets are met over time, emissions from fossil-fueled power plants are expected to decline. Demand for electricity will increasingly be met through renewable energy sources, including offshore wind. By displacing emissions from fossil-fueled power-generating facilities, these wind projects are expected to lead to reductions in emissions. Remaining fossil-fueled power plants would continue to contribute emissions. Other ongoing and planned 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 (see Appendix F, Sections F.2.5 through F.2.9, F.2.12, and F.2.13 for further description of ongoing and planned activities).

3.4.3.2 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). Appendix F provides further information on these activities.

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

Air emissions: Most air pollutant emissions and air quality impacts from future offshore wind projects would occur during construction, potentially from multiple projects occurring simultaneously. The only projects currently proposed for which construction could occur simultaneously with the Project is Kitty Hawk Wind North and Kitty Hawk Wind South. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. Potential areas of overlap could include port and vessel activity in the Newport News/Norfolk/Hampton Roads region. As a result, air quality impacts would shift spatially and temporally across the 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[3] emissions from construction-generated dust.

During operations, emissions from future offshore wind projects within the 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 N (Dominion Energy 2023a) provides details of these emissions sources for construction and operations, as well as regulatory applicability of emissions by geographic area for purposes of NEPA and permitting.

The aggregate operational emissions for all projects within the geographic analysis area would vary by year as successive projects begin operation. As wind energy projects come online, power generation emissions overall would decrease, and the region as a whole would realize a net benefit to air quality. The future offshore wind projects other than the Proposed Action that may result in air pollutant emissions and air quality impacts within the geographic analysis area include projects within all or portions of Lease Area OCS-A 0508 (Appendix F, Table F-3). Projects currently proposed in this lease area include Kitty Hawk Wind North and Kitty Hawk Wind South, which together would have a maximum capacity of 2,484 Mw from the installation of 190 WTGs (Table F2-1). Based on the assumed offshore construction schedule in Table F-3, construction of the Proposed Action would occur in 2023–2027, construction of Kitty Hawk Wind North would occur in 2024–2026, and construction of Kitty Hawk Wind South would occur in 2026–2029. Consequently, construction of either or both Kitty Hawk Wind projects would overlap with construction of the Proposed Action in 2024-2027.

During the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than the Proposed Action within the geographic analysis area (i.e., Kitty Hawk Wind North and Kitty Hawk Wind South), summed over all construction years, are estimated to be 4,263 tons of CO, 15,586 tons of NO_X, 538 tons of PM_{10}, 521 tons of $PM_{2.5}$, 264 tons of SO_2, 670 tons of VOCs, and 963,302 tons of carbon dioxide equivalent (CO_2e) (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F2-4). 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.

During operations, emissions from future offshore wind projects within the 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. Estimated operational emissions from Kitty Hawk Wind North and Kitty Hawk Wind South would be 343 tons per year of CO, 869 tons per year of NO_X, 39 tons per year of PM_{10}, 36 tons per year of $PM_{2.5}$, 12 tons per year of SO_2, 43 tons per year of VOCs, and 64,216 tons per year of carbon dioxide equivalent (CO_2e) (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F2-4). Operational emissions would overall be intermittent and dispersed throughout the 112,799-acre Lease Area 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 would help offset emissions from fossil fuels, improving regional air quality and reducing GHG emissions. 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 0.3–0.8 degrees Celsius (0.5–1.4 degrees Fahrenheit) 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

[3] 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.

pollutant emission contributions of the existing and projected mixes of 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; Buonocore et al. 2016). The displacement of fossil fuels by wind energy is highly influenced by how individual power plants respond to the introduction of wind energy. For example, the process of changing the plant's output may temporarily increase the plant's emissions (Katzenstein and Apt 2009).[4]

Climate change: Construction and operation of other (not the proposed Project) 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 source location. Increasing energy production from offshore wind projects would likely reduce regional GHG emissions by displacing energy from fossil fuels.[5] This reduction would more than offset the relatively small GHG emissions from offshore wind projects (Appendix F). U.S. offshore wind projects would by themselves probably have a limited impact on global emissions and climate change, but they may be substantial and beneficial as a component of many actions addressing climate change, and integral for fulfilling state plans regarding climate change.

Accidental releases: Future offshore wind activities could release air toxics or hazardous air pollutants (HAPs) because of accidental chemical spills within the geographic analysis area. Section 3.21, *Water Quality*, includes a discussion of the nature of releases that would be anticipated. Up to about 80,448 gallons (304,529 liters) of coolants, 986,204 gallons (3.7 million liters) of oils and lubricants, and 157,713 gallons (597,009 liters) of diesel fuel would be contained in the wind turbine and substation structures for Kitty Hawk Wind North and Kitty Hawk Wind South (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F2-3).

If accidental releases occur, they would be most likely during construction but could occur during operations and decommissioning of offshore wind facilities. These may lead to short-term 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 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). BOEM expects air quality impacts from accidental releases would be short term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 33-year period with a higher probability of spills during future project construction, but they would not be expected to contribute appreciably to overall impacts on air quality.

[4] Katzenstein and Apt (2009) modeled a system of two types of natural gas generators, four wind farms, and one solar farm. The power output of wind and solar facilities can vary relatively rapidly as meteorological conditions change, and the natural gas generators vary their power output accordingly to meet electrical demand. When gas generators change their power output their emissions rates may increase above their steady-state levels. As a result, the net emissions reductions realized from gas generators reducing their output in response to wind and solar power can be less than the reduction that would be expected based solely on the amount of wind and solar power. The study found that reductions in CO_2 emissions would be about 80 percent, and in NO_X emissions about 30 to 50 percent, of the emissions reductions expected if the power fluctuations caused no additional emissions.

[5] In 2020, the generation mix of the Pennsylvania-New Jersey-Maryland (PJM) Interconnection, the regional grid to which the Project would connect, 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).

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

3.4.3.3 Conclusions

Impacts of the No Action Alternative. 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. Additional, higher-emitting, fossil-fuel energy facilities would be built, or would be kept in service, to meet future power demand, fired by natural gas, oil, or coal (Dominion Energy 2020). To the extent that state goals and regulations for expansion of renewable energy capacity are met, and the added renewable energy capacity is sufficient to meet demand, such additional fossil-fuel energy facilities might not be built or kept in service. Impacts of building or retaining fossil-fuel energy facilities would be mitigated partially by other future offshore wind projects including offshore New England, New York, New Jersey, Delaware, and Maryland.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change. Climate predictions for the Southeast indicate increased temperatures, which can increase ozone levels, and warmer and drier autumns that are expected to result in lengthening of the period of seasonal ozone exposure (U.S. Global Change Research Program 2018).

BOEM anticipates that the impacts of ongoing activities, such as air pollutant emissions and GHGs, would be **moderate**, because ambient pollutant concentrations would be expected to increase but not to levels that could exceed the NAAQS or Virginia AAQS.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and air quality would continue to be affected by the primary IPFs. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on air quality. Furthermore, potential activities other than offshore wind include increasing air pollutant and GHG emissions through construction and operation of new energy generation facilities to meet future power demands. Continuation of current regional trends in energy development could include new power plants that could contribute to air quality and GHG impacts in Virginia and the neighboring states. BOEM anticipates that the impacts of planned activities other than offshore wind would be **moderate**. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **moderate** impacts on air quality, primarily driven by recent market and permitting trends indicating future fossil-fueled electric generating units would most likely include natural-gas–fired facilities.

Considering all of the IPFs collectively, BOEM anticipates that the overall air quality and climate impacts associated with future offshore wind activities in the geographic analysis area combined with ongoing activities, reasonably foreseeable environmental trends, and planned activities other than offshore wind would result in **moderate** adverse impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Pollutant emissions during operations would be generally lower and more transient. Construction and operations would contribute most to emissions of CO_2. Most air pollutant emissions and air quality impacts would occur during multiple overlapping project construction phases from 2024 through 2025 (Appendix F, Table F-3). Overall, adverse air quality impacts from future offshore wind projects are expected to be relatively small and transient. Future offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequent **moderate beneficial** impacts on air quality.

3.4.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *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 Wind Farm Area and offshore export cable routes;
- Soil characteristics at excavation areas, which may affect fugitive emissions; and
- Emission control strategy for fugitive emissions due to 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 (202) allowed in the PDE.

3.4.5 Impacts of the Proposed Action on Air Quality

The Proposed Action may generate emissions and affect air quality in the Virginia Beach region and nearby coastal waters during construction, O&M, and decommissioning activities. Onshore emissions would occur in the onshore export cable corridors and at points of interconnection. 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, Section 3 (Dominion Energy 2023a) provides additional information on land use and proposed ports.

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 Action, be it offshore in the Wind Farm Area or at any of the onshore construction or support sites. Ozone levels in the region also could be affected.

The Proposed Action's WTGs and offshore and onshore cable corridors would not themselves generate air pollutant emissions during normal operations. However, the substations and switching station would have diesel-fueled emergency generators that would produce exhaust emissions during testing and switchgear containing SF_6, which could leak. Air pollutant emissions from equipment used in the construction, O&M, and decommissioning phases could affect air quality in the Project area and nearby coastal waters and shore areas. Most emissions would occur temporarily during construction, offshore in the Wind Farm Area, onshore at the landfall sites, along the offshore export cable routes and onshore interconnection cable route, at the onshore substations, and at the construction staging areas. Additional emissions related to the proposed Project could also occur at nearby ports used to transport material and personnel to and from the Project site. However, the Proposed Action 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.

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. Fugitive dust emissions would occur as a result of excavation and hauling of soil during onshore construction activities. Emissions from the OCS source, as defined in the CAA, would be permitted as part of the OCS permit for which Dominion Energy has begun the application process.

Air emissions – construction: Fuel combustion and solvent use associated with the Proposed Action would cause construction-related 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. Construction equipment would comply with all applicable emissions and fuel-efficiency standards to minimize combustion emissions and associated air quality impacts. The total estimated construction emissions of each pollutant are summarized in Table 3.4-2. COP, Appendix N (Dominion Energy 2023a) provides details of the emission sources for construction.

Table 3.4-2 Coastal Virginia Offshore Wind Total Construction Emissions

Year	U.S. tons							Metric tons			
	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	HAP	CO_2	CH_4	N_2O	CO_2e
2023	7	31	1	1	0.1	2	0.4	10,688	0.10	0.27	10,771
2024	915	1,520	64	62	33	85	9	135,381	9	5	137,022
2025	2,095	3,017	142	138	86	198	19	276,758	18	10	280,228
2026	1,438	1,727	93	90	74	141	13	179,794	10	7	182,196
2027	536	601	35	34	28	53	5	67,184	4	3	68,081
Total	**4,991**	**6,896**	**335**	**325**	**222**	**479**	**47**	**669,805**	40	25	**678,298**

Source: COP, Tables 4.1-16–4.1-20 and Appendix N, Table N-1 (Dominion Energy 2023a).
Sum of individual values may not equal total due to rounding.

The emissions estimates in this section do not include emissions from raw material extraction, materials processing, and manufacturing of components, i.e., full life-cycle analysis. However, recently published studies have analyzed the life-cycle impacts of offshore wind (Ferraz de Paula and Carmo 2022; Rueda-Bayona et al. 2022; Shoaib 2022). These studies concluded that the materials that have the greatest impact on life-cycle emissions generally are steel and concrete and that materials recycling rates have a large influence on life-cycle emissions. The National Renewable Energy Laboratory harmonized approximately 3,000 life-cycle assessment studies with around 240 published life-cycle analyses of land-based and offshore wind technologies (NREL 2021). Although wind has higher upstream emissions than many other generation methods, its life-cycle GHG emissions are orders of magnitude lower than other generation methods. NREL (2021) estimated that the central 50 percent of GHG estimates reviewed were in the range of 9.4–14 grams of CO_2 equivalent per kilowatt-hour, while life-cycle GHG estimates for coal and natural gas are on the scale of 1,000 grams of CO_2 equivalent per kilowatt-hour (Dolan and Heath 2012) and 480 grams of CO_2 equivalent per kilowatt-hour (O'Donoughue et al. 2013), respectively.

3.4.5.1 Offshore Construction

Emissions from potential sources or construction activities associated with the Proposed Action 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 substation installation. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and 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 emergency generators at times, potentially resulting in increased emissions for limited periods. Dominion Energy's measures to avoid, minimize, and mitigate the potential impact-producing factors include compliance with applicable fuel-efficiency and emissions standards, compliance with fuel sulfur content standards, and compliance with a Fugitive Dust Control Plan (COP, Table 4.1-22; Dominion Energy 2023a).

The nearest Class I area, the Swanquarter Wilderness Area in North Carolina, is located about 87 miles (140 kilometers) south of the Project. This distance is greater than the 100-kilometer distance within which USEPA recommends that the federal land manager of the Class I area be notified about a project that requires a federal air quality permit. Winds blow from the Project area toward the Swanquarter Wilderness Area for only a small portion of the year (Appendix I, Figure I.2-1). Emissions from Project construction activities would not be concentrated at a single point but would occur throughout the analysis area. As a result, those Project emissions that occur when the wind is blowing from the Project area toward the Swanquarter Wilderness Area would be relatively well dispersed before being transported toward the Swanquarter Wilderness Area. For these reasons, adverse air quality impacts are not expected at the Swanquarter Wilderness Area due to the Proposed Action.

The largest air quality impacts are anticipated during construction, with smaller and more infrequent impacts anticipated during decommissioning. During the construction phase, the total emissions of criteria pollutants and ozone precursors from all offshore wind projects, including the Proposed Action, proposed within the geographic analysis area, summed over all 4 construction years, are estimated to be 5,241 tons of CO, 16,265 tons of NO_X, 551 tons of PM_{10}, 534 tons of $PM_{2.5}$, 227 tons of SO_2, 663 tons of VOCs, and 1,059,288 tons of CO_2 (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F2-4). 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 shift spatially and temporally across the geographic analysis area. The largest combined air quality impacts from offshore wind would occur during overlapping construction and decommissioning of multiple offshore wind projects. Construction of the proposed Project would overlap with construction of Kitty Hawk Wind North from 2024 to 2027, and with the first year (2026) of Kitty Hawk Wind North's operations (Appendix F, Table F-3). Most air quality impacts would remain offshore because the highest emissions would occur in the offshore region, and the northerly and southwesterly prevailing winds would result in most emission plumes remaining offshore. However, ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts on air quality from ongoing and planned activities would be minor 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 geographic analysis area would be limited in time.

3.4.5.2 Onshore Construction

Onshore activities of the Proposed Action would consist primarily of HDD, duct bank construction, cable-pulling operations, and switching station and substation construction. Onshore construction would include 14.3 miles (23.0 kilometers) of interconnection cable following Interconnection Cable Route Option 1.

Emissions 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. Dominion Energy's proposed mitigation measures include complying with applicable fuel-efficiency and emissions standards, complying with fuel sulfur content standards, and developing and implementing a Fugitive Dust Control Plan (COP, Table 4.1-22; Dominion Energy 2023a).

These emissions would be highly variable and limited in spatial extent at any given period and would result in minor impacts, as they would be temporary 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.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to 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.

3.4.5.3 Operation and Maintenance

Air emissions – O&M: During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. 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 have no pollutant emissions. Emergency generators on the substations would operate only during emergencies or testing, so emissions from these sources would be negligible and transient. Pollutant emissions from O&M would be mostly the result of operations of ocean vessels used for maintenance activities. Crew transfer vessels would transport crews to the Wind Farm Area for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would travel infrequently to the Wind Farm Area for significant maintenance and repairs. 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 geographic analysis area. COP, Section 3.5 (Dominion Energy 2023a) provides a more detailed description of offshore and onshore O&M activities, and COP, Table 4.1-21 summarizes emissions during O&M. The annual estimated emissions for O&M are summarized in Table 3.4-3. COP Appendix N (Dominion Energy 2023a) provides details of these emission sources for operations, as well as regulatory applicability of emissions by geographic area for purposes of NEPA and permitting.

Table 3.4-3 Coastal Virginia Offshore Wind Operations and Maintenance Emissions

Period	U.S. tons							Metric tons				
	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	HAP	CO_2	CH_4	N_2O	SF_6 [1]	CO_2e
Annual	419	396	18	18	8	24	2	35,418	3.0	1.2	0.23	41,074
Lifetime (33 years)	13,823	13,079	605	587	267	776	65	1,355,425	101	40	8	1,355,432

Source: COP, Table 4.1-21 and Appendix N Tables N-7, N-8, and N-12; Dominion Energy 2023a.
Values have been rounded.
[1] SF_6 emissions are calculated based on total storage of 100,821 pounds of SF_6 and a leakage rate of 0.5 percent per year.

BOEM anticipates that air quality impacts from O&M of the Proposed Action alone would be minor, occurring for short periods several times per year during the anticipated 33 years.

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. Dominion Energy intends to use port facilities in the Hampton Roads, Virginia, area 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.

Compliance with the NAAQS and Prevention of Significant Deterioration increments: Emissions from the OCS source, as defined in the CAA, would be permitted as part of the OCS permit for which CVOW is currently in the application process. The Project must demonstrate compliance with the NAAQS. The OCS air permitting process includes air dispersion modeling of emissions to demonstrate compliance with the NAAQS. The CAA also provides protection of air quality in Class I wilderness areas by means of the NAAQS and the Prevention of Significant Deterioration (PSD) program and gives federal land managers (FLMs) a responsibility to protect the air quality–related values of Class I areas from the adverse impacts of air pollution. If emissions from the Project would cause or contribute to adverse impacts on the air quality–related values of a Class I area, the permitting authority (i.e., USEPA) can deny the permit. As part of the air quality–related values analysis, the Project must demonstrate that significant visibility degradation would not occur.

NAAQS and PSD dispersion modeling: As part of the CVOW *Outer Continental Shelf Air Permit Application* (Application) (Dominion Energy 2023b), CVOW conducted dispersion modeling to demonstrate that the O&M phase of the Proposed Action will show modeled compliance with the NAAQS and with PSD increments (allowable increases in pollutant concentrations). The Application provides further detail on the modeling. Construction activities were not modeled because the PSD regulations at 40 CFR 52.21(i)(3) allow for an exemption from specific standard air quality analyses if the construction emissions satisfy two criteria: (1) they are temporary and (2) they do not impact a Class I area or an area where an applicable PSD Increment is known to be violated. With respect to the temporary designation, the USEPA typically considers construction emissions lasting for less than 2 years in a given location to be temporary for PSD permitting purposes but can approve longer durations as temporary on a case-by-case basis. Project construction activities associated with OCS sources are scheduled to last up to 2 years, 8 months, but could be less than 2 years barring unforeseen delays. Dominion Energy has requested that USEPA consider the Project's construction emissions as temporary for purposes of the 40 CFR 52.21(i)(3) exemption.

Dispersion modeling was conducted in accordance with USEPA's *Guideline on Air Quality Models*, which is contained in 40 CFR Part 51, Appendix W, *Guidance for Ozone and Fine Particulate Matter Permit Modeling.* USEPA's AERMOD-AERCOARE model was used to estimate criteria pollutant concentrations for comparison to the NAAQS and PSD increments. Meteorological data collected at NOAA Buoy Station #44014 (located 64 nautical miles east of Virginia Beach, Virginia, and 22 nautical miles to the southeast of the southeast corner of the Lease Area) were processed with AERCOARE to create overwater meteorological data files comprising 5 years of hourly observations for input to AERMOD. Emissions of secondary pollutants (particulate matter and ozone formed in the atmosphere from reactions of precursor chemicals) were estimated using USEPA's *Guidance on the Development of Modeled Emission Rates for Precursors as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program*.

Table 3.4-4 and Table 3.4-5 present a summary of model results for comparison to the NAAQS and PSD increments, respectively. As shown in the tables, all pollutant levels are less than the NAAQS and PSD increments.

Table 3.4-4 Estimated Pollutant Concentrations During O&M Compared to NAAQS

Pollutant	Averaging Period	Rank[1]	Modeled Design Concentration[2] ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
CO	1-hour	H2H	490	1,718	2,208.0	40,000
CO	8-hour	H2H	181.1	1,145	1,326.1	10,000
NO_2	1-hour	98th%ile	178.6	Included[3]	178.6	188
NO_2	Annual	Max	2.5	14.3	16.8	100
PM_{10}	24-hour	H2H	6.3	21.0	27.3	150
$PM_{2.5}$	24-hour	98th %ile	0.9[4]	16.0	16.9	35
$PM_{2.5}$	Annual	Max	0.1[4]	7.3	7.4	12
SO_2	1-hour	99th %ile	21.9	5.2	27.1	196
SO_2	3-hour	H2H	20.9	6.8	27.7	1,300

Source: Dominion Energy 2023b, Table 5.12-2.
$\mu g/m^3$ = micrograms of pollutant per cubic meter of air
[1] H2H = highest second-highest, 98th %ile = 98th percentile, 99th %ile = 99th percentile, Max = Maximum annual concentration.
[2] Maximum modeled design concentration.
[3] Seasonal and hourly varying background concentrations were included directly in AERMOD using the SEASHR model option.
[4] Includes $PM_{2.5}$ secondary concentration.

Table 3.4-5 Estimated Pollutant Concentrations During O&M Compared to Prevention of Significant Deterioration Increments

Pollutant	Averaging Period	Rank[1]	Modeled Design Concentration[2] ($\mu g/m^3$)	PSD Increment ($\mu g/m^3$)
NO_2	Annual	Max	2.5	25
PM_{10}	24-hour	H2H	6.3	30
PM_{10}	Annual	Max	0.1	17
$PM_{2.5}$	24-hour	H2H	6.2[3]	9
$PM_{2.5}$	Annual	Max	0.1[3]	4
SO_2	3-hour	H2H	20.9	512
SO_2	24-hour	H2H	9.6	91
SO_2	1-hour	Max	0.2	20

Source: Dominion Energy 2023b, Table 5.12-3
$\mu g/m^3$ = micrograms of pollutant per cubic meter of air.
[1] H2H = highest second-highest, Max = Maximum annual concentration.
[2] Maximum modeled design concentration.
[3] Includes $PM_{2.5}$ secondary concentration.

Class 1 area assessments: The nearest PSD Class I areas to the Project are the Swanquarter NWA in North Carolina (106.6 miles [171.6 kilometers] from the nearest boundary of the Project considering the main lease area), Shenandoah National Park (NP) in Virginia (187.28 miles [301.4 kilometers]), and the E.B. Forsythe (Brigantine) NWA (179.33 miles [288.6 kilometers]). All other Class I areas are well over 186 miles (300 kilometers) away. Because the closest Class I areas are located over 62 miles (100 kilometers) from the Project, the screening procedure described in the Federal Land Managers (FLM) Air Quality Related Work Group (FLAG) guidance (FLAG 2010) was conducted to evaluate potential impacts in the Class I areas and whether a Class I Air Quality Related Values (AQRV) analysis is required. This guidance recommends using the "Q/D" ratio to determine if a Class I AQRV analysis is required, where Q is the sum of the maximum 24-hour emissions (in tons per year based on continuous operation) of PM_{10}, SO_2, NO_X, and sulfuric acid, divided by the site distance, D, in kilometers from the nearest Class I area boundary. The emissions are based on the annual potential emission rates for the Project during the construction phase and the O&M phase. If the value of Q/D is less than 10, a Class I AQRV analysis is likely not required. The calculated Q/Ds for the O&M Phase are only 1.9 or less; therefore, no Class I AQRV analysis was performed for the O&M Phase. However, the construction phase results in a Q/D greater than 10 for the Swanquarter NWA indicating that a Class I AQRV analysis is necessary. In addition, the National Park Service (NPS), which is the designated FLM of Shenandoah NP, requested that an AQRV study be conducted for Shenandoah NP even though it is over 186 miles (300 kilometers) away and the Q/D is less than 10. The NPS also requested that an assessment be conducted for two National Seashore areas, Cape Hatteras and Cape Lookout, both of which are Class II areas. The results of these analyses are described herein. The Application provides further detail on the Class I area assessments.

PSD increment analysis: Because the nearest Class I areas are located greater than 31 miles (50 kilometers) from the Project, the initial PSD increment assessment evaluates if maximum predicted concentrations at a distance of 31 miles (50 kilometers) are less than Class I PSD Increment Significant Impact Levels established by USEPA. Long range transport modeling using the CALPUFF model was conducted to estimate maximum predicted concentrations at receptors located at the Swanquarter NWA and the Shenandoah NP. As shown in Table 3.4-6, the estimated impacts due to CVOW are less than the USEPA Class I Significant Impact Levels . Accordingly, USEPA considers that no further analysis is necessary for impacts that are less than the Significant Impact Levels.

Table 3.4-6 Estimated Impacts due to the Project at Class I Areas Compared to Significant Impact Levels

Pollutant	Averaging Period	Class I SIL ($\mu g/m^3$)	Maximum Predicted Concentration ($\mu g/m^3$)			
			Construction		O&M	
			Swanquarter	Shenandoah	Swanquarter	Shenandoah
NO_2	Annual	0.1	0.02	0.003	0.006	0.0006
$PM_{2.5}$	24-hour	0.27	0.13	0.075	0.02	0.012
$PM_{2.5}$	Annual	0.05	0.009	0.008	0.002	0.0012
PM_{10}	24-hour	0.3	0.05	0.01	0.01	0.003
SO_2	3-hour	1	0.05	0.02	0.03	0.01
SO_2	24-hour	0.2	0.02	0.07	0.01	0.004
SO_2	Annual	.01	0.0006	0.0001	0.0003	0.00005
O_3	8-hour	1 ppb	0.99	0.58	0.13	0.08

Source: Dominion Energy 2023b, Table 6.1-3.
$\mu g/m^3$ = micrograms of pollutant per cubic meter of air; ppb = parts per billion; SIL = Significant Impact Level.

Visibility analysis: The visibility analysis (plume blight) is an estimate of the impacts due to Project emissions on the visual quality in the area. The USEPA's VISCREEN screening model was used to assess visibility impairment at Class II vistas at First Landing State Park in Virginia Beach, Virginia, as well as Cape Hatteras and Cape Lookout National Seashores, both in North Carolina. The Application provides further detail on the visibility assessment.

The maximum short-term emission rates expected during the course of a year are input to the model. Plume perceptibility and contrast values modeled for the Class II areas were conservatively compared to Class I criteria because no there are no established Class II criteria. The modeling results in the OCS Application indicate that plume blight and contrast are less than Class I criteria for all viewing angles. Values less than the criteria indicate that the visual impact is not considered adverse, and no further visibility analysis is required.

Deposition analysis: USFWS and NPS have established Deposition Analysis Thresholds to use as screening level values for the additional amount of sulfur and nitrogen deposition within Class I areas from new or modified PSD sources. A Deposition Analysis Threshold is defined as the additional amount of nitrogen or sulfur deposition flux within an FLM area, below which estimated impacts from a proposed new or modified source are considered negligible. If a project has a predicted nitrogen or sulfur deposition impact less than the Deposition Analysis Threshold, the USFWS and NPS will consider that impact to be negligible and no further analysis would be required for that pollutant. The Deposition Analysis Thresholds established for both nitrogen and sulfur in eastern FLM areas and wilderness areas is 0.010 grams per hectare per year. The Application provides further detail on the deposition assessment.

The CALPUFF model was used to predict atmospheric deposition as an annual average in units of grams per square meter per second. The modeled deposition fluxes of each oxide of sulfur and nitrogen were processed in accordance with FLAG (2010) guidance and converted to units of grams per hectare per year for comparison to the Deposition Analysis Thresholds. The predicted nitrogen and sulfur deposition rates are less than the applicable Deposition Analysis Thresholds. Consequently, no adverse deposition impacts are expected due to the Project.

Soil, vegetation, and growth analysis: USEPA has established sensitivity thresholds for evaluation of impacts on soils and vegetation (USEPA 1980). Based on the project emissions and given that maximum pollutant concentrations would all be located offshore it was assumed that impacts on soils and vegetation would be lower than applicable thresholds. In addition, as shown in Table 3.4-6, ozone impacts would be insignificant (less than Significant Impact Levels), and therefore, are not expected to affect vegetation. The Application provides further detail on the soils and vegetation assessment.

To the extent that industrial, commercial, and residential growth would occur in the surrounding area due to the construction and operation of the Project, increases in emissions would be expected from these activities. A significant portion of the regional construction force in the Project area is currently available to build the Project while a small percentage of the labor force would be drawn from outside the commuting region. Also, it is expected that any new housing demand can be met with existing housing in the region. The O&M base port is assumed to be located at Fairwinds Landing in Norfolk, Virginia; no other induced commercial or industrial construction in the area would be necessary to support the Project. Therefore, significant emissions from these sources associated with the Project are not anticipated. For further discussion of economic impacts see Section 3.11, *Demographics, Employment, and Economics*.

Avoided emissions: Increases in renewable energy could lead to reductions in emissions from fossil-fueled power plants. The USEPA Avoided Emissions and Generation Tool (AVERT) (USEPA 2021b) was used to estimate the emissions avoided as a result of the Proposed Action. Once operational, the Proposed Action would result in annual avoided emissions of 2,803 tons of NO_X, 375 tons of $PM_{2.5}$, 4,396 tons of SO_2, and 5,867,210 tons of CO_2. This estimate is derived assuming the electricity generation mix of 2018 for generating units in the Mid-Atlantic Region[7] included in AVERT. If renewable energy sources make up more of the electricity generation mix in the future, these potential benefits would be

[7] The Mid-Atlantic Region as defined in AVERT consists of Delaware, the District of Columbia, Maryland, New Jersey, Ohio, Pennsylvania, Virginia, and West Virginia, and parts of Illinois, Indiana, Kentucky, Michigan, North Carolina, and Tennessee.

proportionally diminished as overall air emissions decrease and air quality improves. The avoided CO_2 emissions are equivalent to the emissions generated by about 1.2 million passenger vehicles in a year (USEPA 2020a). 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 11 years of operation, $PM_{2.5}$ in 3 years, SO_2 in 1 month, and CO_2 in 4 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 3.4-7 presents the estimated avoided health effects.

Table 3.4-7 COBRA Estimate of Annual Avoided Health Effects with Proposed Action

Discount Rate [1] (2023)	Avoided Mortality (cases/year)		Monetized Total Health Benefits (U.S. dollars/year)	
	Low Estimate [2]	High Estimate [2]	Low Estimate [2]	High Estimate [2]
3%	23.468	53.118	$256,803,637	$581,261,911
7%	23.468	53.118	$228,730,914	$517,720,736

[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 2021c).
[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 2021c).

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) 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. 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 95th 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 3.4-8 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 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 estimates of emissions from the Project in each year. In Table 3.4-8, 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.

Table 3.4-8 Estimated Social Cost of GHGs Associated with the Proposed Action

Description	Social Cost of GHGs (2020$) [1,2]			
	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	25,309,000	102,364,000	157,514,000	311,149,000
Avoided Emissions	-1,592,421,000	-6,626,394,000	-10,237,836,000	-20,259,292,000
Net SCC- CO_2	**-1,567,112,000**	**-6,524,030,000**	**-10,080,322,000**	**-19,948,143,000**
SC-CH_4				
Construction, Operation, and Decommissioning	75,000	205,000	281,000	544,000
Avoided Emissions	-5,529,000	-6,626,394,000	-10,237,836,000	-20,259,292,000
Net SCC-CH_4	**-5,454,000**	**-6,626,189,000**	**-10,237,555,000**	**-20,258,748,000**

Description	Social Cost of GHGs (2020$) [1,2]			
	Average Value, 5% Discount Rate	Average Value, 3% Discount Rate	Average Value, 2.5% Discount Rate	95th Percentile Value, 3% Discount Rate
SC-N_2O				
Construction, Operation, and Decommissioning	388,000	1,456,000	2,228,000	3,870,000
Avoided Emissions	-6,092,000	-23,555,000	-36,221,000	-62,776,000
Net SCC-N_2O	**-5,704,000**	**-22,099,000**	**-33,993,000**	**-58,906,000**
SC-SF_6				
Construction, Operation, and Decommissioning	1,547,000	6,438,000	9,946,000	19,682,000
Avoided Emissions	0	0	0	0
Net SCC-CH_4	1,547,000	6,438,000	9,946,000	19,682,000
SC-GHG[3]				
Construction, Operation, and Decommissioning	27,319,000	110,463,000	169,969,000	335,245,000
Avoided Emissions	-1,604,042,000	-13,276,343,000	-20,511,893,000	-40,581,360,000
Net SC-GHG	**-1,576,723,000**	**-13,165,880,000**	**-20,341,924,000**	**-40,246,115,000**

Estimates are over the lifetime of the CVOW Wind project. Estimates are rounded to the nearest $1,000.
[1] The following calendar years were assumed in calculating SC-GHG: construction 2026–2028, operation (35 years) 2029–2064, and decommissioning 2065–2067.
[2] Negative cost values indicate benefits.
[3] SC-GHG is the sum of the social costs for CO_2, CH_4, N_2O, and SF_6.

Table 3.4-9 presents the annual emissions, avoided emissions, and net emissions of CO_2 over the operational lifetime of the Proposed Action. Net emissions are the Proposed Action emissions minus the avoided emissions. The No Action Alternative would result in no emissions during construction, O&M, and decommissioning because no project would 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, 5,322,616 metric tons per year of CO_2 (Table 3.4-9), would be equivalent to about 1,090,000 additional passenger vehicles per year. These estimates are relative to the 2018 grid configuration as noted previously; however, 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.

Table 3.4-9 Net Emissions of CO_2 for the Proposed Action

Alternative	CO_2 Emissions (metric tons) [1,2]					
	Construction	Operation				Construction + Operation
	Construction (Total)	O&M Emissions (Annual)	Avoided Emissions (Annual)	Net Emissions (Annual)	Operational Lifetime Net Emissions (Total)	Total Lifetime Net Emissions
No Action	0	0	0	0	0	193,617,930 [3]
Proposed Action	747,700	45,276	-5,867,210	-5,821,934	-192,123,814	-191,376,114

[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 Proposed Action.

Air emissions – Decommissioning: At the end of the operational lifetime of the Project, Dominion Energy would decommission the Project. Dominion Energy 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.

The dismantling and removal of the turbine components (blades, nacelle, and tower) and other offshore components would largely be a “reverse installation” process subject to the same constraints as the original construction phase. Onshore decommissioning activities would include removal of facilities and equipment and restoration of the sites to pre-Project conditions where warranted. 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 37 years and in the future will have lower emissions than current vessels and equipment. Dominion Energy anticipates minor and temporary air quality impacts from the Proposed Action due to decommissioning.

Climate change: The Proposed Action would produce GHG emissions that contribute to climate change; however, its contribution would be less than the emissions offset during operation of the Project. 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 these activities 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, it is anticipated that there would be a net reduction in GHG emissions as a result of reduced emissions from fossil-fueled electric generation, and no collective adverse impact on climate change as a result of offshore wind projects. Additional offshore wind projects would likely contribute a relatively small emissions increase of CO_2. Development of offshore wind projects including the Proposed Action and construction, O&M, and eventual decommissioning activities would cause some GHG emissions to increase, primarily through emissions of CO_2. The additional GHG emissions anticipated from the planned activities including the Proposed Action over the 37-year period would have a negligible incremental contribution to existing GHG emissions. As noted in Section 3.4.3.1, *Impacts of the No Action Alternative,* under Executive Order 43, Virginia committed to developing 5,500 MW of wind and solar energy by 2028. The Proposed Action's generating capacity of up to 3,000 MW would contribute up to 55 percent of the 5,500 MW target.

Accidental releases: The Proposed Action could release VOCs or HAPs because of accidental chemical spills. Based on the COP (Tables 3.3-2 and 3.3-6), the Proposed Action would have up to about 855,670 gallons (3.2 million liters) of coolants and damping liquid, 695,770 gallons (2.6 million liters) of oils and lubricants, and 19,812 gallons (74,997 liters) of diesel fuel in its 202 WTGs and three offshore substation structures. Accidental releases including spills from vessel collisions and allisions may lead to short-term 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 3.21.5, *Impacts of the Proposed Action on Water Quality*, as well as the distributed nature of the material. BOEM anticipates that these activities would have a negligible air quality impact as a result of the Proposed Action alone.

Collectively, based on the COP (Tables 3.3-2 and 3.3-6; Dominion Energy 2023a) and Kitty Hawk Wind North (2021), and Kitty Hawk Wind South (2022), there would be up to about 884,881 gallons (3.3 million liters) of coolants, 1,075,264 gallons (4.1 million liters) of oils and lubricants, and 80,191 gallons (303,557 liters) of diesel fuel contained in the 403 structures among the Proposed Action and future planned activities in the geographic analysis area.

3.4.5.4 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

Air emissions – O&M: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts of ongoing and planned activities would be minor. Using the assumptions in Appendix F, Table F-3, O&M emissions from ongoing and planned activities could begin in 2026. Emissions would largely be due to the same source types as for the Proposed Action, including commercial vessel traffic, and operation of emergency diesel generators. Such activity would result in short-term, intermittent, and widely dispersed emissions. Planned activities, including the Proposed Action, are estimated to emit 1,234 tons per year of CO, 4,090 tons per year of NO_X, 141 tons per year of PM_{10}, 136 tons per year of $PM_{2.5}$, 63 tons per year of SO_2, 172 tons per year of VOCs, and 260,888 tons per year of CO_2 when all projects are operating (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022; Appendix F, Table F2-4). Anticipated impacts on air quality from O&M emissions would be transient, small in magnitude, and localized. A net improvement in air quality is expected on a regional scale as the Project begins operation and displaces emissions from fossil-fueled sources.

Air emissions – Decommissioning: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined air quality impacts from ongoing and planned activities would be minor. The decommissioning process for all offshore wind projects is expected to be similar to that for CVOW, and impacts would be similar to those of CVOW decommissioning. Because the emissions related to onshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. If decommissioning activities for projects overlap in time, then impacts could be greater for the duration of the overlap.

Climate change: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined GHG impacts on air quality from ongoing and planned activities 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.

Accidental releases: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined accidental release impacts on air quality from ongoing and planned activities would be negligible due to the short-term nature and localized potential effects. Accidental spills would occur infrequently over the 33-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 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.

3.4.5.5 Conclusions

Impacts of the Proposed Action. The Proposed Action would result in a net decrease in overall emissions over the region compared to the No Action Alternative. Although there would be some air quality impacts due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. 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 3.4-7). **Minor** air quality impacts would be anticipated for a limited time during construction, maintenance, and decommissioning, but there would be a **minor beneficial** impact on air quality near the Wind Farm Area and the surrounding region overall to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants in the future. Dominion Energy has proposed mitigation measures (Appendix H, Table H-1) that would reduce potential impacts through complying with applicable emissions and fuel standards and requiring dust control plans for onshore construction areas. 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 operation), and the large geographic area over which they would be dispersed (throughout the 112,799-acre 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 Virginia AAQS. For the same reasons, concentrations of HAPs are not expected to lead to adverse effects on human health.

Cumulative impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends, impacts resulting from individual IPFs affecting air quality would range from **negligible** to **minor,** with **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the air quality impacts of ongoing and planned activities would be **minor**. 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, the overall impacts on air quality would be **minor** because pollutant concentrations associated with offshore wind development are not expected to exceed the NAAQS and Virginia AAQS.

3.4.6 Impacts of Alternatives B and C on Air Quality

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B described in this section.

Impacts of Alternatives B and C. The air quality and climate impacts of Alternatives B and C would be similar to those of the Proposed Action. Alternatives B and C could have lower emissions from offshore construction and operation compared to the Proposed Action (207 WTGs), to the extent that these alternatives would reduce the number of WTGs (up to 176 WTGs under Alternative B and up to 172 WTGs under Alternative C). Based on the number of WTGs, emissions would be greatest with the

Proposed Action, less with Alternative B, and least with Alternative C, with Alternatives B and C having emissions levels similar to each other.

To the extent that a reduced number of WTGs and the use of lower-capacity turbine generators (14 MW for Alternatives B and C) would result in a reduction in the total annual MW-hours generated compared to the Proposed Action, benefits from reduced emissions from fossil-fueled power plants would be lower. As under the Proposed Action, construction of the onshore interconnection cables would follow Interconnection Cable Route Option 1, and would have the same emissions as the Proposed Action for interconnection cable construction.

Compared to the Proposed Action, Alternatives B and C could have slightly lesser impacts from accidental releases to the extent that these alternatives would reduce the number of WTGs.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.4.6.1 Conclusions

Impacts of Alternatives B and C. Minor impacts would be expected under Alternatives B and C. The same construction, O&M, and decommissioning activities described for the Proposed Action would still occur, albeit at slightly differing scales. Alternatives B and C could have **minor** air quality impacts compared to the Proposed Action, with impacts varying slightly based on potentially shorter construction periods due to reduced numbers of WTGs. Overall, Alternatives B and C would have similar **minor** impacts on air quality compared to the Proposed Action, with impacts varying only slightly based on differing numbers of WTGs. As under the Proposed Action, Alternatives B and C would result in **minor beneficial** impacts on air quality in the long term due to reduced emissions from fossil-fueled power plants.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contributions of Alternatives B and C to the impacts of individual IPFs affecting air quality and climate change from ongoing and planned activities would be the same as those of the Proposed Action, with impacts ranging from **negligible** to **minor**. Offshore wind projects, including Alternatives B and C, would result in **moderate beneficial** impacts overall due to reduced emissions from fossil-fueled power plants.

3.4.7 Impacts of Alternative D on Air Quality

Impacts of Alternative D. The air quality impacts of Alternative D would be similar to those of the Proposed Action. Alternatives D-1 and D-2 would have the same number of WTGs and the same offshore cable route as the Proposed Action and, therefore, the same anticipated offshore emissions. Alternatives D-1 and D-2 differ in the selection of onshore interconnection cable routes. Under Alternative D-1, only Interconnection Cable Route Option 1 would be approved and constructed, and the new Harpers Switching Station would be constructed. Under Alternative D-2, only Interconnection Cable Route Option 6 would be approved and constructed, and the new Chicory Switching Station would be constructed.

The overall length of onshore interconnection cable for Alternative D-1 (Interconnection Cable Route Option 1) is the same as for Alternative D-2 (Interconnection Cable Route Option 6) at 14.3 miles (23.0 kilometers). However, Alternative D-2 (Interconnection Cable Route Option 6) would use a hybrid above/below ground approach having 9.7 miles overhead and 4.5 miles underground, while Alternative D-1 (Interconnection Cable Route Option 1) would use an entirely aboveground (overhead) approach.

The underground portion of Alternative D-2 (Interconnection Cable Route Option 6) could be constructed by surface trenching, HDD, microtunneling, or similar methods, or a combination of these, depending on local geotechnical and surface conditions. Surface trenching typically involves greater use of earthmoving equipment than does overhead line construction or the other underground construction techniques, and consequently has potential for greater emissions (on a per-mile basis), especially of fugitive dust. Also, based on the types of construction equipment CVOW would use, BOEM expects that overhead construction would produce greater emissions (on a per-mile basis) than HDD or microtunneling. Thus, the total emissions from construction of the underground portion of the cable could be either greater or less than emissions from construction of the same length of overhead cable, depending on the relative distances that were constructed by each underground construction method. As a result, short-term, minor air quality impacts associated with the installation of cables for Alternative D-2 (Interconnection Cable Route Option 6) could differ from the impacts associated with installation of cables for Alternative D-1 (Interconnection Cable Route Option 1).

In addition, Alternative D-2 (Interconnection Cable Route Option 6) includes construction of the Chicory Switching Station, which would have a total footprint of 35.5 acres (14.4 hectares), while Alternative D-1 (Interconnection Cable Route Option 1) includes construction of the Harpers Switching Station, which would have a total footprint of 46.48 acres (18.8 hectares). The construction total disturbance area is an indicator of amounts of land-disturbing activities and associated construction equipment usage and the resulting emissions. Therefore, BOEM expects that emissions associated with the construction of the Harpers Switching Station would be greater than with the Chicory Switching Station, especially for fugitive dust, due to the larger disturbance area of the Harpers Switching Station. However, BOEM expects that the overall construction air quality impacts for the onshore interconnection cables would be short term and minor under either Alternative D-1 (Interconnection Cable Route Option 1) or Alternative D-2 (Interconnection Cable Route Option 6).

Impacts from accidental releases under Alternative D would be the same as under the Proposed Action.

Overall, the differences in emissions among the Proposed Action and the other action alternatives would be small, and the air quality and climate impacts would be substantively the same as described for the Proposed Action. Similarly, the quantities of coolants, oils and lubricants, and diesel fuel under the other action alternatives would be similar to those of the Proposed Action and, therefore, the impacts on air quality from accidental releases are expected to be comparable to those of the Proposed Action.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternatives D-1 and D-2 to air quality impacts resulting from ongoing and planned activities would be the same as those described under the Proposed Action.

3.4.7.1 Conclusions

Impacts of Alternative D. The expected short-term, **minor** impacts associated with the Proposed Action alone would not change under Alternative D-1 or D-2. Alternatives D-1 and D-2 would have the same number of WTGs as the Proposed Action and the same construction, O&M, and decommissioning activities would still occur, albeit at slightly differing scales. Their construction emissions would differ because of differences in cable construction methods and the footprint sizes of the proposed switching stations. Overall, Alternatives D-1 and D-2 would have similar **minor** impacts on air quality compared to the Proposed Action, with construction impacts varying based on the potential selection of onshore cable routes and substations. As under the Proposed Action, Alternatives D-1 and D-2 would result in **minor beneficial** impacts on air quality and climate change in the long term due to reduced emissions from fossil-fueled power plants.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contributions of Alternatives D-1 and D-2 to the impacts of individual IPFs affecting air quality and climate change from ongoing and planned activities would be similar to those of the Proposed Action, with impacts ranging from **negligible** to **minor**. Offshore wind projects, including the Alternatives D-1 and D-2, would result in **moderate beneficial** impacts overall due to reduced emissions from fossil-fueled power plants.

3.4.8 Agency-Required Mitigation Measures

3.4.8.1 Effect of Measures Incorporated into the Preferred Alternative

No air quality mitigation measures were identified through completed consultations, authorizations, and permits for incorporation in the Preferred Alternative.

Table 3.4-10 Additional Agency-Required Measures: Air Quality[1]

Measure	Description	Effect
SF_6 leak rate monitoring and detection	Leak detection and monitoring requirements of less than 1% would be required, in line with IEC and USEPA guidance.	This measure would reduce emissions of SF_6.

[1] Also Identified in Appendix H, Table H-3.

3.4.8.2 Effect of Measures Incorporated into the Preferred Alternative

BOEM has identified the following additional measure in Table 3.4-10 and Table H-3 in Appendix H as incorporated in the Preferred Alternative: SF_6 leak rate monitoring and detection. This measure, if adopted, would reduce emissions of SF_6 which is a potent GHG.

3.5. Bats

This section discusses potential impacts on bat resources from the Proposed Action, alternatives, and ongoing and planned activities in the bat geographic analysis area. The bat geographic analysis area, as described in Appendix F, *Planned Activities Scenarios*, Table F-1 and illustrated on Figure 3.5-1, includes the East Coast from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group. 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 Description of the Affected Environment for Bats

Detailed descriptions of bats occurring inland and offshore Virginia can be found in the COP (Section 4.2.3.1, Section 2.1 of Appendix O-1, Section 1.2 of Appendix O-2, and Section 2 of Appendix O-3; Dominion Energy 2023. Seventeen bat species are known to occur in Virginia; 14 of these species are thought to have the potential to occur in coastal areas of Virginia either in or adjacent to the proposed Project area (COP, Section 4.2.3.1, Table 4.2-12; Dominion Energy 2023). Two of the 14 bat species are federally listed; the northern long-eared bat (*Myotis septentrionalis*) and the Indiana bat (*Myotis sodalis*). The northern long-eared bat is endangered and is found throughout Virginia. The Indiana bat is endangered and typically does not occur in the eastern part of Virginia (Timpone et al. 2011), but more recent studies have documented its presence, including a maternity colony, in the coastal plain of the state (St. Germain et al. 2017; Silvis et al. 2017; De La Cruz 2020). On September 13, 2022, USFWS announced a proposal to list the tri-colored bat (*Perimyotis subflavus*), as endangered under the ESA. The northern long-eared bat, Indiana bat, and tri-colored bat also are listed as state threatened (northern long-eared) and endangered (Indiana and tri-colored) species, respectively (VDWR 2021). Two other state-listed bat species may also overlap the Project area: little brown bat (*Myotis lucifugus*) and Rafinesque's big-eared bat (*Corynorhinus rafinesquii macrotis*). Bats use a variety of terrestrial environments for foraging and roosting during summer breeding and migration periods. The Onshore Project components would be located primarily in already developed areas, but bats could use other types of nearby undeveloped habitats.

Bat species consist of two distinct groups based on their overwintering strategy: cave-hibernating bats (cave bats) and migratory tree bats (tree bats). Cave-hibernating bats migrate from summer habitat to winter hibernacula in the mid-Atlantic region (Maslo and Leu 2013), while tree bats migrate to southern parts of the United States (Cryan 2003), and some species are likely present year-round in Virginia (Timpone et al. 2011). Of the tree bat species, only the silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*) are considered migratory in North America due to their seasonal (spring and fall) migrations over several degrees of latitude (Cryan 2003), with the eastern red bat being more likely to occur offshore (Hatch et al. 2013; Sjollema et al. 2014).

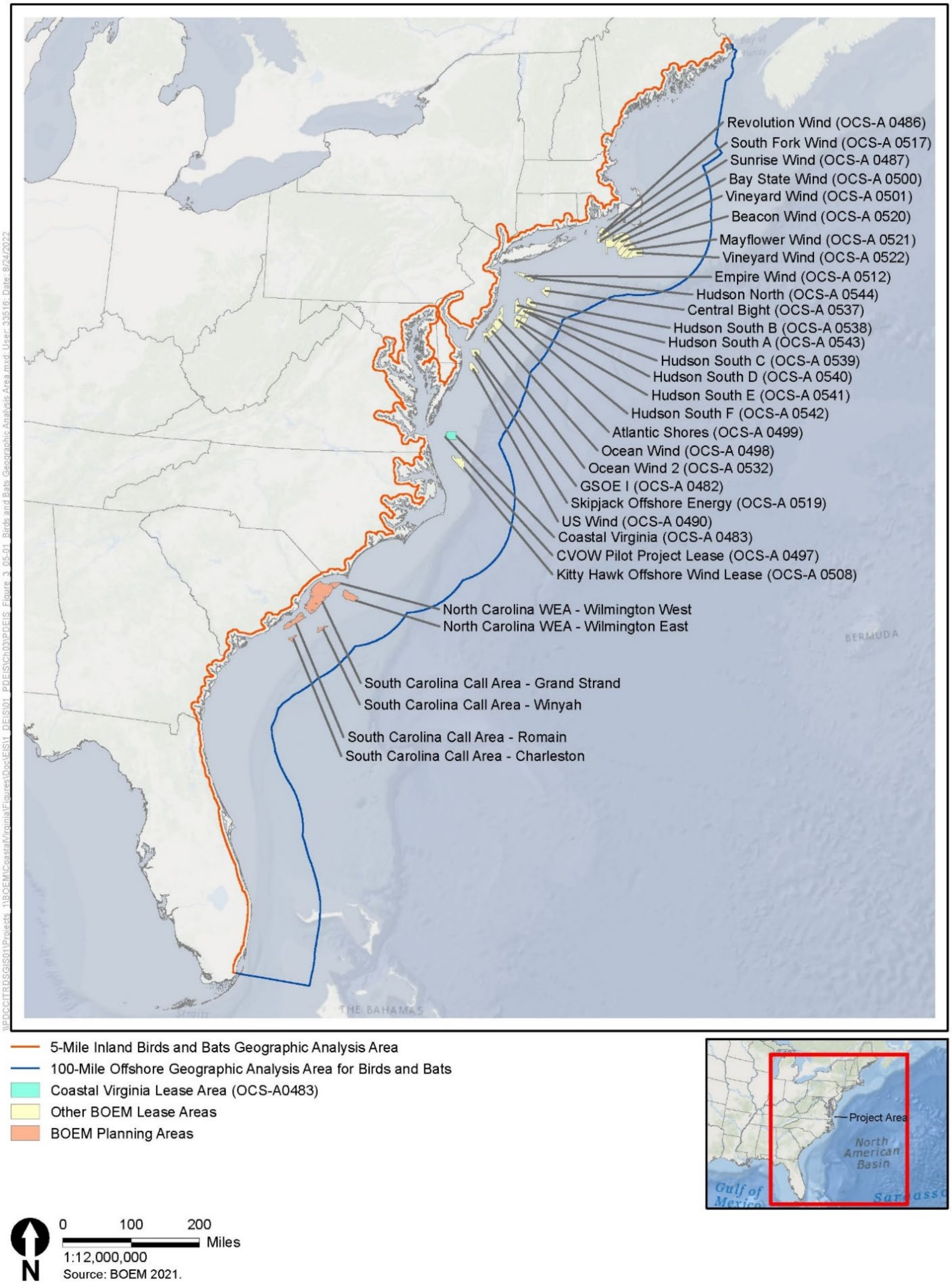


Figure 3.5-1 Birds and Bats Geographic Analysis Area

Bats are terrestrial species that spend almost their entire lives on or over land but can occasionally occur offshore during spring and fall migration and under very specific conditions such as low wind, good visibility, and high temperatures (Smith and McWilliams 2016; True et al. 2021). Generally, bat activity offshore is less than onshore and decreases with increased distance from shore (Brabant et al. 2021; Solick and Newman 2021). Recent studies, combined with historical anecdotal accounts, indicate that tree bats sporadically travel offshore during spring and fall migration, with 80 percent of acoustic detections occurring in August and September (Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Petersen 2016). However, unlike tree bats, the likelihood of detecting a *Myotis* species or other cave bat is substantially less in offshore areas because bat activity in the mid-Atlantic decreases 6 miles (20 kilometers) from shore (Pelletier et al. 2013; Sjollema et al. 2014; Petersen 2016). Solick and Newman (2021) reported over 83 percent of *Myotis* species detections occurring less than 5.2 miles (8.3 kilometers) from shore, though there have been rare detections farther offshore in association with research and fishing vessels.

Research based on Block Island and other coastal Rhode Island locations indicated *Myotis* species migrated short distances between the islands and the mainland primarily from July to September (Smith and McWilliams 2016). Acoustic surveys conducted during construction and post-construction at the Block Island Wind Farm did not yield detections of any northern long-eared bats; tri-colored bats were detected only during post-construction and in low numbers (Stantec 2018, 2020). Generally, the post-construction data found relatively low numbers of bats present only during the fall (Stantec 2020). During a long-term study of bat movements conducted from 2012 to 2014 in the coastal, nearshore, and offshore environments of the northeast, mid-Atlantic, and Great Lakes (Stantec 2016; Pelletier et al. 2013), bat calls were detected from 3 to 80 miles (5 to 130 kilometers) offshore. Eastern red bats and other migrants represented the most frequently observed species with peak activity during the spring and fall migrations; very little offshore activity of *Myotis* species in the mid-Atlantic was detected.

Results from the Project offshore bat acoustic survey (COP, Appendix O-2; Dominion Energy 2023) did not document *Myotis* species or any federally listed species in the Offshore Project area. All bat species conclusively identified from the acoustic survey results were long-distance migratory tree bat species (i.e., eastern red bat, Seminole bat [*Lasiurus seminolus*], silver-haired bat, and hoary bat), but some cave-hibernating species may be present among the bats that were unidentified. Overall survey results from April to May 2021 showed a mean of 1.07 bat passes per acoustic detector night, which represented low activity levels across seasons and were concentrated during the fall migration period. Bat passes were distributed across the Offshore Project area and although concentrations of passes occurred, they often represented single nights with multiple bat passes rather than repeated use of the same area over many nights. Additionally, groups of bats were continuously recorded and represented 69 percent of all bat passes recorded, suggesting that a small number of individual bats contributed to large amounts of detected bat activity. Additionally, bats were documented day and night roosting on the vessels in the Offshore Project area. Moreover, post- construction Acoustic and Thermographic Offshore Monitoring of birds and bats for the CVOW-Pilot Project has been underway since April 2021 to collect seasonal information with respect to bat presence at the two WTGs installed for the CVOW-Pilot Project (Dominion Energy 2022). Data through the spring (April 1 to June 15, 2021) and fall (August 15 to October 31, 2021) monitoring seasons showed three bat species were present at the WTGs during both seasons: the silver-haired bat, the eastern red bat, and hoary bat. The number of bat detections was much higher in the fall with 415 calls, compared to in the spring when there were only 4 calls. However, it is important to note that abundance cannot be inferred based on the number of detections as many detections could have been the same individual passing by the detector multiple times. Given these data, the potential exists for some migratory tree bats to encounter offshore facilities during spring and fall migration. BOEM expects this exposure risk to be limited to very few individual tree bats and to occur, if at all, during migration. Given the distance of the Wind Farm Area from shore, BOEM does not expect foraging bats to encounter operating WTGs outside spring and fall migration.

From June 9 to July 2, 2022, a presence/absence mist netting survey was conducted along the Onshore Project area resulting in the capture of 110 bats representing eight species (COP, Appendix O-3; Dominion Energy 2023). Captured bat species included big brown bat (*Eptesicus fuscus*), eastern red bat, southeastern myotis (*Myotis austroriparius*), tri-colored bat, little brown bat, northern long-eared bat, evening bat (*Nycticeius humeralis*), and Rafinesque's big-eared bat. Of the captured species, three lactating female northern long-eared bats were captured and fitted with radio transmitters. One maternity roost was found for one of the lactating females about 374 feet (114 meters) from the proposed onshore export cable route. Two tri-colored bats were captured and then were fitted with transmitters to identify nearby roost sites. One bat was tracked to a roost located approximately 935 feet (285 meters) from the proposed onshore export cable route, and the second roost could not be located due to impassible terrain. Separately, acoustic and mist-netting surveys were conducted from June 21 to July 2, 2022, at Naval Air Station Oceana Dam Neck Annex, which overlaps the cable landing location and a portion of the onshore export cable route (Gilardi and ISIL Engineering 2022). Acoustic analysis confirmed the probable presence of big brown, eastern red, silver-haired, and little brown bats. Mist netting resulted in the capture of 17 bats from six different species including seven eastern red bats, four big brown bats, two little brown bats, two northern long-eared bats, one Rafinesque's big-eared bat, and one Seminole bat. The northern long-eared bats did not have radio transmitters attached, because they were male and the Rafinesque's big-eared bat could not have a radio transmitter attached since it was released due to stress concerns. Previous bat mist netting efforts in the vicinity of the Onshore Project area near the cable landing location did not report captures of any federally listed species, although roost trees and nighttime foraging locations of non-listed species (e.g., tri-colored bat, southeastern myotis) were identified in the forested areas bordering the onshore export cable route along Birdneck Road (Tetra Tech 2019). Acoustic analysis in this same area had no confirmed northern long-eared bat calls, and 16 passes were identified as Indiana bat by KPro software; however, presence was not confirmed during manual vetting (Tetra Tech 2019).

Bats in the geographic analysis area are subject to pressure from ongoing activities generally associated with onshore impacts (e.g., onshore construction and climate change). Onshore construction activities and associated impacts are expected to continue at present trends and have the potential to result in impacts on bat species. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence. Additionally, cave bat species, including the northern long-eared bat, are experiencing drastic declines due to white-nose syndrome (WNS) caused by the fungal pathogen *Pseudogymnoascus destructans*. In Virginia, WNS has resulted in dramatic population declines for the little brown bat, Indiana bat, and tri-colored bat since 2009 (Reynolds 2021). The Proposed Action has the potential to result in impacts on cave bat populations already affected by WNS. While the WNS-related mortality of bats in northeastern North America reduces the likelihood of many individuals being present in the onshore portions of the proposed Project area (Cheng et al. 2021; Reynolds 2021), the biological significance of mortality resulting from the Proposed Action, if any, may be increased given the drastic reduction in cave bat populations in the region. Further, data collected from 2010 to 2019 by the U.S. Geological Survey (USGS) shows that predicted summer occurrence for the northern long-eared, little brown, and tri-colored bats is low along the coast of Virginia, indicating that at least some species are only present in low numbers in the onshore portion of the Offshore Project area (Udell et al. 2022).

3.5.2 Environmental Consequences

3.5.2.1 Impact Level Definitions for Bats

Definitions of impact levels are provided in Table 3.5-1. There are no beneficial impacts on bats.

Table 3.5-1 Impact Level Definitions for Bats

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

3.5.3 Impacts of the No Action Alternative on Bats

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

3.5.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for bats described in Section 3.5.1, *Description of the Affected Environment for Bats,* 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.

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on bats.

- Continued O&M of the Block Island Project (5 WTGs) installed in state waters.
- Continued O&M of the CVOW-Pilot Project (2 WTGs) installed in OCS-A 0497.
- 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 Block Island 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 types of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.5.3.2, *Cumulative Impacts of the No Action Alternative*, for planned offshore wind activities, but the impacts would be of lower intensity.

3.5.3.2 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).

Other planned non-offshore wind activities that may affect bats include increasing onshore construction and the infrequent installation of new structures on the OCS (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). These activities may result in temporary and permanent onshore habitat impacts and temporary or permanent displacement and injury of or mortality to individual bats, but population-level effects would not be expected. See Appendix F, Attachment 1, Table F1-2 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for bats.

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

Noise: Construction of numerous offshore wind projects is projected between 2023 and 2030 in the geographic analysis area (Appendix F, Table F-3). Construction noise from these other projects, most notably from pile driving, may temporarily cause effects on some migrating bats if they are present during construction periods. However, notable noise impacts are not expected because research indicates that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals; no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

Other noise impacts (i.e., displacement from potentially suitable habitats or migration routes) could occur as a result of construction noise (Schaub et al. 2008), but the likelihood of impact is low because only limited use of the OCS is expected, and the use would occur only during spring and fall migration. Additionally, onshore construction noise also has the potential to result in impacts on bats foraging or roosting in the vicinity of construction activities. BOEM anticipates that these impacts would be temporary and highly localized, and bats would be expected to move to a different roost farther from construction noise. This movement would not be expected to result in any impacts, as frequent roost switching is common among bats (Hann et al. 2017; Whitaker 1998).

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

Presence of structures: The primary threat to bats would be from collisions with offshore WTGs. Over 3,154 structures (WTGs, OSSs, and meteorological towers) could be constructed in the geographic analysis area (Appendix F, Table F-3), which could affect migration patterns or pose a collision risk to individual bats.

Although adverse impacts on bats from collisions with operating WTGs cannot be quantified, some level of mortality during operation of offshore wind facilities is assumed. Any new operating wind facility would require a thorough regulatory and environmental review to appropriately site the facility to avoid, minimize, and mitigate adverse impacts on bat species.

Cave bats (including the federally and state listed northern long-eared and Indiana bat) do not tend to fly offshore (even during migrations) and, therefore, exposure to construction vessels during construction or maintenance activities, or the rotor swept zone (RSZ) of operating WTGs in the lease areas is expected to be negligible, if exposure occurs at all (Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016).

Tree bats, include the eastern red bat, the hoary bat, and the silver-haired bat, may pass through the offshore wind lease area during migrations, with limited potential for migrating bats to encounter vessels during construction and conceptual decommissioning of WTGs, OSSs, and offshore export cable corridors, although structure and vessel lighting may attract bats due to increased prey abundance.

Some bats may encounter, or perhaps be attracted to, the offshore wind related structures to opportunistically roost or forage. Several authors, such as Cryan and Barclay (2009), Cryan et al. (2014), and Kunz et al. (2007), discuss several hypotheses as to why bats may be attracted to WTGs. Many of these, including the creation of linear corridors, altered habitat conditions, or thermal inversions, would not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009; Cryan et al. 2014; Kunz et al. 2007). As such, it is possible that some migrating bats may encounter, and perhaps be attracted to, operational WTGs and interact with turbine blades in the RSZ (Cryan et al. 2014; Cryan and Barclay 2009), in addition 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 base of onshore turbine towers (Choi et al. 2020). Offshore operations and maintenance would present a seasonal risk factor to migratory tree bats that may use the offshore habitats during spring or fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during spring or fall migration, the overall occurrence of bats on the OCS is low (COP, Appendix O-2; Dominion Energy 2023; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022).

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 offshore wind development. WTGs for the proposed Project would be spaced approximately 0.75 nautical mile (1.39 kilometers) in an east–west direction and 0.93 nautical mile (1.72 kilometers) in a north–south direction. BOEM assumes that WTGs for other projects would be similarly spaced.

Several factors would reduce potential interactions between bats and operating WTGs, including the proposed spacing between structures associated with offshore wind development and the distribution of anticipated projects. Individual bats migrating over the OCS in the RSZ of projected WTGs would likely fly through project areas with only slight course corrections, if any, to avoid operating WTGs.

Unlike terrestrial migration routes, there are no offshore landscape features that would concentrate migrating tree bats and increase exposure to the offshore wind lease area on the OCS (Baerwald and Barclay 2009; Cryan and Barclay 2009; Fiedler 2004; Hamilton 2012; Smith and McWilliams 2016).

- The potential collision risk to migrating tree bats varies with climatic conditions; for example, bat activity is associated with relatively low wind speeds and warm temperatures (Smith and McWilliams 2016; True et al. 2021). Given the rarity of tree bats in the offshore environment, when combined with broadly spaced turbines and the patchiness of projects, the likelihood of collisions is expected to be low.
- The likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bats have been shown to suppress activity during periods of strong winds, low temperatures, and rain (Smith and McWilliams 2016; True et al. 2021).

Land disturbance: Onshore construction activities involving land disturbance could result in localized, minor, and temporary impacts on bats, including avoidance, displacement, and habitat loss. These impacts would not be biologically notable, and no population-level effects would occur (Hann et al. 2017; Whitaker 1998).

Onshore land development or port expansion activities could also result in limited loss of roosting or foraging habitat for some bat species. However, such minor impacts would be limited in extent, and would not measurably affect bat population abundance or viability as individual projects would be expected to minimize tree removal if not occurring in previously disturbed habitats. As such, onshore construction activities associated with offshore wind development would not be expected to appreciably contribute to overall impacts on bats.

Other considerations: The federally endangered northern long-eared bat is the only bat species listed under the ESA that may be affected by the proposed Project; the Indiana bat is considered extralimital and rare along coastal areas. The tri-colored bat may be affected by the proposed Project, and on September 13, 2022, USFWS announced a proposal to list the tri-colored bat as endangered under the ESA. Ongoing activities, future non-offshore wind activities, and offshore wind activities other than the proposed Project may also affect the northern long-eared bat. As previously described and discussed further in the Biological Assessment (BA) (BOEM 2022, 2023), the possibility of impacts on the northern long-eared bat would be limited to onshore impacts that would generally be during facilities construction.

3.5.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, bats would continue to be affected by existing environmental trends and ongoing activities.

Ongoing activities are expected to have continuing temporary to long-term impacts (disturbance, displacement, injury, mortality, and habitat loss) on bats primarily through onshore construction impacts, the presence of structures, and climate change. BOEM anticipates that the potential impacts on bats resulting from ongoing activities would be **minor**. In addition to ongoing activities, the impacts of planned actions other than offshore wind development may also contribute to impacts on bats, including increasing onshore construction (Appendix F, Attachment 2), however these impacts would be **negligible**. BOEM expects the combination of ongoing and planned actions other than offshore wind development to result in **minor** impacts on bats.

Cumulative impacts of the No Action Alternative. 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 impacts on bats due to habitat loss from increased onshore construction. BOEM anticipates that the cumulative impacts of the No Action Alternative would likely be **negligible** because bat presence in the OCS is anticipated to be limited and onshore bat habitat impacts are expected to be minimal.

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

3.5.4 Relevant Design Parameters and Potential Variances in Impacts

The primary proposed Project design parameters that would influence the magnitude of impact on bats are provided in Appendix E, *Project Design Envelope and Maximum Case Scenario*, and include the following.

- The number, size, and location of WTGs.
- The time of year during which construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E. 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.
- Season of construction: the active season for bats in the geographical analysis area is generally from March through November. Construction outside of this window would have a lesser impact on bats than construction during the active season. However, non-hibernating populations may persist in the area during winter.

3.5.5 Impacts of the Proposed Action on Bats

Noise: Pile-driving noise and onshore and offshore construction noise associated with the Proposed Action alone would not increase the impacts of noise beyond the impacts described under the No Action Alternative (Section 3.5.3, *Impacts of the No Action Alternative on Bats*) and is expected to result in negligible impacts on bats because construction activity would be short term, temporary, and highly localized.

Auditory impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile driving or other construction activities and no temporary or permanent hearing loss would be expected (Schaub et al. 2008; Simmons et al. 2016).

Per the Project BA prepared for the U.S. Fish and Wildlife Service (USFWS) (BOEM 2022, 2023), the interconnection cable route would pass through several areas designated as high or very high ecological value and are in areas with documented northern long-eared bat maternity roosts; however, there are no hibernacula present in the vicinity of Onshore Project components. Mist netting conducted in 2022 indicated that nine species of bat occur along and near the onshore export cable route including northern long-eared bat (five individuals captured) and tri-colored bat (two individuals captured) (COP, Appendix O-3; Dominion Energy 2023; Gilardi and ISIL Engineering 2022).

Behavioral impacts from onshore construction activities could occur associated with use of Direct Steerable Pipe Thrusting for the installation of the offshore export cables to the cable landing location, which would result in temporary noise impacts from installation of the cofferdam, from Direct Steerable Pipe Thrusting in the sea-to-shore transition, and at beach work areas and could result in temporary, localized disturbance or displacement of bats. While the total acreage of the cable landing location footprint is 11.1 acres (4.5 hectares), most of the area would be used for equipment laydown, staging and would not require any vegetative clearing or grading, and permanent impacts would only occur within a 2.27-acre (0.92 hectares) area that is a proposed parking lot. Disturbance impacts at the cable landing location would be short term and limited because the landing is located in a proposed parking lot. The onshore export cable predominately follows developed corridors and previously disturbed land to a common location north of Harpers Road. The onshore export cable route would pass through several habitat types, including open space, developed, forested, agricultural, and wetlands (Tables 3.8-2, 3.8-3, and 3.22-3) that may support bat species, resulting in temporary disturbance impacts on bats. From that point, onshore clearing and construction (and associated noise) would be required at the Harpers Switching Station and for the overhead lines from Harpers Switching Station to Fentress Substation resulting in impacts on varying acreages of wetlands and National Land Cover Database (NLCD) land cover classes, as shown in Tables 3.8-2 and 3.22-3.

Onshore clearing and construction would result in disturbance to bats at the Harpers Switching Station. The Harpers Switching Station would require approximately 5.52 acres (2.23 hectares) for stormwater management facilities; approximately 6.2 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Club; 0.9 acre (0.4 hectare) for relocation of Dewey Road Drive; and 12.5 acres (5.1 hectares) for workspace, fence relocation, and tree removal. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station (Dominion Energy 2023). While impacts at the Harpers Switching Station would largely be on previously developed areas within the Aeropines Golf Club (Table 3.8-2 and 3.8-3), approximately 27.02 acres (10.93 hectares) of tree clearing would be required to support relocation of fairways, construction of the maintenance building, relocation of Dewey Road, and construction of stormwater management facilities and the footprint of Harpers Switching station. With respect to the interconnection cable route, Interconnection Cable Route Option 1 is approximately 14.3 miles (23.0 kilometers) long and would be installed entirely overhead and result in permanent disturbance impacts on a total of 144.2 acres (58.4 hectares) of wetland and NLCD land cover classes (Tables 3.8-2, 3.8-3, and 3.22-3) and would require 117 acres (47 hectares) of tree clearing. The interconnection cable route would culminate at the onshore substation, which would also require land clearing and result in impacts on wetlands and various NLCD land cover classes (Tables 3.8-2 and 3.22-3) and subsequent disturbance impacts on bats. Overall, noise from onshore clearing and construction would be localized and temporary. If the noise disturbs bats, they would likely temporarily move away, potentially from preferred foraging or roosting habitats. However, BOEM expects that no individual fitness or population-level impacts would be expected to occur resulting in negligible impacts on bats from the Proposed Action, and lasting impacts on local breeding populations are not anticipated. Conceptual decommissioning of the Project would have similar impacts as construction and would likely be conducted under similar seasonal restrictions.

For onshore construction activities, Dominion Energy will comply with the existing 4(d) provisions in accordance with the interim guidance until April 1, 2024. Following implementation of the new regulations, Dominion Energy has committed to complying with two time-of-year restrictions for tree-clearing activity, which will reduce noise impacts on bats. The timeframe restrictions are from December 15 to February 15 when bats are wintering in the trees and the weather is typically too cold for them to be moving; and April 15 to July 30 to provide protection to pups, which are typically born after May 1.

Presence of structures: The various types of impacts on bats that could result from the presence of structures, such as migration disturbance and turbine strikes are described in detail in Section 3.5.1, *Description of the Affected Environment for Bats*. The Proposed Action would add up to 202 new WTGs on the OCS where few currently exist.

There is some correlative evidence from inland studies that bat mortality increases with tower height (Barclay et al. 2007; Georgiakakis et al. 2012). Therefore, the Proposed Action could result in higher probability of bat mortality if 16-MW WTGs are chosen over 14-MW WTGs. However, because the overall occurrence of bats (including listed species) on the OCS is low (COP, Appendix O-2, Dominion Energy 2023; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022), the impacts of the Proposed Action are expected to result in minor long-term impacts in the form of mortality; BOEM anticipates the occurrence of such impacts to be rare. In addition, Dominion Energy would use BMPs identified by BOEM COP guidelines (BOEM 2020) and comply with FAA and USCG requirements for lighting and, to the extent practicable, use lighting technology (e.g., low-intensity strobe lights, flashing red aviation lights) that minimize impacts on bat species.

Land disturbance: Impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities occur during the active season (generally March through November). Impacts may include injury or mortality of individuals, particularly juveniles who are nonvolant (i.e., unable to fly) and cannot flush from a roost, if occupied by bats at the time of removal.

There would be potential for habitat impacts on bats as a result of the loss of potentially suitable roosting or foraging habitat. However, the cable landing location would be located in a proposed parking lot, which is highly unlikely to provide important habitat for any bat species. Although acoustic analyses using KPro software had no confirmed northern long-eared bat call but identified 16 passes as Indiana bat, the identities could not be confirmed by manual vetting. No Indiana bats were captured during mist netting efforts in the area (Tetra Tech 2019). While bats may be present in habitat adjacent to the onshore export cable route, exposure is expected to be limited (COP, Appendices O-1 and O-3; Dominion Energy 2023; Gilardi and ISIL Engineering 2022) because much of the routing is collocated with existing roads. Mist netting conducted in 2022 indicated that nine species of bat occur along or near the onshore export cable route, including the northern long-eared bat (five individuals captured) and tri-colored bat (two individuals captured) (COP, Appendix O-3; Dominion Energy 2023; Gilardi and ISIL Engineering 2022). However, the onshore substation and switching station would require tree and vegetation clearing on varying acreages of wetlands and various NLCD land cover classes (Tables 3.8-2 and 3.22-3).

Interconnection Cable Route Option 1 would be approximately 14.3 miles (23.0 kilometers) long and would result in approximately 78.3 acres (31.7 hectares) of temporary disturbance to various NLCD land cover classes (Table 3.8-2). Permanent impacts resulting in the loss of potential habitat would be 127.2 acres (51.5 hectares). While the NLCD does include wetland land cover classes, refer to Section 3.22, *Wetlands*, Table 3.22-3 for wetland impacts on the Onshore Project components based on wetland delineation survey data. The portion of the route that passes through the forested and wetland areas associated with the North Landing River likely provides quality roosting and/or foraging habitat for bats.

Approximately 76 percent of Interconnection Cable Route Option 1 would be collocated with existing linear development. Overall, impacts on bat habitat during construction are expected because northern long-eared bat maternity roosts have been documented close to the proposed route, within 0.04 mile (0.06 kilometer), adjacent to the Naval Auxiliary Landing Field Fentress; within 2.57 miles (4.14 kilometers) of the proposed route, there have been acoustic detections of Indiana bats in the region (12 to14 miles [19 to 22 kilometers] from both the cable landing location and Fentress Substation), and bat activity has been documented throughout the year (COP, Appendix O-1; Dominion Energy 2023). Tree/vegetation clearing would occur along the route in various NLCD land cover class types (Table 3.8-2), and clearing activities would follow existing 4(d) provisions in accordance with the interim guidance until April 1, 2024, and would then follow two timeframe restrictions: December 15 to February 15 and April 15 to July 30. Dominion Energy would maintain a minimum no-tree-clearing buffer of 150 feet (45 meters) around any known northern long-eared bat maternity roosts, and Dominion Energy conducted mist-netting surveys along the Onshore Project area. Additionally, due to the potential impacts, monitoring and mitigation during all seasons may be required.

The switching station parcel at Harpers Road (Interconnection Cable Route Option 1) would be built in a semi-developed area within the Aeropines Golf Club (COP, Appendix O-1; Dominion Energy 2023). Because the Harpers Switching Station would be located adjacent to non-disturbed areas, there is potential for impacts on bat habitat due to anticipated tree clearing (27.02 acres [10.93 hectares]) in mixed forest and woody wetland NLCD land cover classes (Table 3.8-2). The Harpers Switching Station would require approximately 5.52 acres (2.23 hectares) for stormwater management facilities, and approximately 6.2 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the

Aeropines Golf Club, 0.9 acre (0.4 hectare) for relocation of Dewey Road Drive, and 12.5 acres (5.1 hectares) for workspace, fence relocation, and tree removal. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station (Dominion Energy 2022a). The onshore substation parcel (Fentress) is in an existing developed area and is associated with fragmented habitat; expansion of the parcel would require clearing within forested and wetland NLCD land cover classes (Table 3.8-2); therefore, impacts on potentially suitable roosting or foraging habitat would occur but would be limited (COP, Appendix O-1; Dominion Energy 2023; BOEM and Dominion Energy 2022). Refer to Section 3.21, Section 3.14, *Land Use and Coastal Infrastructure*, and Section 3.22, *Wetlands,* for additional details of potential impacts on surface waters, land use, and wetlands.

BOEM anticipates that minor impacts would occur due to adherence to USFWS northern long-eared bat conservation measures; further, these minor habitat impacts would not result in individual fitness or population-level effects given the limited amount of habitat removal. Dominion Energy would likely leave onshore facilities in place for future use. There are no plans to disturb the land surface or terrestrial habitat during conceptual decommissioning of the Proposed Action. Therefore, onshore temporary impacts of conceptual decommissioning would be negligible.

3.5.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities. In the context of reasonably foreseeable environmental trends, combined noise impacts on bats from ongoing and planned actions, including the Proposed Action, would likely be negligible. Combined impacts on bats arising from the presence of structures from ongoing and planned actions, including the Proposed Action, would likely be minor given the expected limited use of the OCS by migrating tree bats. As the Proposed Action would account for about 9.6 percent (up to 202 of 3,287) of the new WTGs on the OCS, a majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action. The combined land disturbance impacts from ongoing and planned actions, including the Proposed Action, would likely be minor, as a small amount of habitat loss would be expected.

3.5.5.2 Conclusions

Impacts of the Proposed Action. Construction, installation, operation, and conceptual decommissioning of the Proposed Action alone would have **negligible** to **minor** impacts on bats, especially if tree-clearing activities are conducted outside the active season. The main notable risk would be from operation of the offshore WTGs, which could lead to **minor** long-term impacts in the form of mortality, although BOEM anticipates this to be rare, and from onshore construction, which could lead to **minor** long-term impacts from loss of suitable onshore roosting and/or foraging habitat. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section 3.5.3, *Impacts of the No Action Alternative on Bats*.

Cumulative impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action, would be **negligible** to **minor**. Considering all the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action, would result in **minor** impacts on bats in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and onshore habitat loss. The Proposed Action would contribute to the overall impact rating primarily through the permanent but limited impacts attributed to onshore habitat loss. Thus, the overall impacts on bats would likely be **minor** because while most impacts are expected to be avoided due to the limited occurrence of bats in the offshore wind lease area (23.75 nautical miles [44 kilometers] from land), some mortality and a small amount of onshore habitat loss is expected.

3.5.6 Impacts of Alternatives B and C on Bats

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. With the exception of the number and size of WTGs, impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning under Alternatives B and C would be similar to those described under the Proposed Action. IPFs associated with the construction and installation of up to 176 WTGs plus spare locations under Alternative B (each 14 MW) and up to 172 WTGs under Alternative C (each 14 MW), including pile-driving noise and temporary avoidance and displacement, would be decreased by approximately 14 percent (Alternative B) or up to approximately 16 percent (Alternative C) compared to the Proposed Action. Fewer WTGs under Alternatives B and C when compared the Proposed Action may allow greater opportunity for migrating tree bats (if present) to avoid WTGs. Overall, the expected negligible to minor impacts on bats would not be materially different than those described under the Proposed Action. The use of 14 MW WTGs under Alternatives B and C may have some potential to decrease collision risk in comparison to the largest WTGs contemplated under the Proposed Action (16 MW) based on early studies of terrestrial wind facilities (Barclay et al. 2007; Georgiakakis et al. 2012). However, more recent research indicates there is no correlation between bat fatality rates and wind turbine size (Smallwood 2020). Given the expected limited use of the OCS by migrating tree bats (COP, Appendix O-2; Dominion Energy 2023; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022), impacts would be expected to remain minor.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.5.6.1 Conclusions

Impacts of Alternatives B and C. Alternatives B and C would involve fewer and potentially smaller WTGs, compared to the Proposed Action, which would have an associated decrease in potential collision risk to bats. However, BOEM expects that the impacts resulting from these alternatives would be similar to the Proposed Action with individual IPFs leading to impacts ranging from **negligible** to **minor**.

Cumulative impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on bats from ongoing and planned actions, including Alternatives B and C, would be similar to those described for the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts. While Alternatives B and C may result in a slightly lower level of impact on bats than described under the Proposed Action, the overall impacts of Alternatives B and C on bats would be the same level as under the Proposed Action: **minor**. This impact rating is derived primarily by ongoing conditions such as climate change, as well as disturbance and habitat removal associated with onshore construction. As described above for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.5.7 Impacts of Alternative D on Bats

Impacts of Alternative D. All offshore components of Alternative D-1 or D-2 are the same as the Proposed Action (202 WTGs and 3 OSSs for the Proposed Action) and impacts on bats from the Offshore Project components would be the same as evaluated under the Proposed Action. Onshore, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under Alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same.

In contrast to the Proposed Action, Alternative D-2 involves approval of only Interconnection Cable Route Option 6 (Hybrid Route), which would be approximately 14.3 miles (23.0 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods and installed via open trench, micro tunneling, and HDD. It would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.8 miles (15.8 kilometers) to the onshore substation (Fentress).

In contrast to the Proposed Action, Alternative D-2 involves approval of only Hybrid Interconnection Cable Route Option 6, which would be approximately 14.3 miles (23.0 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods including open trench, micro tunneling, and HDD. The route would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.8 miles (15.8 kilometers) to the onshore substation (Fentress).

Noise and land disturbance from onshore construction activities of Interconnection Cable Route Option 6 would result in behavioral and habitat loss/fragmentation impacts on bats as a result of temporary disturbance and clearing of a total of 72.1 acres (29.2 hectares) of NLCD land cover classes (Tables 3.8-4 and 3.8-5), whereas the Proposed Action would result in impacts on 78.3 acres (31.7 hectares) (Table 3.8-2). Permanent impacts resulting in the loss of potential habitat would be 116.3 acres (47.1 hectares) for Interconnection Cable Route Option 6 and 127.2 acres (51.5 hectares) for Interconnection Cable Route Option 1. While the NLCD does include wetland land cover classes, refer to Section 3.22 (Table 3.22-4) for wetland impacts on the Onshore Project components based on wetland delineation survey data. Total estimated tree clearing would be 117 acres (47 hectares) for Interconnection Cable Route Option 1 and 101 acres (41 hectares) for Interconnection Cable Route Option 6. Approximately 76 percent of Interconnection Cable Route Option 1 (Proposed Action) and 70 percent of Interconnection Cable Route Option 6 (Alternative D-2) would be collocated with existing linear development. The Chicory Switching Station (Interconnection Cable Route Option 6) is in an area identified as general ecological integrity (C5), and would be built within a forested parcel, with potential for habitat loss/fragmentation for bats due to tree clearing within multiple forest NLCD land cover classes (Table 3.8-4). The Chicory Switching Station would have a footprint of 35.5 acres (14.4 hectares) but would result in a greater area of impact on undeveloped NLCD land cover classes than the Harpers Switching Station, which would be located entirely within the existing Aeropines Golf Club and permanently affect 35.3 acres (14.3 hectares) of NLCD land cover classes. Overall, impacts at the Chicory Switching Station (Alternative D-2) would predominantly occur on previously undisturbed forest/wetland habitats (Tables 3.8-4 and 3.8-5), whereas impacts at the Harpers Switching Station (Proposed Action) would be on portions of developed areas (Tables 3.8-2 and 3.8-3). Similar to the

Proposed Action, impacts associated with onshore clearing and construction would be localized and temporary. While Alternative D-2 would result in a slight increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates the difference in potential impacts on bats would be nominal.

The impacts resulting from noise and land disturbance under Alternative D-1 would be the same as those described under the Proposed Action. Alternative D-2 would have a slightly increased potential to permanently affect forested and wetland habitats when compared to the Proposed Action. As described for the Proposed Action, and based on wetland and NLCD cover class mapping, Alternative D-1 (Interconnection Cable Route Option 1) would have the least potential to permanently affect forested and wetland habitats as compared to Alternative D-2 (Hybrid Interconnection Cable Route Option 6). No individual fitness or population-level effects would be expected from onshore construction and associated loss/fragmentation of foraging associated with Alternatives D-1 or D-2, and, as a result, BOEM anticipates minor impacts. While Alternative D-2 would result in an increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates impacts of Alternatives D-1 or D-2 to be similar on bats to those described under the Proposed Action: negligible to moderate impacts with overall moderate impacts on bats.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternatives D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.5.7.1 Conclusions

Impacts of Alternative D. The Proposed Action only considers Interconnection Cable Route Option 1 while Alternative D considers Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2). BOEM anticipates the impacts on bats resulting from Alternative D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be slightly greater than under the Proposed Action due to construction and clearing occurring on a larger area of undisturbed forest/wetland habitats; however, the impacts are not expected to change under Alternatives D-1 or D-2 relative to the Proposed Action. Impacts on bats would range from **negligible** to **minor**. Impact ratings associated with individual IPFs would not change.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on bats from ongoing and planned actions, including Alternative D-1 or D-2, would be similar to those described for the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts that range from temporary to long term. While Alternative D-1 would result in the same level of impact on bats and Alternative D-2 may result in a slightly higher level of impact on bats than described under the Proposed Action, the overall impacts of Alternatives D-1 or D-2 on bats would be the same as under the Proposed Action: **minor**. This impact rating is derived primarily by ongoing conditions such as climate change, as well as disturbance and habitat removal associated with onshore construction. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.5.8 Agency-Required Mitigation Measures

The measures listed in Table 3.5-2 are recommended for inclusion in the Preferred Alternative. If the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced.

Table 3.5-2 Measures Resulting from Consultations: Bats[1]

Measure	Description	Effect
Adaptive mitigation for birds and bats	BOEM will require that Dominion Energy develops and implements a Post-Construction Monitoring (PCM) plan based on Dominion Energy's Proposed Bird and Bat Monitoring Framework in coordination with USFWS and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring. Prior to commencing offshore construction activities, Dominion Energy must submit the PCM for BOEM and USFWS review. BOEM and USFWS will review the PCM and provide any comments on the plan within 30 calendar days of its submittal. Dominion Energy must resolve all comments on the PCM to BOEM and USFWS's satisfaction before implementing the plan. a. Monitoring. Dominion Energy must conduct monitoring as outlined in Dominion Energy's Proposed Bird and Bat Monitoring Framework, which will include acoustic monitoring of bat presence, the use of motus receivers and tags to monitor bird and bat movements, and others TBD. b. Annual Monitoring Reports. Dominion Energy must submit to BOEM (at renewable_reporting@boem.gov), USFWS, and BSEE (at OSWSubmittals@bsee.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 6 months of completion of the last avian survey. The report must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. BOEM, USFWS, and BSEE will use the annual monitoring reports to assess the need for reasonable revisions (based on	If the reported post-construction bat monitoring results indicate bat impacts deviate substantially from the impact analysis included in this EIS, then Dominion Energy must make recommendations for new mitigation measures or monitoring methods.

Measure	Description	Effect
	subject matter expert analysis) to the PCM. BOEM, BSEE, and USFWS reserve the right to require reasonable revisions to the PCM and may require new technologies as they become available for use in offshore environments. c. Post-Construction Quarterly Progress Reports. Dominion Energy must submit quarterly progress reports during the implementation of the PCM to BOEM (at renewable_reporting@boem.gov) and the USFWS by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The progress reports must include a summary of all work performed, an explanation of overall progress, and any technical problems encountered. d. Monitoring Plan Revisions. Within 15 calendar days of submitting the annual monitoring report, Dominion Energy must meet with BOEM and USFWS to discuss the following: the monitoring results; the potential need for revisions to the PCM, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If BOEM or USFWS determines after this discussion that revisions to the PCM are necessary, BOEM may require Dominion Energy to modify the PCM. If the reported monitoring results deviate substantially from the impact analysis included in the Final BA, Dominion Energy must transmit to BOEM recommendations for new mitigation measures and/or monitoring methods. e. Operational Reporting (Operations). Dominion Energy must submit to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) an	

Measure	Description	Effect
	annual report summarizing monthly operational data calculated from 10-minute SCADA data for all turbines together in tabular format: the proportion of time the turbines were operational (spinning at >x rpm) each month, the average rotor speed (monthly rpm) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the impact analysis included in the Final BA. f. Raw data. The Lessee must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to BOEM, BSEE and USFWS, upon request for the duration of the Lease. The Lessee must work with BOEM to ensure the data are publicly available. USFWS may specify third-party data repositories that must be used, such as the Motus Wildlife Tracking System or MoveBank, and such parties and associated data standards may change over the duration of the monitoring plan.	
Annual bird and bat mortality reporting	Dominion Energy must provide an annual report to BOEM and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with federal or research bands must be reported to the United States Geological Survey Bird Band Laboratory, available at https://www.pwrc.usgs.gov/bbl/. Any	Annual bat mortality reporting can inform the Avian and Bat Post-Construction Monitoring Plan (see previous measure), which could lead to Dominion Energy recommending new mitigation measures or monitoring methods to reduce impacts on bats. In addition, mortality data can inform future BOEM offshore wind EIS analyses for proposed wind farms on the Atlantic OCS.

Measure	Description	Effect
	occurrence of a dead ESA-listed bird or bat must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state.	
Surveys, Avoidance, and Minimization (bat acoustic surveys)	To minimize potential impacts on northern long-eared bats and Indiana bats, which may be present year-round, Dominion Energy has conducted surveys (mist-net) and is developing avoidance and minimization measures, including adhering to the existing requirements for tree clearing under 4(d) provisions prior to implementation of the new regulations on April 1, 2024 and adhering to the year-round time of year restrictions for suitable habitat included in the new regulation in coordination with BOEM, USFWS, and VDWR.	This measure could result in additional impact reduction on ESA-listed bats and non-protected bats.

[1] Also Identified in Appendix H, Table H-2.

3.5.8.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.5-2 and Appendix H, *Mitigation and Monitoring*, Table H-2 are incorporated in the Preferred Alternative. These measures, if adopted, would further define how the effectiveness and enforcement of APMs would be ensured and improve accountability for compliance with APMs by requiring monitoring, reporting, and adaptive management of potential bat impacts on the OCS. However, 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 are unlikely to appreciably contribute to impacts on bats regardless of measures intended to address potential offshore bat impacts. In the onshore environment, conducting pre-construction surveys and coordinating with VDWR and USFWS would ensure impacts on bats and their habitats would be avoided and minimized to the extent practicable. Because these measures ensure the effectiveness of and compliance with APMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.2, *Environmental Consequences*.

3.6. 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 3.6-1, includes both a 10-mile (16.1-kilometer) radius/buffer around the Wind Farm Area and a 330-foot (101-meter) buffer around the export cable route corridors. The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect marine 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). Finfish, invertebrates of commercial or recreational value, and EFH are addressed in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*.

3.6.1 Description of the Affected Environment for Benthic Resources

This section discusses potential impacts on benthic resources, excluding fishes (Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*) and commercially important benthic invertebrates (Section 3.13) from the proposed Project, alternatives, and ongoing and planned activities in the benthic resources geographic analysis area. The benthic resources geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.6-1, includes the Offshore Project area. Soft sediment types in the Offshore Project area are shown on Figure 3.6-2.

The geographic analysis area is based on where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources and includes a 10-mile (16.1-kilometer) buffer around the Lease Area and a 330-foot (100.6-meter) buffer around the offshore export cable route corridor. These buffers would account for transport via local 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).

Descriptions of the benthic resources offshore Virginia are provided in a previous Environmental Assessment (EA) (BOEM 2015); benthic resources offshore Virginia are characterized in the lease issuance EA for New Jersey, Delaware, Maryland, and Virginia (BOEM 2012) and the COP (Dominion Energy 2023) and are incorporated by reference.

The benthic resources specific to marine habitats and associated biological assemblages in the Offshore Project area are described in Section 4.2.4 of the COP (Dominion Energy 2023), prepared in accordance with BOEM site characterization requirements (30 CFR 585.626), and BOEM's benthic habitat survey guidelines (BOEM 2019). The description of the benthic resources in the Offshore Project area was supported by a 2020 Benthic Resource Characterization Survey (BRCS) with the survey report (COP, Appendix D; Dominion Energy 2023). The BRCS included the Offshore Project area, which includes those portions of the Project components in the Lease Area and offshore export cable route corridor that could be directly or indirectly affected by the construction and installation, operations and maintenance, or conceptual decommissioning of the Project. The Lease Area covers approximately 112,799 acres (45,648 hectares) of seafloor with water depths up to 98 feet (30 meters) in the offshore export cable route corridor and 49 to 131 feet (15 to 40 meters) in the Lease Area.

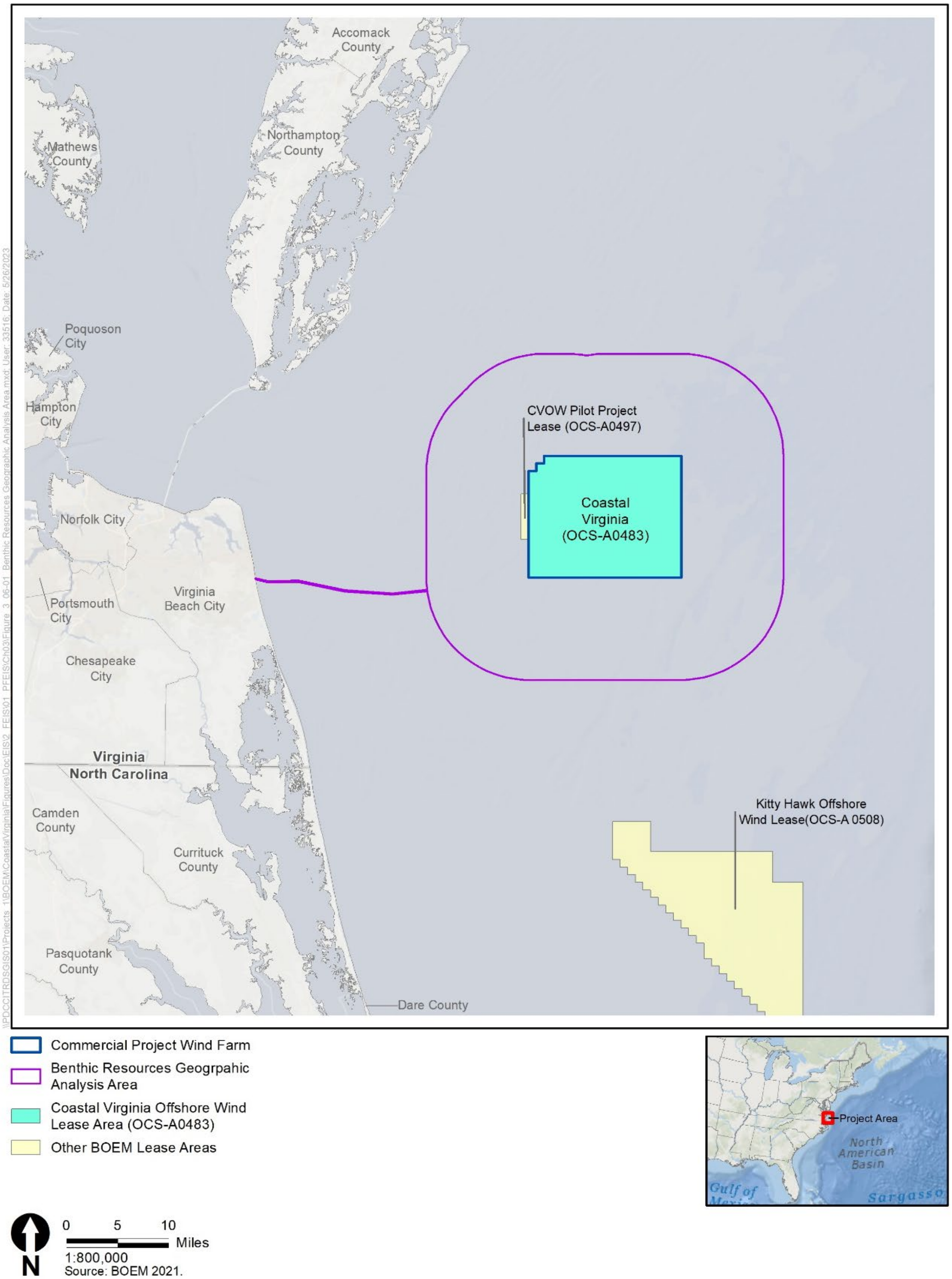


Figure 3.6-1 Benthic Resources Geographic Analysis Area

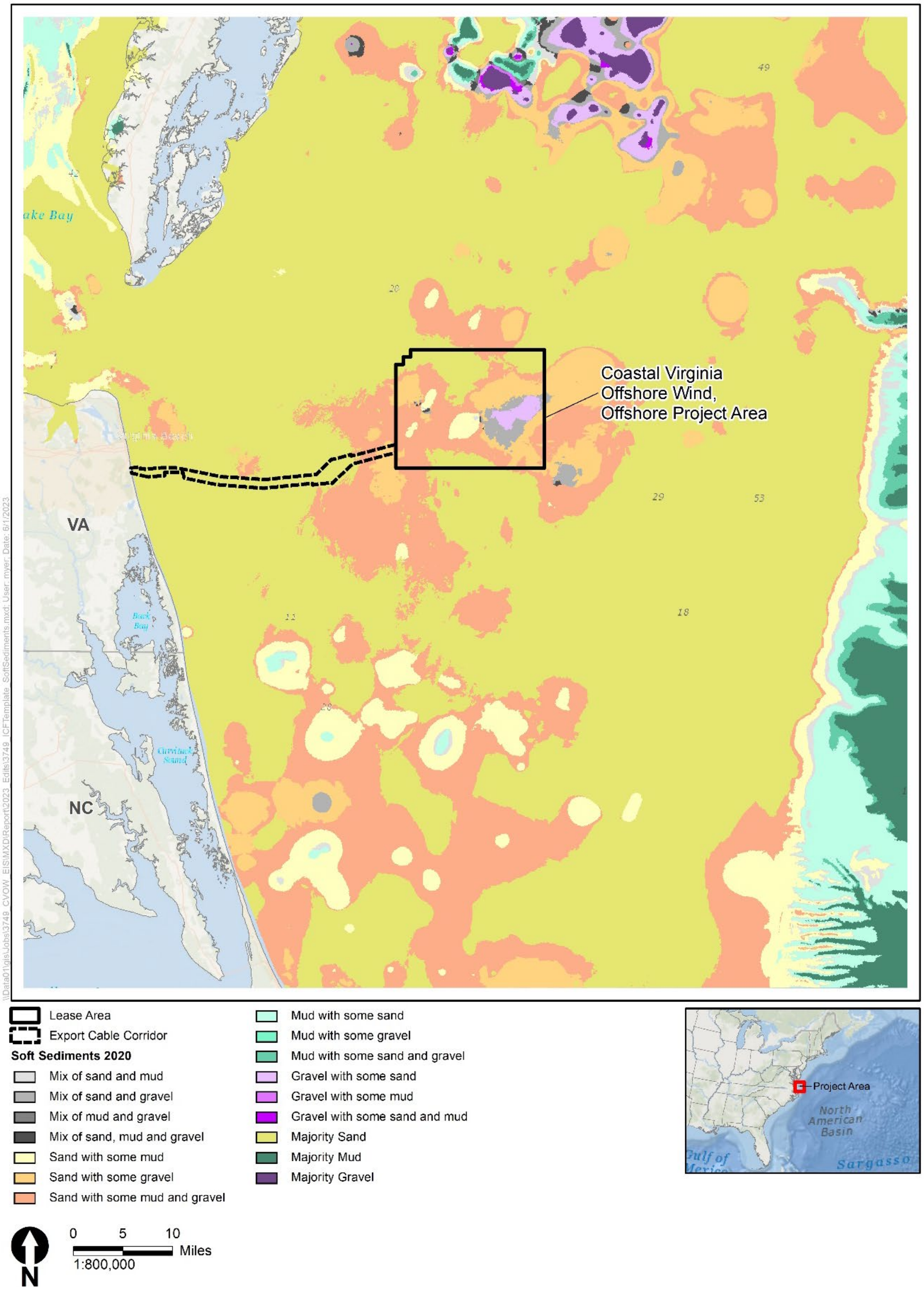


Figure 3.6-2 Soft Sediment Types in the Offshore Project Area for the Coastal Virginia Offshore Wind Project

The following conclusions were drawn based on the results of the 2020 BRCS, with other findings incorporated by reference.

- The surficial benthic substrate in the Mid-Atlantic Bight is primarily soft-bottom, sandy seascape exhibiting both flat-bottom relief and benthic features such as ripples (defined as wavelengths less than 16.4 feet [5 meters], and a height less than 1.6 feet [0.5 meter] [BOEM 2020]), sand waves (defined as wavelengths that exceed 197 feet [60 meters] and are 5 feet [1.5 meters] in height [BOEM 2020]), and ridges. Areas of heterogenous, hard-bottom, and other complex habitats also exist within the Mid-Atlantic Bight. (MARCO n.d.; Stevenson et al. 2004; USGS n.d.).
- The Offshore Project area is dominated by fine to coarse sand, 93.2 percent primarily fine sand with patches of gravel (3.7 percent) and silt clay substrates (3.0 percent) within the Lease Area and along the export cable route corridor. Muddy sand is prevalent in the nearshore portion of the export cable route corridor, while the rest is dominated by low-relief sandy seabed, with sand ridges, and ripples.
- Bottom topography in the Offshore Project area is characterized by a sedimentary fan, shelf valley tributaries to the north and east, and a series of sand ridges trending northeast to southwest. Rugosity is virtually zero throughout the area.
- Natural reefs are reportedly absent from the Offshore Project area. However, artificial reef habitat, including the Triangle Reef (also known as "Triangle Wrecks" and charted as a Fish Haven) is located in the northern portion of the Lease Area (Figure 3.6-3). Additionally, other charted shipwrecks that likely function as artificial reef habitats are present in other locations of the Offshore Project area and adjacent waters.
- No seagrass beds are reported to occur within the offshore export cable route corridor or elsewhere in the Offshore Project area.
- Typical of the Mid-Atlantic Bight, sand shoals, ridges, waves, megaripples, and ripples were identified in the Offshore Project area and provide habitat for benthic infaunal organisms typical of this region.
- The dominant benthic infauna identified in the Offshore Project area were annelids, mollusks, and arthropods. Polychaetes were numerically dominant across all sampling areas, followed by mollusks and crustaceans.
- Mollusks had the highest overall biomass followed by annelids and crustaceans.

The regional oceanography is driven by multiple factors, with currents below the surface as the most influential. The Gulf Stream waters move warm water from the south northward along the shelf, and the cold waters of the Labrador current mouth south along the coast. This combination creates consistent eddies and gyres in the Mid-Atlantic Bight. Fresh water flow from Chesapeake Bay also influences the regional currents. The cold northern waters sink under the warmer waters, creating the Mid-Atlantic Bight Cold Pool. The Cold Pool extends from the south of Georges Bank to near Cape Hatteras. The Cold Pool develops in the spring and ensures vertical stratification through the summer and fall (Friedland et al. 2022; Miles et al. 2021; Lentz 2017).

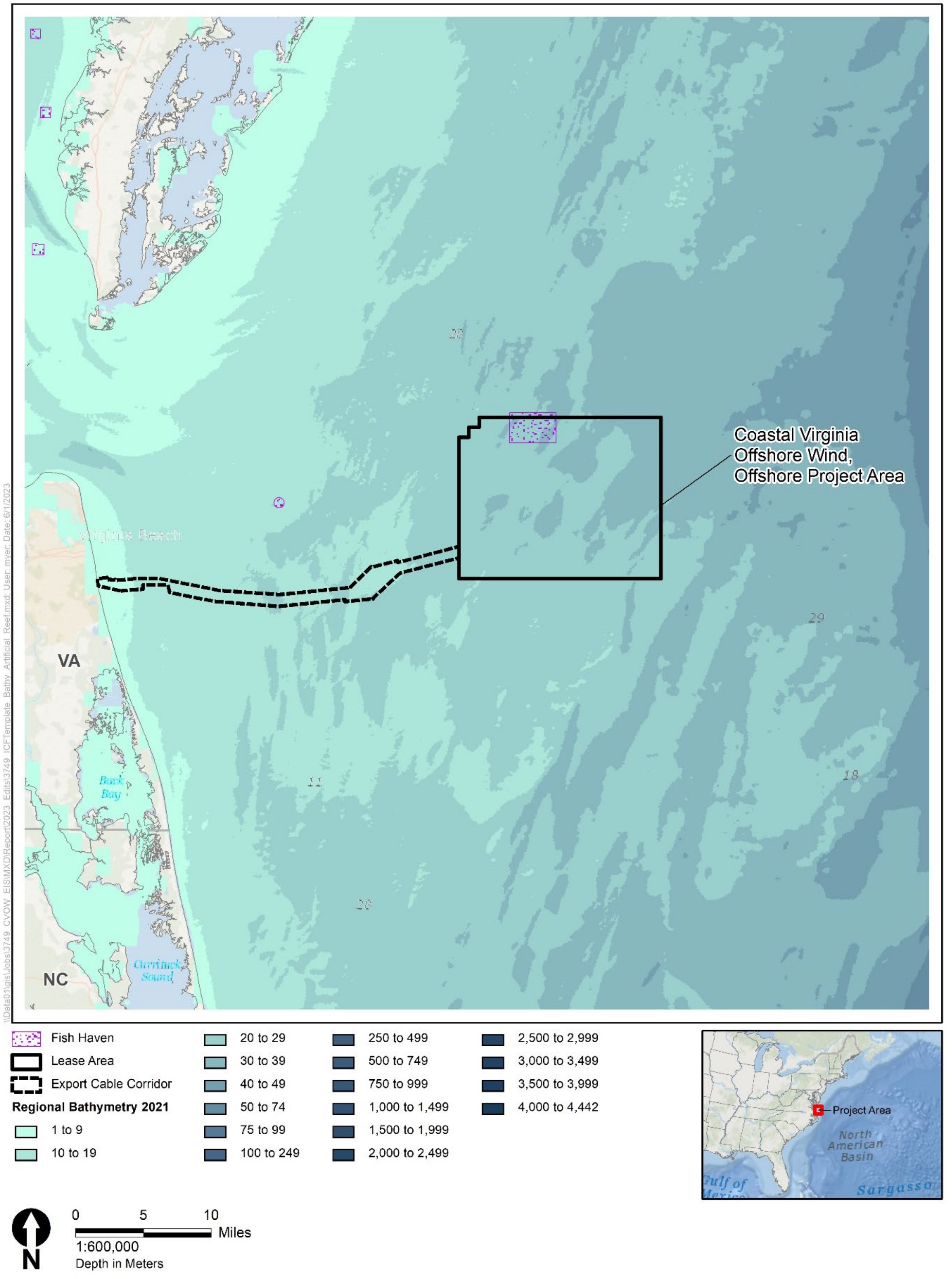


Figure 3.6-3 Bathymetry and Artificial Reef Areas in the Offshore Project Area for the Coastal Virginia Offshore Wind Project

The inner continental shelf is characterized by a seabed morphology consisting of relatively flat, migrating sand waves and ripples with occasional larger shoals. The seabed generally slopes west to east toward the OCS edge, with the shallowest waters in the west. The seafloor conditions are dominated by sand and silt-sized sediments. These homogenous conditions were identified by multibeam echo sounding and side-scan sonar imaging techniques. The geotechnical assessments were ground-truthed via the benthic grab samples, underwater video, borings, cone penetration tests, and further verified via historical grab sample and still photo data (Guida et al. 2017; Cutter and Diaz 1998). The CVOW-C benthic survey report (COP, Appendix D; Dominion Energy 2023) characterized the area as sand dominated. Sand dominated all grab samples with a mean of 93.2 percent (primarily fine sand), followed by 3.7 percent gravel and 3.0 percent silt and clay. Surveys conducted for the CVOW-Pilot Project (Tetra Tech 2013, 2014) classified the Lease Area as a softbottom mosaic with fine to coarse sands and low organic content. Northeasterly trending sand ridges of high relief and extent are situated on a broad, shallow shoal complex (two or more shoals and the trough separating them) to the southwest. These shoals are typically megahabitats, and are often composed of different meso, macro, and microhabitats defined by such factors as exposure, sediment texture, depth, and rugosity (Rutecki et al. 2014). Differences in benthic community structure occur between the current-facing side and the lee sides of the shoal (CSA et al. 2009). Adults, settled juveniles, and larvae of multiple fish and invertebrate species use these shoal complexes for refuge, spawning, larval recruitment, foraging, and migration (Rutecki et al. 2014). Sand ridges and troughs provide complex physical structures that are often associated with greater species diversity, abundance, overall function, and productivity. A 2-year study by Slacum et al. (2010) conducted on the inner continental shelf of the Mid-Atlantic Bight showed greater species diversity, abundance, and richness of benthic organisms in flat-bottom habitats than in shoal habitats. They also noticed seasonal trends with lower values of all those indices during the winter than in the spring through fall (Slacum et al. 2010). The distance between simple and complex habitats plays an import role in the diel migration (Diaz et al. 2003). Trawls data from Diaz et al. (2003) suggested that during the day the complex habitats had twice as many fish relative to the nearby sand habitats, while the opposite was true at night. In the Mid-Atlantic Bight, sand ridges and troughs are areas of biological significance for migration and spawning of many fish species. (Refer to Sections 3.9 and 3.13 for additional information.) Shoal habitats occur in high-energy environments and migrate in a generally southwest direction within the Mid-Atlantic Bight (Rutecki et al. 2014). The northern portions of the Lease Area consist of sand ridges and superimposed bedforms. Smaller surficial features, including dunes and sediment ripples resulting from short-term wave and tidal processes, are superimposed on the more extensive features throughout, indicating the potential for sediment transport within the Mid-Atlantic Bight. Substrates are typically fine to medium-grain sand within the Offshore Export Cable Corridor (OECC), with some gravel and small sand ridges and waves no higher than 8.2 feet (2.5 meters) in the deeper portions. Slopes are consistently less than 5 degrees along the OECC. Closer to the boundaries of the Offshore Project area, ridges and waves increase in width and attain maximum heights of 16.4 feet (5.0 meters) (Tetra Tech 2013). Site-specific geophysical surveys provide a more detailed description of bottom habitat features for the Lease Area and OECC (COP, Appendix E; Dominion Energy 2023).

Various benthic fauna are found in the continental shelf habitat of the Project area ranging in size from microscopic to larger macrofauna. Common macrofauna of the inner continental shelf include species from several taxa, including echinoderms (e.g., sea stars, sea urchins, sand dollars), cnidarians (e.g., sea anemones, soft corals), mollusks (e.g., bivalves, cephalopods, gastropods), bryozoans, sponges, and crustaceans [i.e., amphipods]) (BOEM 2012). The Project area has similar fauna with polychaete worms numerically dominant throughout and mollusks comprising most (78.2 percent) of the total biomass, followed by annelids (9.6 percent), and arthropods (7.8 percent) (COP, Appendix D; Dominion Energy 2023).

Artificial reefs are human-made underwater structures that are developed intentionally or from remnants of objects built for other purposes, such as shipwrecks. Artificial reef habitat does occur in the northern portion of the Lease Area ("Triangle Reef" Fish Haven) (Figure 3.6-3; COP Figure 4.2-15; Dominion Energy 2023), as well as charted shipwrecks that function as artificial reef habitat in other locations of the Offshore Project area and adjacent waters (COP, Figure 4.2-15; Dominion Energy 2023). Triangle Reef consists of several large, scuttled World War II-era ships (tankers and transport ships), tires, cable spools, and other materials deposited in the Fish Haven area since the 1970s to facilitate artificial reef development (Lucy 1983; VMRC 2020) and serves as a targeted fishing location. For more information on Triangle Reef, see Appendix I, *Environmental and Physical Settings*, Section I-3, or Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*.

3.6.2 Environmental Consequences

3.6.2.1 Impact Level Definitions for Benthic Resources

Definitions of impact levels are provided in Table 3.6-1.

Table 3.6-1 Impact Level Definitions for Benthic Resources

Impact Level	Adverse or Beneficial	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.

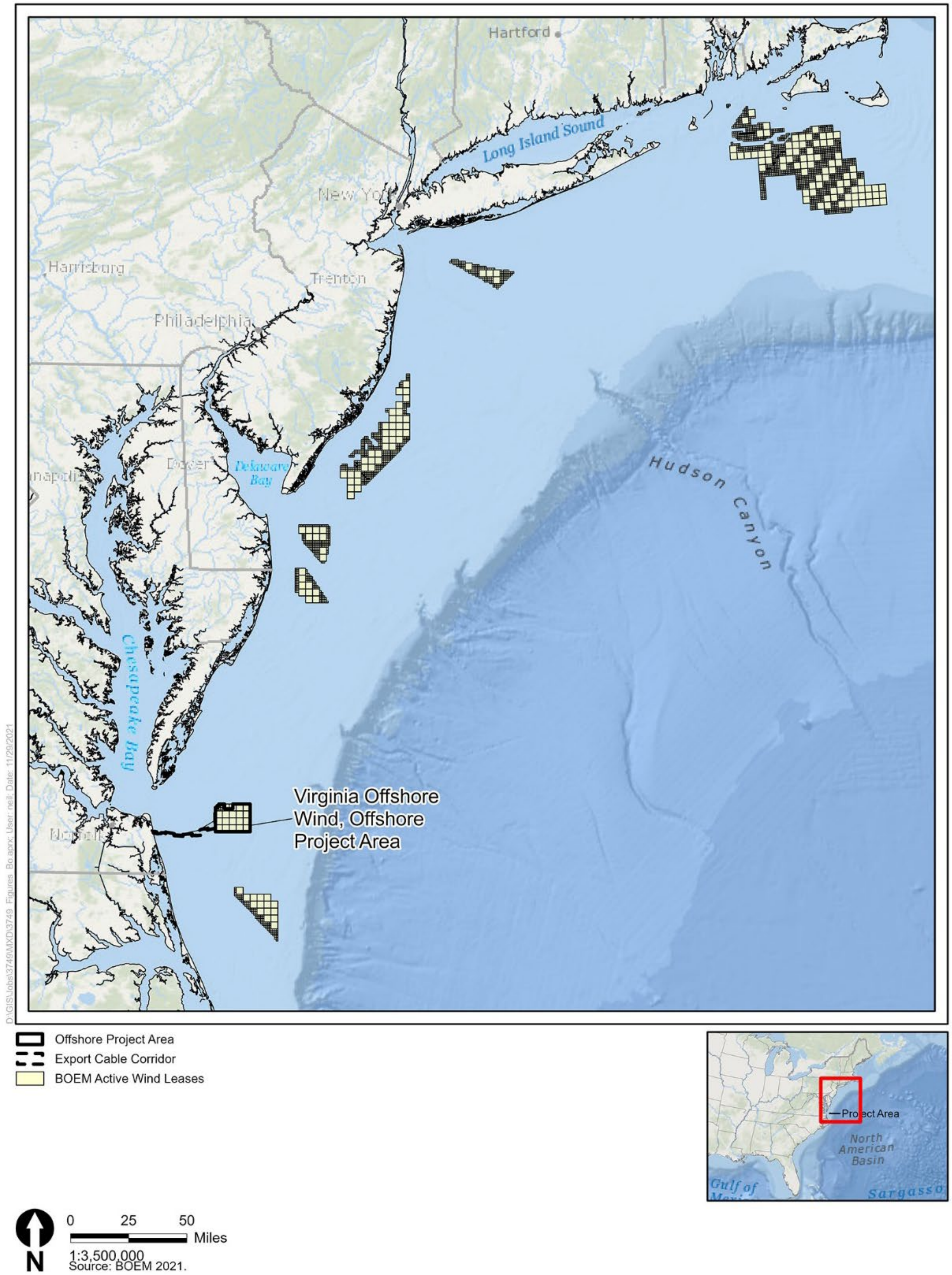


Figure 3.6-4 Renewable Energy Lease Areas Offshore the East Coast

3.6.3 Impacts of the No Action Alternative 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 activities and ongoing offshore wind activities on the baseline conditions for benthic resources. The only ongoing offshore wind project in the geographic analysis area for benthic resources is the CVOW-Pilot Project.

Figure 3.6-4 shows renewable lease areas offshore on the East Coast. 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 within the geographic analysis area, as described in Appendix F. There are no planned offshore wind projects that are within the geographic analysis area at this time. The closest planned offshore wind activities are Kitty Hawk Wind North and Kitty Hawk Wind South, OCS-A 0508 Lease Area offshore North Carolina (COP, Appendix F, Table F-4; Dominion Energy 2023); this lease area is located approximately 24 miles (38.4 kilometers) south of the Offshore Project area (Figure 3.6-5). Since these are outside of the geographic analysis area for benthic resources, they will not be considered as part of the cumulative impacts.

3.6.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for benthic resources described in Section 3.6.1, *Description of the Affected Environment for Benthic Resources*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind activities. Ongoing non-offshore wind activities that may affect benthic resources include new submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, port improvement, military use, marine transportation, fisheries use and management, global climate change, and oil and gas activities (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). Ongoing activities within the geographic analysis area that contribute to impacts on benthic resources are generally associated with inshore dredging, coastal development, offshore construction including bottom disturbance and habitat conversion, and climate change.

This area has high vessel traffic, including trans-Atlantic marine transportation. In turn vessel anchoring, the risk of accidental spills, and nonnative species transfer through ballast water discharge would continue. The Lease Area is within the Virginia Capes Range Complex and the Virginia Capes Operating Area actively used by the military. Anchoring and vessel traffic within this zone contribute to the impacts of ongoing marine activities. Ongoing vessel traffic as well as routine construction and maintenance along the coastline or in nearshore waters add noise to the marine environment. To ensure navigable waterways for high vessel traffic, Norfolk harbor and nearby tributaries will continue to be dredged and material disposed of at the nearby Dam Neck Ocean Disposal Site (DNODS). Dredging can cause localized short-term impacts (habitat alteration, injury, and mortality). Dredging activities disturb the benthic habitats, suspend sediment, and increase turbidity which decreases overall water quality. Sediment deposition following dredging can also cause mortality by smothering benthic organisms, including shellfish.

Due to the life cycles of demersal finfish and invertebrate species, adverse impacts may extend outside of the vicinity of a port. The magnitude of impacts would depend on the time (season) and place (habitat type) where the activities would occur. Dredging typically occurs only in sandy or silty habitats, which are abundant in the benthic resources geographic analysis area and are quick to recover from disturbance.

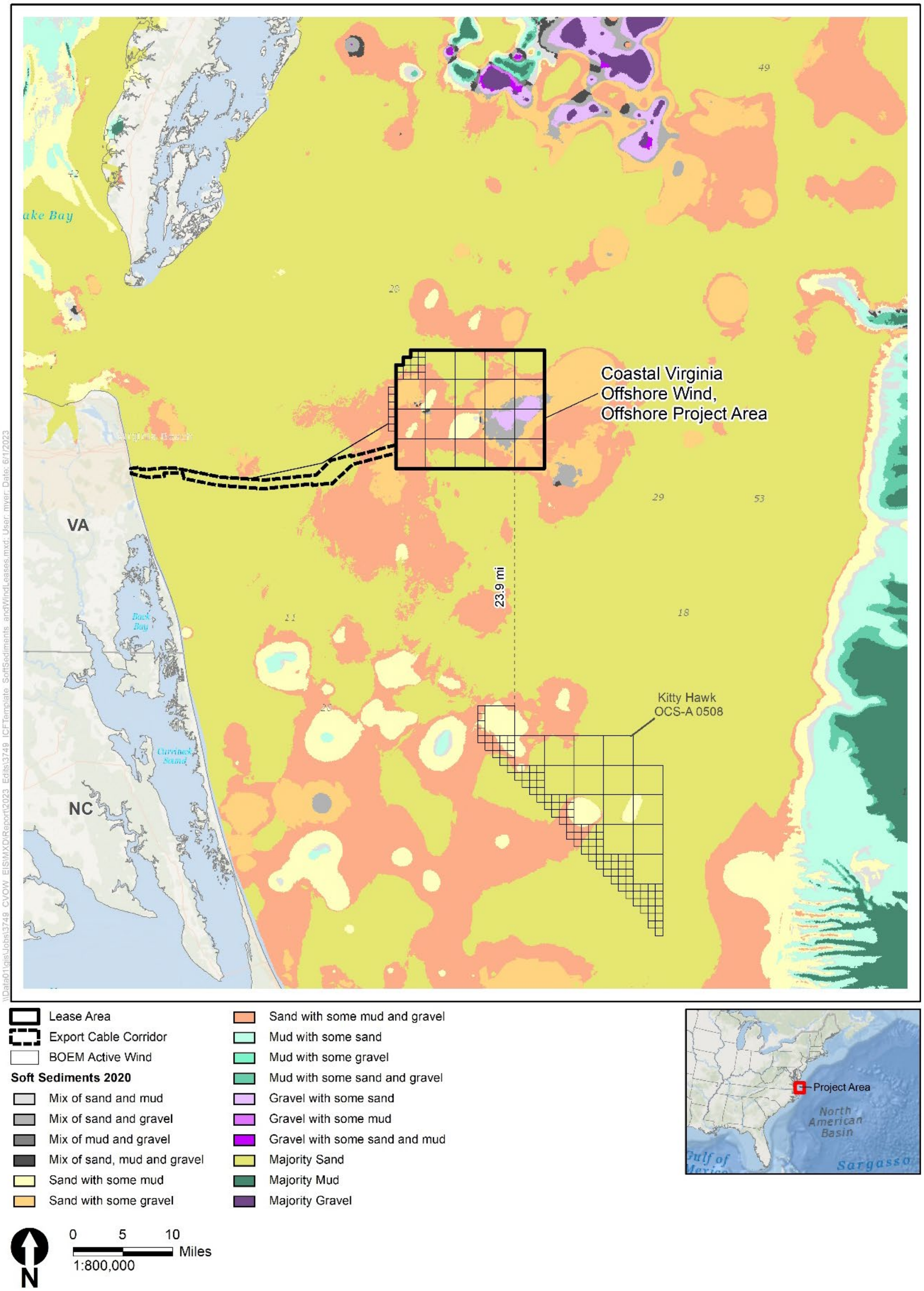


Figure 3.6-5 Kitty Hawk Offshore Wind OCS-A 0508 Lease Area, 24 miles (38.4 kilometers) from the Offshore Project Area of the Coastal Virginia Offshore Wind Project and Area Sediment Types

Ongoing commercial and recreational fishing would continue within the geographic analysis area. Fishing regulations for finfish and shellfish are implemented and enforced by Virginia, individual local municipalities, NOAA, or all depending on jurisdiction. The regulations affect benthic ecosystems by modifying the nature, distribution, and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing) (Section 3.9). Seabed disturbance by fishing activity results in physical impacts related to resuspension of fine sediments and scarring of the seabed, chemical effects due to resuspension of nutrients, and biological impacts related to alteration of the benthic community structure (DeAlteris et al. 2000). Fishing, in particular the use of bottom-tending gear, has adverse effects to benthic resources (DeAlteris et al. 2000).

Ongoing offshore wind activities would have the same types of impacts from vessel noise, presence of structures, and nearshore disturbance that are described in detail in Section 3.6.3.2, *Cumulative Impacts of the No Action Alternative*, for planned offshore wind activities, but the impacts would be of lower intensity with only two WTGs for the CVOW-Pilot Project. The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on benthic resources.

- Continued O&M of the CVOW-Pilot Project (two WTGs) installed in OCS-A 0497.

3.6.3.2 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). Because there are no planned offshore wind activities within the benthic resources geographic analysis area, the cumulative impacts will not address future offshore wind projects. Under the No Action Alternative benthic habitat would be disturbed through the following primary IPFs.

Accidental releases: Accidental releases would continue to occur as a result of ongoing and planned activities. An anticipated increase in marine transportation will also increase the risk of accidental releases. Impacts of accidental releases are relative to their magnitude. Smaller releases are expected to occur at a higher frequency and to be less severe, while major releases are expected to be rare but have greater impacts. If accidental releases do occur, their impacts are likely to be localized and short term, with a full recovery expected.

Accidental releases of hazardous materials mostly consist of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater; as such accidental releases would occur at or near the ocean surface in association with vessel operations and would be unlikely to contact benthic resources. The low likelihood, properties of the materials likely to be released, and volume of the potential releases along with the cleanup measures in place suggest impacts on benthic resources would be negligible.

Nonnative species would also be released accidentally, especially during ballast water and bilge water discharges from marine vessels. More than 200 countries around the world use direct and dedicated shipping services to and from Virginia (USCG 2021). More than 40 international commercial vessels use Virginia marine ports (USCG 2021). In 2019 alone, more than 2,500 commercial ships used the Port of Virginia, the second largest exporter on the East Coast (USCG 2021). This volume of vessel traffic implies that accidental releases of nonnative species as a result of ongoing and planned trans-oceanic activities would continue to occur. Accidental releases of trash and debris as a result of increased vessel traffic with planned activities would continue. There is no evidence that anticipated volumes of trash or debris would have measurable impacts on benthic resources.

Anchoring: Ongoing and planned activities include vessels anchoring within the inshore and offshore geographic analysis area. Anchoring from vessels related to ongoing and planned commercial, recreational activities, and military use would continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Sessile and slow-moving species (e.g., corals, sponges, and sedentary shellfish) would be most affected, as physical contact would cause mortality of benthic species. Impacts from anchoring would be localized with temporary elevated turbidity and mortality of soft-bottom benthic resources that are likely to recover relatively quickly (Dernie et al. 2003). Anchoring on hard-bottom (i.e., gravelly) substrates may impart somewhat longer impacts. Given the relatively small amount of seafloor affected by anchoring and short-term turbidity, benthic impacts would be negligible.

Electromagnetic fields: EMF would continue to result from existing and new transmission or communication cables. Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. Transitory exposures to magnetic fields at the seabed above the buried cables were found to be at levels below reported thresholds for effects on the behavior of magnetosensitive marine organisms. EMF strength diminishes rapidly with distance, and potentially meaningful EMFs would likely extend less than 50 feet (15.2 meters) from each cable (McCormick et al. 2008). Some benthic species can detect EMFs, although EMFs do not appear to present a barrier to animal movement. Copping et al. (2016) reported that although burrowing infauna may be exposed to stronger EMFs from marine renewable energy devices, there was no evidence that the EMFs anticipated to be emitted from those devices would affect any species. Common subsea power cables of 850 to 1,600 Amperes (A) would produce EMF of up to 3.2 milliTesla (mT) (Harsanyi et al. 2022). Although in-situ measurements are insufficient, EMF studies have ranged between 200 microTesla (µT) to 165 mT (Harsanyi et al. 2002). The effects of EMF and heat on most invertebrate taxa (e.g., embryonic and juvenile crustaceans and mollusks, horseshoe crabs) remain understudied (Gill and Desender 2020). Albert et al. (2022) found no differences in valve activity or filtration rates (suggesting no hinderance of feeding behaviors) in adult blue mussels exposed to HVDC of 300 µT compared to the control. Yet Jakubowska-Lehrmann et al. (2022) found significantly lower filtration rates in cockles (*Cerastoderma glaucum*) that were exposed to 6.4 mT for 8 days. No changes in the respiration were noted but ammonia excretion rates were significantly lower after exposure to EMFs. Further studies are needed to understand the implications of this conflicting information as it applies in natural marine environments. A direct current of 300 µT did not significantly impair the filter-feeding processes (Albert et al. 2022). Due to the small footprint of existing undersea transmission lines within the geographic analysis area and the fact that EMF decreases rapidly with distance from the cable, impacts from EMF would be negligible.

New cable emplacement and maintenance: New or expanded submarine cables are likely to occur in the geographic analysis area over the next 30 years. These anticipated disturbances would be infrequent, local, and temporary. Cable routes for future projects, including Kitty Hawk, have not been fully determined at the time of preparation of this EIS. If the cable routes enter the geographic analysis area, then benthic impacts would result from installation and routine maintenance. Cable maintenance activities infrequently disturb benthic resources and cause temporary increases in suspended sediment; these disturbances would be local and limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season and benthic substrate. Benthic species are generally adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area. Due to the limited footprint of existing cables and short duration of this type of activity, this would be a minor impact.

Should the installation of the 465 miles (729 kilometers) of the Kitty Hawk Wind North and Kitty Hawk Wind South offshore export cables enter into the geographic analysis area, their impacts would be factored in. However, given the distance from the Project area, impacts would likely be negligible.

Noise: Anthropogenic underwater sounds come from many different sources including vessel traffic, seismic surveys, and active sonar used for navigation of large vessels, and chart plotting. The extent of the impact depends on equipment used, noise levels, and local acoustic conditions. Construction noise occurs frequently along populated areas in the Mid-Atlantic nearshore, but infrequently offshore. Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. The intensity and extent of noise from construction is difficult to generalize, but these impacts on benthic communities are local and temporary. Activities from ongoing site characterization surveys and scientific surveys produce noise around sites of investigation, usually offshore. Noise from G&G surveys of Kitty Hawk cable routes and other site characterization surveys could disturb benthic species in the immediate vicinity of the investigation and cause temporary behavioral changes. These activities would disturb benthic species in the immediate vicinity of the investigation but would likely not affect the invertebrates in the geographic analysis area due to the distance.

Due to the lack of information regarding basic neurological and physiological responses for most species at realistic exposure levels, inferences about the effects of impulsive sound source activity, like pile driving and G&G survey activities, on marine invertebrates can be challenging and fraught with uncertainty (Carroll et al. 2016). There remains a vast gap in our knowledge about sound thresholds and recovery from impact in almost all invertebrates (Carroll et al. 2016) which confounds the ability to assess potential impacts on benthic species from exposure to noise. English (2017) reported marine invertebrates to be considered less susceptible than mammals and fish to loud noise and vibration as their bodies do not generally possess air-filled spaces, but also reported that noise at high levels can cause short-term behavioral responses in marine invertebrates. A recent summary of knowledge on how marine renewable energy devices affect the benthic environment indicated that the impact of sound on epibenthos is poorly understood and is generally lacking (Dannheim et al. 2020). Hawkins and Popper (2014) identified various informational gaps concerning effects of noise on invertebrates (e.g., mechanisms for sound detection) that suggest assessment of impacts on benthic species from noise is speculative and would likely be negligible.

Port utilization: Port utilization and maintenance are expected to increase from ongoing and planned activities. USACE and private ports may undertake dredging projects periodically. There are several planned port improvement projects within the Mid-Atlantic Bight, but none within the geographic analysis area at this time. Ongoing sediment dredging for navigational purposes would continue in shallow and nearshore areas, resulting in localized, short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through sediment deposition. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on the season. There are two active projects along the Virginia Coast with dredge disposal sites located offshore Norfolk, Virginia (Norfolk site) and DNODS (USACE 2020; USEPA 2019), though it is possible that new disposal sites are created. Impacts of infrequent ocean disposal on benthic resources would be short term because spoils are typically recolonized naturally. Some organisms would become buried under the dredge spoils; however, most sediment-dredging projects have time-of-year restrictions to minimize impacts on benthic resources. In addition, USEPA has established dredge spoil criteria and it regulates the disposal permits issued by USACE. The benthic species in these habitats are generally adapted to the turbidity and periodic sediment deposition that occur naturally. Overall, projects around port utilization, including dredging and port construction would have moderate but localized impacts on benthic resources.

Presence of structures: The presence of structures including shipwrecks, artificial reefs, and meteorological buoys or towers would lead to impacts on benthic resources through entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation, and habitat conversion. Each is described in subsequent text.

The presence of structures would increase the risk of gear loss/damage by entanglement. The lost gear, moved by currents, could disturb, injure, or kill benthic organisms. The intermittent impacts at any one location would likely be measurable and the risk of occurrence would persist while the structures and debris were present. Anthropogenic structures alter local water flow (hydrodynamics) at a fine scale and would cause wake effects that would concentrate prey and alter larval recruitment dynamics (ICF 2021). The presence of vertical structures in the water column, such as artificial reefs creates turbulence that transports nutrients and have been reported to increase food availability for filter-feeders on and near the structures creating a beneficial impact (Degrear et al. 2020).

If artificial reef structures continue to be added to the Fish Haven area, measurable beneficial benthic impacts could result from the creation of reefing habitat. Marine communities in the geographic analysis area are influenced by changes in physiochemical conditions including temperature, pH, storm frequency and severity, and nutrient availability that may be influenced by climate change. Following physical disturbance of the benthos, sessile and slow-moving species may have limited ability to relocate and avoid the rapid onset of adverse conditions; these species may, therefore, experience range retractions rather than shifts. Alternatively, if an environmental change is gradual relative to the organism’s life cycle, even relatively sessile species may adjust. Changes in long-term thermal trends also can influence seasonal movement patterns of marine species. Further, climate change-induced warming of bottom water temperatures on the Mid-Atlantic continental shelf is expected to continue, with a corresponding range shift for sessile and sedentary benthic species to the north and possibly offshore in response (Powell et al. 2020). These changes in centers of benthic species abundance to the north and south would affect community structure and function (Hale et. al. 2017). Additionally, warming ocean temperatures and other climate change–related factors may induce favorable environmental conditions for nonnative species (Zhang et al. 2020).

Structures either natural or artificial create uncommon vertical relief in a predominantly soft-bottom seascape. Structure-oriented fishes would be attracted to these locations as they create reef-like habitats (Mavraki et al. 2021; Degrear et al. 2020), considered a beneficial impact. However, with an increase in fish aggregation, predation in the vicinity of these structures also has the potential to increase predation, an adverse impact on the benthic community (Raoux et al. 2017). These impacts are expected to be localized but long term, continuing for as long as the structures remain. Impacts are expected to be moderate due to the temporal scale and would produce moderate beneficial impacts as well.

New structures provide novel surfaces for colonization and recruitment of marine fauna, creating different benthic communities. The inclusion of colonizing species would result in a faunal assemblages shift, altering local food web dynamics, and increases in biomass for benthic invertebrates (Kerckhof et al. 2019; Raoux et al. 2017; Stenberg et al. 2015).

Discharges: Discharges would continue to occur as a result of ongoing and planned activities within the geographic analysis area. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, as vessel traffic continues to increase. There is no evidence that the volumes and extent of anticipated discharges would have any impact on benthic resources; impacts of discharges on benthic resources would be negligible.

Regulated fishing effort: Commercial and recreational fishing would continue in the geographic analysis area. Fishing regulations for finfish and shellfish are implemented and enforced by Virginia municipalities, NOAA, or both depending on jurisdiction. Disturbance of benthic invertebrate communities by commercial fishing activities can adversely affect community structure and diversity and limit recovery (Avanti Corporation and Industrial Economics 2019), although this impact would be less notable in sandy areas that are strongly influenced by tidal currents and waves (Nilsson and Rosenberg 2003; Sciberras et al. 2016).

Seabed profile alterations: Dredging, mechanical trenching, or both used in the course of offshore construction could cause localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through the sediment deposition IPF. The level of impact from seabed profile alterations would depend on the time of year that they occur, particularly in nearshore locations, and especially if they overlap temporally and spatially with sites characterized by high benthic organism abundance and diversity. Avoiding spring and summer activities that corresponds with spawning season of some invertebrates, may help minimize potential impacts on benthic species. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance, although full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). Locations, amounts, and timing of dredging for future offshore wind projects are not known at this time. Mechanical trenching, used in more resistant sediments (e.g., gravel, cobble), would cause seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line installation in the trench. Therefore, seabed profile alterations, while locally intense, would have limited impact on benthic resources in the geographic analysis area, as a full recovery is expected. Due to the 24-mile (38.4-kilometer) distance of the Kitty Hawk offshore wind lease located outside of the geographic analysis area, impacts on seabed profile alternations expected from offshore wind activities are not expected within the geographic analysis areas.

Sediment deposition and burial: Cable emplacement and maintenance activities (including dredging) in or near the geographic analysis area during construction projects could cause sediment suspension for 1 to 6 hours at a time, after which the sediment is deposited on the seafloor. Sediment deposition would result in adverse impacts on benthic resources, including smothering. Benthic organism tolerance to being covered by sediment (sedimentation) varies among species, with sensitivity to burial determined primarily by infaunal feeding and motility type (Trannum et al. 2010; Jumars et al. 2015). The sensitivity threshold for shellfish varies by species but would be generalized as deposition greater than 0.79 inch (20 millimeters) (Colden and Lipcius 2015; Essink 1999; and Hendrick et al. 2016). Smit et al. (2008) evaluated the significance of depositional thickness on impacts on benthic communities. Estimates from that study indicated median (50 percent) and low (5 percent) effects levels of 2.13 inches (54 millimeters) and 0.25 inch (6.3 millimeters) of sediment deposition, respectively. That is, 2.13 inches (54 millimeters) is the thickness estimated to adversely affect 50 percent of the benthos in the study, and a sediment burial thickness of 0.25 inch (6.3 millimeters) affected 5 percent of the studied benthos. The level of impact from sediment deposition and burial would depend on the time of year that it occurs, especially if it overlaps temporally and spatially with sites characterized by high benthic organism abundance and diversity. The impacts of burial would likely be short term. Due to the 24-mile (38.4-kilometer) distance of the Kitty Hawk offshore wind lease located outside of the geographic analysis area, impacts on seabed profile alternations expected from offshore wind activities exclusive of the Proposed Action would be minor.

Climate change: Benthic resources may be affected by climate change, including ocean acidification and warming, sea level rise, and altered habitat/ecology. Ocean acidification caused by atmospheric carbon dioxide (CO_2) may contribute to reduced growth or the decline of benthic resources with calcareous shells (Pacific Marine Environmental Laboratory 2020). Warming of ocean waters is expected to influence the distribution and migration of some benthic species and may influence the frequencies of various diseases (Hoegh-Guldberg and Bruno 2010; Brothers et al. 2016). Based on trends in the Northeast and Mid-Atlantic regions over the last 35 years, some benthic fish and invertebrate species have moved to the north and/or farther offshore into deeper waters (NOAA 2022). Additionally, ocean-atmosphere numerical models generally predict a decline/slowing of the Atlantic meridional overturning circulation (AMOC) from effects of climate change (Demo et al. 2021). The AMOC currents are the main driver of the distributions of nutrients, heat, and carbon present in the ocean, which affect the biogeochemical cycles and ecosystems around the globe (Bakker et al. 2016; Good et al. 2018). During the last glacial period, sizable and sudden climatic shifts occurred in the North Atlantic when major fluctuations occurred in the AMOC (Schmittner 2005). Modeled simulations show a decline of plankton stocks of more than 50 percent, which would have large implications on the productivity of oceans in the future (Schmittner 2005). Coastal runoff and inputs further stress nearshore marine environments. Organic enrichment can be detrimental if it occurs in oxygen-deficient sediments (De Mesel et al. 2015; Wilding 2014). Impacts associated with climate change have the potential to alter species distributions, increase individual mortality, degrade habitat value, and increase disease occurrence. Climate change is having notable and measurable effects on regional benthic resources and the impacts are likely to be moderate.

3.6.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, benthic resources would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary short-term to permanent, long-term on benthic resources. These effects are primarily related to offshore construction impacts, vessel traffic, dredging, and regulated fishing using bottom tending gear. BOEM expects the combination of ongoing activities would result in **negligible** to **moderate** impacts on benthic resources.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing and planned activities would continue, and benthic resources would continue to be affected by natural and anthropogenic IPFs. Planned activities would contribute to impacts on benthic resources due to increased offshore construction.

Ongoing and planned activities for offshore wind and non-offshore wind activities would continue to have temporary to long-term impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources, primarily through presence of structures, habitat conversion, and climate change. Short-term impacts would also occur from increased vessel traffic, anchoring, cable emplacement, dredging and fishing using bottom-tending gear. Throughout the geographic analysis area for benthic resources, as previously discussed, impacts from ongoing activities, especially seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, would be **moderate**. Reasonably foreseeable activities include increasing vessel traffic, increasing construction, marine surveys, marine minerals extraction, port expansion, channel deepening activities, and the installation of new towers, buoys, and piers—would result in **minor** benthic impacts. The combination of ongoing activities and reasonably foreseeable activities including ongoing offshore wind would result in **moderate** adverse impacts on benthic resources and could potentially include **moderate beneficial** impacts.

Considering all the IPFs together, the overall impacts in the geographic analysis area are expected to be **moderate** adverse impacts and could potentially include **moderate beneficial** impacts.

3.6.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on benthic resources.

- The total amount of long-term habitat alterations from scour protection for the foundations, inter-array cables, and export cables in each type of habitat.
- The total amount of each type of habitat temporarily altered by the installation method of the export cable in the Project area and inter-array and inter-link cables.

- The number, size, and type of foundations used for the WTGs and OSSs. Dominion Energy could construct a maximum of 202 WTGs using monopile (31 feet [9.5 meters]) and three OSSs using four piles (9-foot [2.8-meter] pins).
- The methods used for cable laying, as well as the types of vessels used.
- The amount of pre-cable-laying dredging, if any, and its location.
- The time of year when foundation and cable installations occur (i.e., the greatest impact would occur if installation activities coincided with sensitive life stages for benthic organisms).
- The number, size, and location of WTGs because the level of hazard related to WTGs is proportional to the number of WTGs installed (i.e., fewer WTGs would result in less impacts on benthic environments).
- Seasonal timing of construction and installation to avoid coinciding with sensitive life stages of benthic organisms.

Variability of the proposed Project design exists as outlined in Appendix E.

3.6.5 Impacts of the Proposed Action on Benthic Resources

Under the Proposed Action, the construction, operation and maintenance, and conceptual decommissioning of up to a 3,000-MW wind energy facility consisting of up to 202 WTGs and three OSSs in the Lease Area and associated export cables would occur offshore Virginia in the range of design parameters outlined in the COP (Dominion Energy 2023), subject to applicable mitigation measures. Maximum potential short-term and long-term habitat disturbances by the Proposed Action are presented in the COP (COP, Tables 3.3-3, 3.3-4, 3.3-7, 3.3-8, 3.4-4, and 4.2-17; Dominion Energy 2023). Under the Proposed Action, 205 acres (82.8 hectares) of benthic habitat would be permanently disturbed, and an estimated 11,547 acres (4,673 hectares) would be temporarily disturbed through the IPFs provided below.

As per Dominion Energy's commitment to seasonal restrictions from November through April, no WTG or OSS foundation installation activities are planned for winter. Monopile and OSS pin pile installation is planned for part of spring (May), summer (June, July, and August), and part of fall (September through October) annually. Inter-array and offshore export cable emplacement associated with construction of the WTGs and OSSs would occur during two separate construction seasons, which would provide a recovery period for sand ridge habitats between the installation of the inter-array and offshore export cables. These planned seasonal breaks are also expected to benefit some transitory fish species, including the ESA-listed species, the Atlantic sturgeon. In a recent study, Atlantic sturgeon were present within the cable route during November through April, and within the Lease Area December through May (Hager and Breault pers. comm. to G. Fulling). (See Section 3.13, *Finfish, Invertebrates and Essential Fish Habitat* for more information about ESA listed fish species.) Additionally, there would be an approximate 1 to 2.5-month period between installation of each offshore export cable installation, with the potential for a longer period dependent on weather conditions and operational needs for cable resupply. There would be several months of seafloor rest following the completion of offshore export cable installation at one OSS prior to commencement of inter-array cable emplacement associated with the next OSS (Dominion Energy 2023).

Accidental releases: The risk of accidental releases would increase as a result of the Proposed Action. The risk of any type of accidental release would be increased primarily during construction or conceptual decommissioning but may also occur during operations and maintenance activities. The increase in the risk of accidental releases attributable to the Proposed Action is expected be negligible in comparison to the risk from ongoing activities.

Non-routine events such as oil or chemical spills would have adverse or lethal effects on marine life, including benthic resources. However, Project-related hazardous materials mostly consist of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater; consequently, they are unlikely to contact benthic resources with minor exception. Historically, most diesel spills from OCS activities (e.g., from associated vessels or maintenance activities) in the Western and Central Gulf of Mexico Planning Areas are relatively rare and small with the median size for spills ≤1 barrel (42 gallons) to be 0.024 barrel (approximately 1 gallon) (Anderson et al. 2012). Spills of sufficient size to reach shore could affect intertidal and shallow subtidal benthic resources via adsorption and sinking. A large spill from the Proposed Action is very unlikely given the fuel storage capacities of Project vessels. Small spills should therefore be expected to be unmeasurable and have a negligible impact on benthic fauna. Larger spills are unlikely but could have a larger impact on benthic fauna due to adverse effects on water quality (Section 3.21, *Water Quality*) and the potential for sinking in shallow marine benthic environments. Effective spill response mitigation would reduce near-term and long-term impacts from an incident. Dominion Energy's proposed Response Plan for oil spills and other marine pollution incidents is presented in Appendix Q of the COP (Dominion Energy 2023), and the increase in risk of a spill related to the Proposed Action is expected to be negligible.

Should an accidental release occur within or near the artificial reefs in the Fish Haven, the potential impacts would be greater. The reduction of water quality could kill filter-feeding benthic organisms which form the foundation of marine food webs. These effects would also be carried over to species which prey on filter feeders. A release in proximity to sensitive benthic habitats could reduce recruitment of coral polyps which have low tolerance for poor water quality. Introduction of petroleum compounds could inhibit growth of artificial reefs which could cause cascading adverse impacts in nearby reefs and habitats. The increase in risk of a spill near artificial reefs related to the Proposed Action is expected to range from minor to moderate depending on the material spilled, volume of the spill and other environmental conditions.

As discussed in Section 3.6.3.2, *Cumulative Impacts of the No Action Alternative***,** the potential impacts of nonnative species on benthic communities would increase due to an increase in vessel traffic. The incremental increase in vessels due to the Proposed Action is expected be negligible in comparison to the risk from ongoing activities. Trash and marine debris also enable the range expansion of nonnative species. Increased vessel traffic may lead to an increase in marine debris through the accidental release of trash.

Anchoring: Installation, construction, operation and maintenance, and conceptual decommissioning would be conducted from vessels utilizing spuds, jack-up barges, dynamic positioning, or securing to existing structures; therefore, only minimal anchoring would occur. An expected 1,659.2 acres (671.5 hectares) of temporary disturbance from anchoring in the nearshore and Offshore Project area (COP, Table 4.2-17; Dominion Energy 2023). Impacts on benthic resources from anchors, spuds, jacks, chains, or other gear that contact the seafloor would crush or bury small sessile benthic organisms located directly in the footprint. Injured and dying organisms in turn may attract scavengers such as starfish, whelk, and other fish (Ramsay et al. 1998). The dragging of this gear would also temporarily disturb seafloor and the benthic infauna. The affected areas would likely be recolonized and the benthic organisms would likely recover relatively quickly from the short-term impact. Therefore, impacts on benthic resources from anchoring are expected to be negligible.

Should anchoring occur within close proximity to artificial reefs within the Fish Haven, there would be an increased impact. This impact would be even greater if anchoring devices make contact with the artificial reef structures. Physical damage to the reef structure could displace or kill the organisms within the habitat which rely on the structure for shelter and food. Bottom-contacting gear would increase local turbidity as sediments would be temporarily suspended. Sedimentation can smother benthic species, depending on their burial sensitivity. Expected impacts of vessel anchoring and bottom contacting gear near sensitive reef habitats are expected to range from negligible to minor.

Electromagnetic fields: Under the Proposed Action, and the process of transmitting power to onshore infrastructure, a network of cables would need to be installed. Once these cables begin to transmit power, the effects from EMFs and cable heat would initiate. EMF production during the operation of power transmission cables can be detected by some benthic species but does not appear to present a barrier to movement. The weak electric fields induced in seawater and in local electrosensitive marine organisms were found to be below reported detection thresholds (COP, Appendix AA; Dominion Energy 2023). Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2016), but alterations of behavior have been documented for benthic species (skates and lobster) near operating up to 65.3 µT emitted from DC cables in a lab setting (Hutchison et al. 2018). The impacts from EMF are localized and affect the animals only while they are relatively close to the EMF source. EMFs would be minimized by shielding or by burying cables to the target depth of up to 9.8 feet (3 meters) for inter-array cables and up to 16.4 feet (5 meters) for export cables.

Regarding cable heat, the maximum current (amps) that a cable can carry without exceeding its temperature rating, ampacity, is strongly influenced by the heat transfer in the surrounding marine environment (Callender et al. 2021). Models have demonstrated that the permeability of the sediment where the cable is placed is an important factor. Parameters such as ambient water temperature, burial depth and spacing between cables affect the ampacity of DC submarine cables (Mardiana 2011; Hutchison et al. 2021). The cable vendor modeled heat transfer from the OECC at cable burial depth of 8 feet (2.5 meters). Results predicted that the minor increases in sediment temperatures above the buried cable would not degrade benthic habitat and are biologically insignificant. In instances where target burial depth cannot be achieved, the protective material will hinder burrowing of invertebrates, while the heat would dissipate as ocean water flows through and around the mattresses. Thermal impacts of subsea export cables would be extremely localized, negligible, and not ecologically significant (COP, Section 4.2.4.3; Dominion Energy 2023).

Although acknowledging that little is known about potential impacts of EMFs on benthic species, the available information suggests that field strengths expected from the Proposed Action would be below levels shown to cause effects (COP, Appendix AA; Dominion Energy 2023). Therefore, BOEM expects the impacts on benthic species from EMF to be negligible.

New cable emplacement and maintenance: Construction is planned to occur from 2024 to 2027 between May 1 and October 31 (Appendix F, Table F2-1), which would include the inter-array and offshore export cables to support the WTGs and OSSs. Up to 300 miles (484 kilometers) in total of inter-array cables would be installed, with an average inter-array cable length of 5,868 feet (1,789 meters) between turbines. The offshore export cables would have a total length of 337.9 miles (543.7 kilometers). As the OECC approaches the shoreline, the cables would be installed in an offshore trenchless installation punchout conduit located 1,000 to 1,800 feet (305 to 549 meters) from shore. This would avoid adversely affecting sensitive, shallower, nearshore habitats and avoid the high-impact zone of the beach shoreline.

Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance, pre-grapnel runs, and UXO identification surveys. Dominion Energy does not anticipate the need for boulder or sand wave removal, based on analysis of previous G&G survey data, which did not identify any boulders larger than 1.6 feet (0.5 meter). A pre-grapnel run may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the siting corridor. The pre-grapnel runs would create a path 82 feet (50 meters) wide, and the cable installation trench would be constructed inside of this cleared path. The clearance of UXOs would create a path 164 feet (50 meters) wide around the expected cable corridors, though they may require a larger sweep near high risk areas (e.g., DNODS). The seabed disturbance footprint for UXO identification and mitigation, which will entail relocation of UXO that cannot be avoided by micrositing, is anticipated to be approximately 161.5 square feet (15 square meters) per mitigation of one UXO. These relocated UXOs would not be buried and would remain on the seafloor. The area of temporary disturbance associated with both UXO identification and mitigation, as well as the relocation of large marine debris would be 1.58 acres (0.64 hectare), assumed to be half for UXOs and the other half for large marine debris (COP, Table 4.2-17; Dominion Energy 2023). Areas with sand waves do not require separate burial methods/tools to be installed and will therefore use either the hydroplow or tracked trencher. The maximum construction corridor for the inter-array cable corridor would be 2,988.8 acres (1,209.5 hectares), and the OECC would be 3,358.51 acres (1,359.14 hectares).

The cable would be buried using the methods covered in the PDE (Appendix E), including jet trench, trench former, chain cutting, hydroplow, mechanical trenching plow, or a mechanical cutter to create a trench along the seabed, all mechanisms in which the cable is simultaneously laid and buried in a single pass. The preferred installation method would use a jet trencher, while chain cutting, trench forming, pre-trenching, and mechanical are not currently anticipated. Cable burial methods would result in an increase in suspended sediments and an increase in the water content of sediments (i.e., the ratio of the mass of fluid to the mass of solids) within the trench. To predict the duration of suspended sediment, Dominion Energy completed a Sediment Transport Modeling Study in 2021 (COP, Appendix J; Dominion Energy 2023). Samples were collected at 25 locations, 17 of which were within the OECC. On average sediment samples from the OECC had 81 percent fine sediment. It is important to note that these concentrations do not occur at all locations simultaneously. Given the speed of the jet plow, only small sections of the Offshore Project area would be disturbed at any given time during Project construction. Results found that suspended sediment concentrations dropped out rapidly with time. At most locations within the Offshore Project area, the concentrations of suspended sediments dropped by 75 percent or greater within 4 minutes of jet-plowing activity. Fine sand, the coarsest fine sediment particle class, has a settling velocity of 5.9 feet per minute (3 centimeters per second) and remains in suspension for approximately 1 minute (COP, Appendix J; Dominion Energy 2023). Therefore, at locations with higher sand content, suspended sediment concentrations decreased by 69 percent or greater within 1 minute of jet plowing operations. This reduced the amount of sediment that could be transported in the water column due to currents, and most of the fine sand deposits within 16.4 feet (5 meters) of the trench centerline. The very fine sediments (clay) remained in suspension for about 4 hours, a relatively short period of time. The results of the study additionally indicate that deposition thicknesses decreased rapidly away from the trench (COP, Appendix J; Dominion Energy 2023). Average deposition thicknesses were less than 0.4 inch (1 centimeter) within 82.0 feet (25 meters) of the trench centerline for flood tides and less than 0.4 inch (1 centimeter) within 32.8 feet (10 meters) of the trench centerline for ebb tides. Areas with coarse sediments as identified in the OECC (1,694 acres [686 hectares] of rocky substrate, 2.8 acres [1.1 hectares] of gravel mixes, and 1,691.2 acres [684.4 hectares] of gravelly substrate), these sediments would be immediately deposited in the jet plow trench. However, jet plow configurations, including the angle of the plow blade and water pressure through the jet nozzles, can be adjusted during cable installation and could result in less sediment mobilizing in the water column than the results of the conservative model.

Although no hard-bottom substrate was found in the Offshore Project area, in areas where seabed conditions might not allow for cable burial to the desired depth, concrete mattresses would be used for cable protection. Approximately 0.1 percent of the length of offshore export cable would be covered with cable protection. Recovery rates of these disturbed surfaces would depend on species present and their recovery capabilities, the extent of disturbance, and the nature of protection material.

Entrainment related to the plow operations within the cable corridors would result in 100 percent mortality of the planktonic species. This mortality would occur during water withdrawal from the cable-laying vessel supporting and towing the jet plow system. South Fork Wind Farm estimated that zooplankton and ichthyoplankton entrained by jet plows installing cables amount to no more than 0.001 percent of the total populations in the area, based on data from NOAA's Marine Resource Monitoring, Assessment and Prediction Program and Ecosystem Monitoring sampling (BOEM 2021).

Contaminated sediments are not known to be a problem in the geographic analysis area for benthic resources. The nearby DNODS has been permitted and in operation since 1967, but there has been no documentation of contaminated sediments in or around the site (USEPA 2009). This disposal site also serves as a band borrow site for beach renourishment projects. Micrositing would occur within the OECC as it nears DNODS as it is a higher risk area for UXOs.

Unavoidable mortality, damage, or displacement of invertebrate organisms would occur, within the path of construction, while injury or damage could occur in the immediate vicinity. The estimated area affected by the temporary construction footprint in the Offshore Project area (6,036.6 acres [24.4 square kilometers]) (COP, Table 3.4-4; Dominion Energy 2023) would be 5.3 percent of the total Lease Area (112,799 acres [456 square kilometers]). Sediment in the Offshore Project area is dominated primarily by fine sand (93.2 percent) followed by gravel (3.7 percent) and silt and clay (3.0 percent). Polychaete worms dominated the fauna numerically and mollusks dominated the fauna by biomass (Section 3.6.1). The seafloor would be disturbed by cable trenches, skid tracks, dredging, anchoring, and spud prints that could cause temporary sediment suspension. Dominion Energy only intends to use dredging as a last resort to achieve the adequate burial depth, though no hydraulic dredging operations are anticipated. Only minor variations occur between the cable burial equipment proposed by Dominion Energy (including jet trenching, plowing, chain cutting, trench former).

The sediment texture is strongly linked with the composition of the benthic invertebrate community (Rutecki et al. 2014). The fine- and medium-grained sand that makes up the majority of the Offshore Project area provides uniform and simple (non-complex) habitat for benthic infaunal organisms typical of this region. Cable emplacement associated with construction of the WTGs and OSSs would occur during two separate construction seasons with a 12-month recovery period for affected sand ridge habitats. Diaz et al. (2003) found that the microhabitats, such as sand waves, provided refuge for juvenile fish. Disturbance of sand waves and ridges would be temporary, given that sand waves and ridges are changing, mobile features. These sand-dominated substrates are resilient by nature and are capable of tolerating disturbances because the sediment is regularly disturbed by wave action, nor'easters, offshore storms, and hurricanes (Rutecki et al. 2014). The sediment composition from the crest to the trough varies and each microhabitat supports different benthic invertebrates (Rutecki et al. 2014). The overall amount of seafloor disturbance under the Proposed Action is small relative to the total Lease Area, and impacted sand ridges are likely to recover faster than the trough microhabitats (Rutecki et al. 2014). Past studies following sand mining operations showed that the time scales for recolonization also vary by taxonomic group, with polychaetes and crustaceans recovering in the first several months and deep burrowing mollusks recovering within several years (Brooks et al. 2006).

The artificial reefs within the Fish Haven area would offer additional relief commonly used by structure-oriented species black sea bass, flounders, monkfish, ocean pout, hakes, and scup (Guida et al. 2017). New cable emplacement in this habitat would disrupt benthic communities, temporarily increase turbidity, and subject benthic organisms to sedimentation. Expected impacts near sensitive habitats are expected to range from negligible to minor, provided no physical damage occurs to the reef structures during cable installation or any operational maintenance.

Complex and sensitive habitats may take longer to recover but would likely recover to pre-Project conditions (HDR 2020). Past models to evaluate the potential biological and physical effects of offshore dredging within sand ridges and swale features found that the leading edges of the shoal are the most active area and would, therefore, refill more quickly than the crest, while the trailing edges would refill more slowly (CSA et al. 2009). This modeling also showed that dredging in striped patterns infilled uniformly along the length and recovered more rapidly than other dredge patterns (CSA et al. 2009). These longitudinal stripes may have recovered at a rapid rate due to adjacent untouched areas for the length of the excavation. Other studies on offshore dredging and sand mining projects within Maryland and Delaware have demonstrated that shoal width, length, and base area all increase until water depth is approximately 115 feet (35 meters) and then begin to decrease (Nairn 2011). While shoals are within the growth state, they are likely to rebuild themselves once dredged (CSA et al. 2009; Nairn 2011). Water depths in the Lease Area range from 59 to 135 feet (18 to 41 meters) MLLW, and water depths along the OECC range from 23 to 92 feet (7 to 28 meters) MLLW (Appendix D; Dominion Energy 2023).

The OECC was sited to avoid hard substrates and sensitive benthic habitats. There is little to no evidence of complex or biogenic habitat within the Offshore Project area, based on the criteria in the NOAA (2021) recommendations, and Dominion Energy would further microsite within the OECC to avoid such identifiable habitats where feasible to minimize the probability of adverse interactions with sensitive benthic resources. Dominion Energy would establish a preliminary horizontal buffer of 984 feet (300 meters) around known biological and cultural resources such as artificial reefs or shipwrecks, noting that this buffer may be re-evaluated subsequent to site-specific surveys.

Offshore operation and maintenance the Proposed Action would require maintenance and inspections (COP, Section 3.5.1; Dominion Energy 2023). All surface maintenance and inspection will not affect benthic communities. The offshore export cables and inter-array cables would be monitored through distributed temperature sensing equipment. The distributed temperature sensing system would be able to provide a real time monitoring of temperature along the offshore export cable corridor, alerting Dominion Energy should the temperature change, which could be the result of scouring of material and cable exposure. Only cable repairs, if required, would temporarily affect benthic communities, and only in a localized area immediately adjacent to the repair. Assuming repairs would be infrequent and affecting only small sections of the cables, impacts are expected to have no detectable effects and would be negligible.

BOEM does not expect population-level impacts on benthic species (i.e., generally accepted ecological and fisheries methods would be unable to detect a change in population, which is the number of individuals of a particular species that live in the geographic analysis area) from cable emplacement activities as a result of the Proposed Action. Benthic fauna would recolonize disturbed areas over time that have not been displaced by new structures. Impacts from new cable emplacement and maintenance are expected to be notable and short term, with most resources making a full recovery; impacts on benthic resources from the Proposed Action are expected to be minor, providing artificial reefs are avoided.

Noise: The Proposed Action would result in noise from the installation, operation, maintenance, and decommissioning of WTGs and OSSs. The noise produced from pile driving during installation of up to 202 WTG foundations would occur intermittently from 2025 to 2027 between May 1 and October 31 (Appendix F, Table F2-1). Installation methods would include a hydraulic hammer, hydraulic impact hammer, vibratory hammer, vibratory and water jetting, or a combination of these. Technical details related to pile-driving noise are analyzed for demersal and benthic fishes and commercially important invertebrates in Appendix J, *Noise Modeling Report*. The noise may cause mobile fauna to move away from the area for a short while (COP, Section 4.2; Dominion Energy 2023). English (2017) reported marine invertebrates to be considered less susceptible than fish and to loud noise and vibration as their bodies do not generally possess air-filled spaces but noise at high levels could cause short-term behavioral responses in marine invertebrates within approximately 10 meters of the disturbance.

The responses to noise originate from the particle motion created from the noise source. The effects of the detectable particle motion on invertebrates are typically limited to within a few meters of the source or less (Edmonds et al. 2016; Popper and Hawkins 2018; Payne et al. 2007). However, recent lab research (Jones et al. 2020, 2021) indicates that longfin squid can sense and respond to vibrations from impact pile-driving noise at a greater distance based on recorded sound exposure experiments. This suggests that other infaunal species may exhibit a behavioral response to vibration effects at greater distances. This noise would be produced intermittently during installation of each foundation. Noise transmitted through water and through the seabed can cause injury to or mortality of benthic resources in a limited area around each pile and can cause short-term stress behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and ambient acoustic conditions. The current summary of knowledge on how marine renewable energy devices affect benthic environment indicated the impact of sound on epibenthos is poorly understood and is generally lacking (Carroll et al. 2016; Dannheim et al. 2020); impacts on benthic species from construction activities is uncertain and considered speculative.

Overall, the duration of impact pile-driving activities would be relatively short term (approximately 4 hours per day if two piles are installed). Although a noise mitigation design has not been finalized at this time, Dominion Energy is considering noise mitigation systems such as the Hydro Sound Damper, the Noise Mitigation Sleeve, or the AdBm Noise Mitigation System; far-from-pile noise mitigation systems, or both such as a double big bubble curtain, to achieve, at minimum, acoustic isopleth ranges that meet the modeled scenario using 10 dB noise mitigation. As discussed in Section 3.6.3.2, *Cumulative Impacts of the No Action Alternative*, noise from offshore construction and conceptual decommissioning may have impacts on benthic species but they would most probably be negligible due to the temporal scale and mitigation.

The overall impact on benthic resources from noise from pile-driving activities under the Proposed Action are conservatively expected to be short term and minor.

Noise from trenching/cable burial is expected to occur but would have a limited impact on benthic resources. Noise from trenching of inter-array and export cables would be temporary, local, and extend only a short distance beyond the emplacement corridor. The affected areas would likely be recolonized in the short term. However, impacts on benthic species from noise are speculative since there remains a vast gap in knowledge about sound thresholds and recovery from impact in almost all invertebrates. Cable-laying and trenching noise is expected to have no detectable effects on benthic resources; impacts are expected to be negligible.

There will be noise from WTG operations and maintenance activities but would have limited, if any effect on benthic species. Noise associated with operational WTGs may be audible to some benthic fauna; this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would adversely affect benthic species, and is at least 10 to 20 dB lower than ship noise of the same frequency (English et al. 2017; Tougarrd et al. 2020). Impacts on benthic resources from operations and maintenance noise are expected to be negligible.

Port utilization: Dominion Energy and the Port of Virginia have executed a lease agreement for a portion of the existing Portsmouth Marine Terminal (PMT) facility in the city of Portsmouth, Virginia, to serve as a construction port. The construction port will be used to store monopiles and transition pieces and to store and pre-assemble wind turbine generation components. Dominion Energy understands that the Virginia Port Authority (VPA) is planning to improve PMT to support broadscale offshore wind development. Dominion Energy anticipates that the port upgrades will meet the needs of Dominion Energy's efforts to construct an offshore wind farm off the coast of Virginia. Dominion Energy has evaluated several alternatives to lease portions of existing facilities in the Hampton Roads, Virginia, region for an O&M facility for the Project. The selected lease location for the O&M facility is Lambert's Point, which is located on a brownfield site in Norfolk, Virginia. Subleases are ongoing in parallel with architecture and engineering designs with an anticipated completion date in the first quarter of 2023. Dominion Energy and the Port of Virginia are also evaluating leasing portions of the existing facilities at VPA's PMT or Newport News Marine Terminal (COP, Sections 3.1 and 3.3.2.6; Dominion Energy 2023). Improvements would be made to support broadscale offshore wind development. For both PMT and the O&M facilities, in the event that upgrades or a new, build to suit, facility is needed for any purpose, construction would be undertaken by the lessor and would be separately authorized, as needed (COP, Section 3.3.2.6; Dominion Energy 2023). Temporary laydown and construction port(s) in Europe or North America would be needed during the construction and installation phases of the Project.

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 4 years and would decrease during operations. Vessel traffic would increase again during conceptual decommissioning. In addition, increased port utilization and vessel traffic would require dredge maintenance, performed periodically by USACE. Therefore, any port expansion and construction activities related to the additional offshore wind projects (e.g., need for navigation dredging) would also add to the total amount of disturbed benthic area, resulting in disturbance and mortality of benthic organisms and temporary to permanent habitat alteration. Existing ports are heavily modified/impaired benthic environments, and future port projects would likely implement best management practices to minimize impacts (e.g., stormwater management, turbidity curtains). Therefore, the degree of impacts on benthic resources from port expansion activities in the geographic analysis area would likely be short term and negligible.

Presence of structures: The presence of structures would lead to impacts on benthic communities through entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic resources, and habitat conversion. The Maximum Layout includes 202 WTG foundations (with a capacity of 16 MW) and three OSSs, respectively. The OSSs would be within the WTG grid pattern oriented at 35 degrees and spaced approximately 0.75 nautical mile (1.39 kilometers) in an east–west direction and 0.93 nautical mile (1.72 kilometers) in a north–south direction.

The footprint of the foundation and the scour would be 0.95 acre (0.38 hectare) per WTG. Under the Maximum Layout, the total for the 202 WTGs would be 191.9 acres (77.66 hectares) (COP, Table 4.2-17; Dominion Energy 2023) of surface area, most of which is related to the scour protection apron (up to four layers). The three OSSs with scour protection would be an additional 11.4 acres (4.61 hectares). Adding in the cable protection at cable crossings and the offshore trenchless punchout nearshore (1.19 acres [0.48 hectare]), 204.49 acres (82.75 hectares) of seafloor habitat would be permanently altered by presence of structures.

The presence of these offshore structures would increase the risk of gear loss/damage by entanglement. The lost gear, moved by currents, would disturb, injure, or kill benthic resources. The intermittent impacts at any one location would likely be localized and short term, although the risk of occurrence would persist as long as the structures and debris remain; such impacts on benthic resources are expected to be negligible.

The addition of these human-made structures would also alter local water flow (hydrodynamics). Studies in the North Sea have used hydrodynamic modeling to assess ecosystem responses to large offshore wind farms (Daewel et al. 2022; Christiansen et al. 2022; Dorrell et al. 2022; Floeter et al. 2022). Although past models have had success in interpreting local conditions based on added objects, none have been able to interpret results at the scale of offshore wind farms. Models are complicated by the underlying physics of stratified flows (Dorrell et al. 2022). Results from Daewel et al. (2022) have predicted changes in the mixed layer depth to be 1 to 2 meters shallower in and around the turbines. The current was also estimated to be a reduction of 15 percent of the prevailing residual current (Daewel et al. 2022). Net primary productivity both decreased and increased based on the spatial layout. The related phytoplankton biomass however showed on average below 1 percent changes (Daewel et al. 2022). Christiansen et al. (2022) showed that even though variability did occur in temperature and salinity, the changes were indistinguishable from interannual variability. A severe overall impact by the wake effects on the ocean's thermodynamic properties is thus not expected but rather large-scale structural change in the stratification strength and unanticipated mesoscale spatial variability in the mean current field (Christiansen et al. 2022). Nevertheless, further investigations are necessary. The beneficial impact of increased food availability for filter-feeders on and near the structures has also been reported (Degrear et al. 2020). A recent study completed by BOEM that focused on the Rhode Island and Massachusetts Wind Energy

Areas (WEAs) assessed the "mesoscale" effects of offshore wind energy facilities on coastal and oceanic environmental conditions and habitat by examining how oceanic responses would change after turbines are installed, particularly with regards to turbulent mixing, bed shear stress, and larval transport (Johnson et al. 2021). The results of this modeling effort indicate that changes in currents lead to discernable increases and decreases in larval settlement density but are not expected to be considered overly relevant (at a regional fisheries management level). Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are also not well understood. The consequences for benthic resources from such hydrodynamic disturbances are anticipated to be localized, to vary seasonally, and have minor impacts.

Although the benthic characterization is primarily homogenous sand with little relief, sand ripples, waves, and ridges do occur in the geographic analysis area. Areas of complex habitat and heterogenous seabed contribute to the biodiversity of the benthic community. The Proposed Action would alter some existing benthic habitat by converting soft-bottom substrate to hard surfaces. The conversion of this habitat could lead to reef-like, hard-bottom areas. As the reef matures, deposition of shell hash and other detritus is expected to build up around the foundations (Causon and Gill 2018). The increase in food availability for filter-feeders on and near the structures, in turn, leads to increased densities of mobile invertebrates (e.g., crabs, lobsters), attraction of pelagic and demersal fish, and foraging opportunities for marine mammals (Coates et al. 2014; Dannheim et al. 2020; English et al. 2017; Degrear et al. 2020). Benthic species dependent on hard-bottom habitat could benefit from an increase in hard surfaces, although the new habitat could also be colonized by nonnative species (e.g., certain tunicate species). De Mesel et al. (2015) observed this stepping stone effect, especially in the intertidal species observed. Enhanced biodiversity is expected from this addition of new hard-bottom substrate. This indicates that offshore wind farms and the additional hard-bottom substrate that they provide would also result in beneficial impacts on local ecosystems by attracting fishes who prey on benthic organisms (ICF 2021; Degrear et al. 2020). A study looking at long-term effects of offshore wind farms on the fish communities concluded that species diversity was significantly higher close to the turbines, indicating that the reef-effect from the turbines was large enough to attract fish species with a preference for rocky habitats, but not large enough to have adverse negative effects on species inhabiting the original sand bottom between the turbines (Stenberg et al. 2015).

The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be localized, predominantly within tens of meters of each structure. Scouring, caused by these hydrodynamic forces is likely to be most noticeable at the foundation of the structure. Due to their dynamic features, and tidal and seasonal fluctuations, scour features can change by up to 2 feet (0.6 meter) on a monthly average (HDR 2020). Some fluctuation would be alleviated with scour protection measures (HDR 2020). Changes in local water flow are expected to vary seasonally and impacts are expected to be negligible.

It remains unclear if the increase in fish around turbine structures is due to increased food availability thereby attracting more fish (as secondary consumers), or if fish are detracted from nearby environments (Hogan et al 2023). The addition of new hard-bottom substrate in a predominantly soft-bottom environment would enhance local biodiversity (Degrear et al. 2020; Pohle and Thomas 2001; Fautin et al. 2010). This indicates that marine structures would generate some beneficial impacts on local ecosystems. However, some impacts such as the loss of soft-bottom habitat may be adverse. Soft bottom is the dominant habitat type in the region, the species that rely on this habitat are not likely to experience population-level impacts (Guida et al. 2017; Greene et al. 2010). A successional sequence of impacts on benthic resources by the presence of artificial hard substrates is likely but might not be foreseeably defined due to the current lack of knowledge, particularly on long-term changes and large-scale effects (Dannheim et al. 2020).

The proximity of artificial reefs within the Fish Haven would also serve as stepping stones for invasive species and habitat spread (De Mesel et al. 2015). Species such as the lionfish (*Pterois* spp.) aggregate around offshore structures. Lionfish species have been located in offshore waters both with and without artificial structures, which complicates the interpretation of the role turbines play in the spread of some invasive species. Therefore, Dominion Energy would develop a lionfish monitoring and adaptive management plan. The presence of the wind turbines and associated foundations expand the hard bottom habitat, which are rare within the region (COP, Section 4.2.4.2; Dominion Energy 2023).

Construction activities disrupting soft-bottom habitat may injure or kill sessile or slow-moving demersal life stages of fishes and invertebrates, including eggs and larvae (see Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, for further details on fish). Direct seafloor disturbance would crush or bury small sessile benthic organisms located directly in the footprint of pile driving or scour protection placement. Given that most benthic species in the region are planktonic as larvae, disturbed areas would likely be recolonized by species that require hard surfaces within about 1 year (Dernie et. al. 2003). Other benthic species are mobile and can return to these hard-bottom regions. Because hard-bottom habitats in the geographic analysis area are relatively limited (COP, Appendix D; Dominion Energy 2023) this change in the benthic community could increase biodiversity.

In accordance with BOEM requirements (e.g., 30 CFR 585) Dominion Energy would be required to remove, decommission, or both all Project infrastructure and clear the seabed of all obstructions following termination of Project operational activities and the lease. The conceptual decommissioning process for the WTGs and OSSs is anticipated to be the reverse of construction and installation, with Project components transported to an appropriate disposal or recycling facility. All foundations/Project components would be removed to 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)), unless other methods are deemed suitable through consultation with the regulatory authorities, including BOEM. Some components such as scour protection would be permanent because they would not be removed during decommissioning. Other components such as the submarine cabling and presence of offshore structures (WTGs and OSSs) would be long term, lasting the life of the Project.

Overall, the addition of the offshore structures would increase long-term benthic habitat complexity around the structures for the duration of the Project. In light of the above information, BOEM anticipates that the impacts associated with the presence of structures would be moderate adverse on soft-bottom communities and moderate beneficial on structure-oriented or hard-bottom communities. The overall impacts on benthic resources resulting from the presence of structures would be permanent, as long as the structures remain.

Discharges: The Proposed Action is not anticipated to cause any impacts on benthic resources from discharges that would include uncontaminated bilge water and treated liquid wastes. Uncontaminated ballast water can be discharged or retained onboard as part of the ballast management plan (COP, Table 3.5-1; Dominion Energy 2023). Many discharges are required to comply with permitting standards established to ensure that discharge impacts on the environment are mitigated. There is no evidence that the anticipated volumes and nature of these discharges would have any overall impact on benthic resources; impacts are expected to be negligible. Should discharges occur near the artificial reefs within the Fish Haven area, the reduction of water quality could pose a greater impact to the sessile species present. Coral reefs have a very low tolerance for deterioration of water quality and impacts could range from minor to moderate.

Regulated fishing effort: Regulated fishing effort would affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). The Proposed Action, as well as other future offshore wind development, could influence this IPF. Habitat conversions from the Proposed Action would require altered harvesting models for commercial and recreational fisheries, but VIMS is aware that these are being studied by Dominion Energy and would be addressed upon completion of all studies (comment received on the Draft EIS: 0014-0048; Dominion Energy 2023). Likewise, studies from the UK have shown changes in commercial fishing practices due to the offshore structures. A decline in bottom-towed fishing activity was recorded in wind farms where turbines were constructed in a densely aggregated patch, and an increase in fishing activity where turbines were positioned as several distinct aggregated patches within the site (Dunkley and Solandt 2022). The intensity of impacts on benthic resources under future fishing regulations are uncertain, but would likely be similar to, or less than, under existing conditions, and are expected to recover with mitigation measures and be minor. Should regulated fishing continue within the Fish Haven area, there would be an increased risk of entanglement on the nearby artificial reefs and the turbine structures.

Dominion Energy has committed to a Fisheries Monitoring Plan to establish baseline conditions for the surf clam, whelk, and black sea bass specifically. Post-construction surveys would be compared to baseline survey data to assess fisheries status after construction. See Section 3.13, *Finfish, Invertebrates and Essential Fish Habitat*, for details on the black sea bass surveys.

Whelk surveys would occur at roughly 3-day intervals using whelk pots, which is a common gear type in the *Busycon* (spp.) fisheries. Sampling will occur twice a month during times of traditionally high fishing activity (November to March) and once a month during times of traditionally low fishing activity (April to October) (21 cruises: 4 in year 1 and 17 in year 2). Baited pots are weighted allowing them to remain on the sea floor. To reduce the number of vertical lines and reduce entanglement potential, these pots will be deployed in strings (or trawls) of multiple pots along the seafloor, which are connected by groundlines. The approximate length of each trawl would be 1,800 feet (149 meters) with 150-foot (45-meter) spacing between the pots.

Atlantic surf clam surveys would use a novel dredge that has been specially designed for research sampling with reduced bar spacing that allows for the sampling of a wider size range of clams relative to a standard commercial clam dredge for commercial use. Each dredge tow would sample the bottom for 5 minutes at a vessel speed of 1.5 knots. A benthic sediment sampler (Peterson grab sampler) would also collect samples of the seabed sediment and benthic macroinvertebrates at each station to characterize the existing environmental conditions within and near the Lease Area. The fisheries monitoring activities would not add significant additional vessel traffic or benthic disturbance from trap placement of dredging, as these fisheries already occur in the Project area. Expected impacts would be similar to other bottom-disturbing activities. The towed sampling dredge would cause localized and direct impacts on both hard- and soft-bottom benthic habitats, resulting in potentially long-term effects on community composition. Soft-bottom impacts would be short-term and expected to recover quickly. Short-term increased suspended sediment is expected in the localized area. For further details see the NMFS *Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service* and addendum (BOEM 2023a, 2023b).

Seabed profile alterations: Much of the Offshore Project area is characterized as unconsolidated sands arranged in waves, megaripples, and ripples with some isolated patches of mud and gravel. During cable installations of the Proposed Action, pre-construction grapnel runs would be conducted as part of the seabed preparations. These runs would cover beyond the area affected by cable emplacement, potentially leading to short-term impacts on benthic organisms including habitat alteration, injury, and mortality. Much of the Offshore Project area is characterized as unconsolidated sands arranged in waves, megaripples, and ripples, with some isolated patches of mud and gravel. These features would temporarily be disturbed by pre-construction grapnel runs, seabed preparation, anchoring, and trenching for cable installation. Permanent impacts would include foundation placement, cable protection, and scour protection installation. Sand ripples and waves disturbed by offshore export and inter-array cable installation would naturally reform within days to weeks under the influence of the same tidal and wind-forced bottom currents that formed them initially (COP, Appendix C, Dominion Energy 2023; Kraus and Carter 2018). Impacts are expected to be minor, but the majority of the seafloor within the Project area will recover completely, without mitigation to the seabed profile alterations. Recovery in sand ridge habitats is largely a function of sediment transport, and water depth (Rutecki et al. 2014). The rate of sediment migration relates to the shoal type and ranges from 13 feet per year (4 meters/year), observed off the coast of North Carolina (Thieler et al. 2014), to stationary, as observed in the west Florida Shelf and the German Bight (Rutecki et al. 2014). It is presumed that sandy habitats, such as the majority of the Project area, are capable of tolerating disturbances as the substrate is regularly disturbed.

Bottom-contacting gear to modify the seabed profile would increase local turbidity as sediments would be temporarily suspended. Sedimentation can smother benthic species, depending on their burial sensitivity. The impact would be even greater if contact is made with the artificial reef structures. Physical damage to the reef structure could displace or kill the organisms within the habitat which rely on the structure for shelter and food. Expected impacts near sensitive reef habitats are expected to range from negligible to minor.

Seabed deposition and burial: Foundation types vary in footprint size and depth of penetration into the sediment. The WTG foundations for the Proposed Action encompass less area on the seafloor but penetrate more deeply into the sediment compared to other technologies (ICF 2021). For the Proposed Action, protective rock or other hard material would be placed within a 230-foot (70-meter) diameter surrounding each foundation to reduce sediment suspension during pile driving. Cable laying and construction would also result in the temporary resuspension and nearby deposition of sediments. In areas where displaced sediment is thick enough, organisms may be smothered, which would result in mortality. (See Section 3.6.3.2 for details on sediment burial sensitivity thresholds). The Sediment Transport Modeling Study conducted in 2021 (COP, Appendix J; Dominion Energy 2023) showed that the average sediment deposition was less than 0.4 inch (1 centimeter) within 82.0 feet (25 meters) of the trench centerline for flood tides and less than 0.4 inch (1 centimeter) within 32.8 feet (10 meters) of the trench centerline for ebb tides. (See *New cable emplacement and maintenance* IPF above for more details on the model results.) Avoiding the spring and summer months for cable burial activities that correspond with spawning season of some invertebrates may help minimize potential impacts of offshore wind to benthic resources.

Like the potential impacts from the seabed profile alterations described above, sediment deposition or burial within close proximity to artificial reefs in the Fish Haven area, could experience negligible to minor impacts. Sediment deposition can smother benthic species, depending on their sensitivity to burial. Expected impacts near sensitive reef habitats are expected to range from negligible to minor.

Because most lightly sedimented areas would recover naturally, and most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area, impacts on benthic resources would be short-term and minor.

Climate change: This IPF would contribute to alterations in ecological relationships, alterations in migration patterns, changes to disease frequency, and the reduced growth rates, especially for invertebrates that have calcareous shells. Because this IPF is a global phenomenon, the impacts through this IPF from planned actions, including the Proposed Action, would be very similar to those in Section 3.6.3.2, *Cumulative Impacts of the No Action Alternative*. The intensity of impacts resulting from climate change are uncertain but with notable and measurable effects on regional benthic resources are anticipated to qualify as moderate.

In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be moderate.

3.6.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

Accidental releases: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be unlikely, and if they occur impacts would be localized, short term, and negligible. Should an accidental release occur within or near the artificial reefs in the Fish Haven area, the potential impacts would be expected to range from minor to moderate depending on the material spilled, volume of the spill and other environmental conditions.

Anchoring: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be localized and short term, and negligible. Should anchoring occur within close proximity to artificial reefs within the Fish Haven area, the potential impacts would be expected to range from negligible to minor, provided the artificial reefs are not physically damaged.

Electromagnetic fields: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be negligible.

New cable emplacement and maintenance: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would result in minor seafloor disturbance from required subsea cables. Effects are expected to be localized and temporary, with recovery in a relatively short time, resulting in minor impacts. Should cables be placed close to artificial reefs within the Fish Haven area, the potential impacts would be expected to range from negligible to minor.

Noise: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are anticipated to be short term and minor, even with mitigation measures.

Port utilization: In the context of reasonably foreseeable environmental trends, global shipping traffic is expected to continue to increase with modest port activity expected in Virginia. Although the degree of impacts on benthos would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on certain fish and invertebrate species could occur beyond the port but with expected negligible impacts on benthic resources.

Presence of structures: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be moderate both in a beneficial and adverse way. The impacts would remain as long as the structures were in place (up to 33 years for the Proposed Action).

Discharges: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be negligible. Should any discharges occur within or near the artificial reefs in the Fish Haven area, the potential impacts would be expected to range from minor to moderate depending on the material discharged, volume of the discharge and other environmental conditions.

Regulated fishing effort: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be minor. (Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, provides additional details.)

Seabed profile alterations: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be minor, as the impacts would be localized, short term, and minor.

Seabed deposition and burial: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, are expected to be minor, as the impacts would be localized, short term, and minor.

Climate change: In the context of reasonably foreseeable environmental trends, no future activities were identified in the geographic analysis area other than ongoing activities.

3.6.5.2 Conclusions

Impacts of the Proposed Action. Proposed Action construction and maintenance activities would likely result in impacts from accidental releases, anchoring, EMFs, new cable placement, underwater noise generated primarily by pile driving, port utilization, presence of structures, discharges, seabed profile disturbances, sediment deposition and burial, and climate change. Construction activities would occur during two separate construction seasons with a 12-month recovery period for the impacted sand ridge habitats. Construction activities near artificial reefs in the Fish Haven area would impart greater impacts as reefs are sensitive habitats with increased biodiversity. Routine operation and maintenance impacts would have minimal impacts on benthic communities and result primarily from localized activities that disturb the seafloor. The benthic impacts resulting from the Proposed Action alone range from **negligible** to **moderate**. However, overall benthic impacts from the Proposed Action would be **minor** because the effect would be localized, and the benthic environment would recover over time without remedial and mitigation actions. In addition, **moderate beneficial** impacts could result from the addition of hard-bottom habitats. The "reefing" effect would benefit species that are structure-oriented, as well as predators of those species.

Cumulative impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action, would range from **negligible** to **moderate** adverse with potentially **moderate beneficial** impacts. Considering all the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action, would range from **negligible** to **moderate** benthic impacts in the geographic analysis area, depending on the IPFs. The main drivers for the moderate impact rating are seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, the potential for greater impacts on nearby artificial reef habitats, and the addition of physical structure, which will modify benthic ecosystems. Minor impacts are expected from the noise of active construction, the disturbance of sediment, and increased turbidity from burying or protecting the cables, changing the profile of the seafloor, and the hydrodynamic disturbances from these structures. These impacts could be greater if activities are near artificial reefs or other sensitive habitats. The Proposed Action would contribute to the overall impact rating primarily through the permanent impacts associated with the presence of structures. Therefore, the overall benthic impacts would likely qualify as **moderate** because a measurable impact is anticipated, but the resource would likely recover completely when the WTGs are removed, with less time for recovery if remedial or mitigating actions are taken.

3.6.6 Impacts of Alternatives B and C on Benthic Resources

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternative B: Alternative B only varies from the Proposed Action by the number of WTGs proposed and the placement of the WTGs. A total of 176 WTGs (26 fewer WTGs than the Proposed Action), along with three OSSs would be installed. Alternative B would use only 14 MW WTGs, each capable of generating up to 14.7 MW for a total up to 2,587 MW. Similar to the Proposed Action, Dominion would place the WTGs in a 0.93- by 0.75-nautical-mile (1.72- by 1.39-kilometer) offset grid in an east–west by northwest by southeast gridded layout. In this Preferred Layout the Fish Haven area within the northern portion of the Lease Area would be an exclusion zone. The eight WTGs, associated inter-array cables and other Project infrastructure would not be sited within the Fish Haven area. This would avoid impacts on or near artificial reefs, shipwrecks, and complex habitats within the Fish Haven area. Three WTGs and associated inter-array cables would also be excluded from the northwest corner of the Lease Area to avoid conflicts with a proposed vessel traffic fairway. Along with the Fish Haven area as an exclusion zone, Alternative B would have a decrease in impacts related to the duration of noise exposure from pile-driving or jet-plowing operations, and the potential displacement of soft-bottom organisms within the footprint of each construction activity. Under the Preferred Layout, the total area for WTGs and scour protection would be 103.8 acres (42.0 hectares). This layout also includes the three OSSs and cable crossing, for a total of 116.39 acres (47.10 hectares). The decrease in permanent seafloor impacts would be reduced roughly 56 percent which would functionally benefit the benthic species, especially the organisms associated with the artificial reefs within the Fish Haven area. This configuration would still allow micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, to avoid sensitive cultural resources and marine habitats. Onshore components would be the same as described under the Proposed Action. The expected impacts from 176 WTGs and three OSSs would remain minor with moderate beneficial impacts. Onshore components would be the same as described under the Proposed Action.

Impacts of Alternative C: Alternative C, the Sand Ridge Impact Minimization Alternative, was developed to minimize impacts on offshore benthic habitats, including the Fish Haven area and sand ridge habitats. Up to 172 WTGs (14 MW) would be installed in the Lease Area. Alternative C would use 14 MW WTGs generating up to 14.7 MW each in a 0.93- by 0.75-nautical-mile (1.72- by 1.38-kilometer) offset grid pattern for a total up to 2,528 MW. In addition to avoiding the fish haven area, Alternative C would minimize impacts through a combination of micrositing of infrastructure (WTGs, OSSs, and associated cabling), up to 500 feet (152 meters), removing four WTGs and relocating one additional WTG to a spare position. With the exception of the seven identified spare positions, other spare positions in the Lease Area are not desirable due to foundation technical design risk, shallow gas presence, commercial shipping and navigational risk concerns, erosion risk, or presence of a designated Fish Haven area. This configuration reduces seafloor disturbance, including the cross-cutting and trenching of sand ridges. Like the Proposed Action, the cross-cutting trenching activities would occur during two separate construction seasons with a 12-month recovery period for the affected sand ridge habitats. This sequence of construction activities would reduce multiple disturbances to individual sand ridge features that would otherwise occur in a single construction season. Overall Alternative C would have a total of up to 172 WTGs, a reduction of 30 WTGs from the Proposed Action, and 3 OSSs. This reduction of WTGs and the associated inter-array cables and cable length would impact 228 acres (92 hectares), a 16 percent reduction in the amount of disturbed benthic habitat from the Proposed Action. Approximately 169.7 acres (68.7 hectares) of benthic resources would be permanently affected.

Avoidance of the north-central Fish Haven area (i.e., containing artificial shipwrecks and additional reef habitats) (Section 3.6.1, *Description of the Affected Environment for Benthic Resources*) under Alternatives B and C would decrease benthic impacts, and Alternative C would offer additional avoidance and minimization of impacts on complex habitat in the southern portion of the Lease Area where sand ridge habitat occurs. NMFS has identified the sand ridge habitat within the Lease Area as a significant and unique benthic resource to be avoided to reduce the Project impact on invertebrates and on fish that use these resources. Offshore shoal complexes support diverse invertebrate assemblages with faunal differences found between the ridge crest and trough habitats (Rutecki et al. 2014). These habitats serve important ecological functions for the benthic community and the complex food web they support. The sand ridge habitat area encompasses 17 WTG locations, 1 OSS location, and associated inter-array and offshore export cables. However, the overall expected minor impacts and potential moderate beneficial impacts on benthic resources would not be expected to be substantially different from Alternatives B, due to the long-term to permanent impacts from the presence of structures and secondary impacts from the additional structures.

Impacts from installation and construction, O&M, and conceptual decommissioning would be similar to those described under the Proposed Action, with the exception that fewer total WTGs would reduce the amount of disturbed benthic habitat, displacement of soft-bottom organisms from habitat conversion, duration of pile driving and the associated noise impacts, and jet-plowing.

There would be a reduction in the amount of seafloor disturbed and the habitats affected in each alternative, differing under Alternatives B and C, from that described under the Proposed Action, and the impact level would remain minor. The benthic community would not undergo population-level impacts, though habitat conversion is unavoidable. The impacts on the benthic community would be unavoidable and permanent as long as the structures remain.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the combined impacts on benthic resources from ongoing and planned actions, including either Alternative B or C, would be similar to those described under the Proposed Action, with some differences in the amount of seafloor disturbed and the types of habitats affected.

3.6.6.1 Conclusions

Impacts of Alternatives B and C. Alternatives B and C would decrease the number and size of WTGs, and avoid complex habitat, shipwrecks, and artificial reefs, which would have an associated decrease in potential impacts on benthic resources, including priority habitat. BOEM expects that the impacts resulting from Alternatives B and C would be similar to the Proposed Action in a lesser degree and would range from temporary to long term with individual IPFs leading to impacts ranging from **negligible** to **moderate** with potentially **moderate beneficial** impacts, and overall impacts being **minor**.

Cumulative impacts of Alternatives B and C. In the context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including Alternatives B and C, would range from **negligible** to **moderate** with potentially **moderate beneficial** impacts. Considering all of the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including Alternatives B and C, would result in **moderate** benthic impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement and smothering) during WTG and cable installations, habitat conversion from soft- to hard-bottom habitat, fishing using bottom-tending gear, and effects from climate change. Alternatives B and C would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.6.7 Impacts of Alternative D on Benthic Resources

Impacts of Alternative D. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Cable Route Option D-1) or Hybrid Interconnection Cable Route Option 6 (Cable Route Option D-2). Cable Route Options D-1 and D-2 differ from the Proposed Action only with respect to onshore routing of the interconnection cable entirely overhead route or using a hybrid of overhead and underground construction methods. Impacts on benthic resources under Cable Route Options D-1 and D-2 would be the same as those under the Proposed Action and would range from negligible to moderate adverse and moderate beneficial benthic impacts in the geographic analysis area, depending on the IPFs. The overall benthic impacts would likely remain moderate because a measurable effect is anticipated, but the resource would likely recover completely when the WTGs are removed, with less time for recovery if remedial or mitigating actions are taken.

Cumulative impacts of Alternative D. For the same reason, the overall impacts on benthic resources in the context of reasonably foreseeable environmental trends and planned actions would be the same under Cable Route Options D-1 and D-2 as the Proposed Action and would remain moderate.

3.6.7.1 Conclusions

Impacts of Alternative D. Although Cable Route Options D-1 and D-2 would minimize impacts on onshore habitats, BOEM does not anticipate a measurable benefit for benthic resources in the geographic analysis area. Therefore, potential impacts would be same as the Proposed Action and would range from **negligible** to **moderate** with potentially **moderate beneficial** impacts, for an overall **minor** impact.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on benthic resources from ongoing and planned actions, including Cable Route Options D-1, and D-2, would be the same as those described under the Proposed Action, with individual IPFs ranging from **negligible** to **moderate**, and the potential for **minor** to **moderate beneficial** impacts.

3.6.8 Agency-Required Mitigation Measures

No additional measures to mitigate impacts on benthic resources have been proposed for analysis.

3.7 Birds

This section discusses existing bird resources in the geographic analysis area for birds, as described in Appendix F, *Planned Activities Scenario,* Table F-1 and shown on Figure 3.7-1. Specifically, the geographic analysis area for birds includes the East Coast, from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group. The geographic analysis area 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.

3.7.1 Description of the Affected Environment for Birds

This section addresses potential impacts on bird species that use onshore and offshore habitats, including both resident bird species that use the geographic analysis area during all (or portions of) the year and migrating bird species with the potential to pass through the proposed Project area during fall and/or spring migration. Detailed descriptions of birds occurring in and offshore Virginia can be found in COP, Section 4.2.3.1, and Appendix O-1, Section 2.1 (Dominion Energy 2023); in *Virginia Offshore Wind Technology Advancement Project Research Activities Plan* (RAP), Section 4.5 (BOEM 2015); and in *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment*, Section 3.2.3.1 (BOEM 2015). Additional descriptions of bird species in the geographic analysis area can be found in several BOEM wind project documents (BOEM 2012, 2014) and Williams et al. (2015).

Bird species with the potential to occur in the vicinity of Onshore and Offshore Project components are shown in COP, Section 4.2.3.1, Tables 4.2-10 and 4.2-11 (Dominion Energy 2023). Given the differences in life history characteristics and habitat use between offshore and onshore bird species, the sections below provide a separate discussion of each group. This section also discusses bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*). In addition, this section addresses federally listed threatened and endangered birds; further information regarding listed species is provided in the *Coastal Virginia Offshore Wind Commercial Project Biological Assessment* prepared for USFWS (BOEM 2022).

3.7.1.1 Offshore Birds

The Offshore Project area is located approximately 27 miles (23.75 nautical miles) offshore Virginia Beach. Waters in the Offshore Project area may provide seasonal habitat for loons, grebes, sea ducks, gulls, terns, pelagic birds (e.g., shearwaters, storm-petrels, allies), and alcids (e.g., dovekie [*Alle alle*], murre [*Alca* spp.]) according to the Mid-Atlantic Baseline Studies (Williams et al. 2015; Dominion Energy 2023). Some avian species, such as the peregrine falcon (*Falco peregrinus*), shorebirds, and passerines, occur primarily on the mainland and on barrier islands, but may also occur in the Offshore Project area, primarily during migration. Generally, a high diversity of marine birds may use the Offshore Project area because it is located at the southern end of the Mid-Atlantic Bight, an area of overlap between northern and southern species assemblages. A total of 83 marine bird species are known to regularly occur off the Mid-Atlantic Bight (Nisbet et al. 2013). Additionally, offshore and onshore avian surveys were conducted near the Project area that further describe the avian resources (RAP 2015, Appendix L). Survey data indicated that, compared to other areas in the Atlantic OCS, relatively low numbers of nearshore, pelagic, and gull species are predicted to occur in the vicinity of the Project area (Dominion Energy 2023, Figure 4.2-8; BOEM 2015).

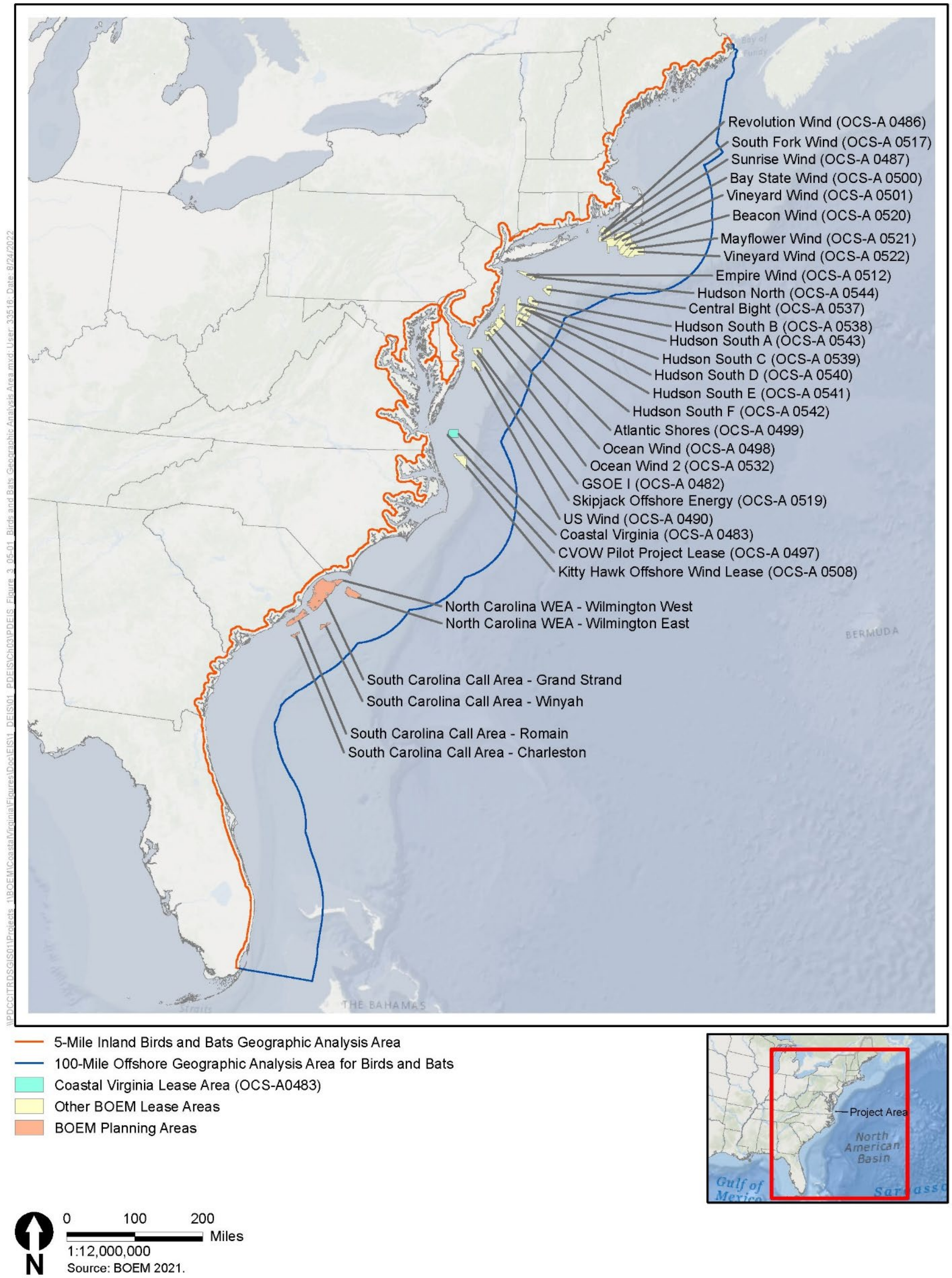


Figure 3.7-1 Birds and Bats Geographic Analysis Area

In the offshore environment, bird abundance generally declines as distance from shore increases (Petersen et al. 2006; NJDEP 2010; Paton et al. 2010). A study offshore New Jersey showed bird densities dropping precipitously a few nautical miles from shore with avian densities highest near shore during all seasons, further noting that this trend was much more pronounced in winter than summer (NJDEP 2010). In addition, the number of bird species also declines with distance from shore. For example, of the 164 waterbird species that use the Atlantic Flyway, 58 species use offshore (3 to 11 nautical miles [5 to 20 kilometers from shore]) and pelagic environments, and the remaining 106 species use bays, coastlines, and nearshore environments (Watts 2010). Therefore, for marine birds, the Offshore Project area is generally located in low bird abundance due to its distance from shore (COP, Figure 4.2-8; Dominion Energy 2023; BOEM 2015), while the offshore export cable corridor likely would have higher abundances related to proximity to shore. This is supported by COP, Appendix O-1 (Dominion Energy 2023), which provides a detailed qualitative exposure assessment (minimum, low, medium, and high) using available literature and data for birds that have the potential to pass through the Offshore Project area. The exposure assessment indicated that the proposed Project is unlikely to affect coastal or marine bird populations because, with the exception of storm-petrels, exposure for most species is minimal to low. The Offshore Project area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species; Project activities would also avoid marine bird concentration areas. Federally protected species, a category that includes golden eagle, bald eagle, red knot (*Calidrus canutus rufa*), piping plover (*Cheradrius melodus*), and roseate tern (*Sterna dougallii dougallii*), as well as the black-capped petrel (*Pterodroma hasitata*) which is a candidate species, are expected to have limited exposure and, thus, risk to individuals is unlikely.

3.7.1.2 Onshore Birds

Due to the mobility of birds, a variety of species have the potential to use the habitats in or adjacent to the Onshore Project area throughout the year. A list of the most common (75th quantile) bird species identified in the eBird database within a 12-mile (20-kilometer) buffer of the Onshore Project area included 61 different species (COP, Section 4.2.3.1 and Table 4.2-10; Dominion Energy 2023). At the cable landing location, dunes and dune grass, scrub-shrub, artificial wetlands, and residential areas may support avian species, including the double-crested cormorant (*Phalacrocorax auritus*), ring-billed gull (*Larus delawarensis*), great-blue heron (*Ardea herodias*), and brown pelican (*Pelecanus occidentalis*). Along the onshore export cable and interconnection cable routes, mixed forest, wetlands, agricultural areas, and residential areas may support avian species, including the American crow (*Corvus brachyrhynchos*), American robin (*Turdus migratorius*), European starling (*Sturnus vulgaris*), northern mockingbird (*Mimus polyglottos*), northern cardinal (*Cardinalis cardinalis*), mourning dove (*Zenaida macroura*), and blue jay (*Cyanocitta cristata*). The woods adjacent to Rifle Range Road, near the cable landing, would support a variety of species throughout the year, including the northern cardinal, Carolina chickadee (*Poecile carolinensis*), mourning dove, and blue jay. Additionally, the areas adjacent to or encompassing the potential switching station locations may provide breeding, wintering, and migratory stopover habitat due to the mix of forest, field, and wetland habitat. Additionally, onshore avian surveys were conducted near the Project area that further describe the avian resources (RAP 2015, Appendix L). In those surveys, where a total of 79 species represented by 3,578 individuals were observed, the most abundant were common grackles (*Quiscalus quiscula*) followed by tree swallows (*Tachycineta bicolor*) and laughing gulls (*Leucophaeus atricilla*) (RAP 2015, Appendix L). COP, Section 4.2.3.1, Table 4.2-10 (Dominion Energy 2023) lists the most common (75th quantile) birds identified in the eBird database within a 12-mile (20-kilometer) buffer of the Onshore Project area. COP, Appendix O-1 (Dominion Energy 2023) provides a list of the Species of Greatest Conservation Need and their associated habitats and all birds identified in the eBird database within 12 miles (20 kilometers) of the Onshore Project area.

3.7.1.3 Migratory Birds

Despite the level of human development and activity present, the Mid-Atlantic coast plays an important role in the ecology of many bird species. The Atlantic Flyway, which encompasses all of the areas that could be affected by the proposed Project, is a major route for migratory birds, which are protected under the MBTA. Chapter 4 of the Atlantic Final Programmatic Environmental Impact Statement (BOEM 2014) discusses the use of Atlantic coast habitats by migratory birds.

The official list of migratory birds protected under the MBTA, and the international treaties that the MBTA implements, is found at 50 CFR 10.13. The MBTA makes it illegal to "take" migratory birds, their eggs, feathers, or nests. Under Section 3 of Executive Order 13186, BOEM and USFWS established a Memorandum of Understanding (MOU) on June 4, 2009, which identifies specific areas in which cooperation between the agencies would substantially contribute to the conservation and management of migratory birds and their habitats (MMS and USFWS 2009). The purpose of the MOU is to strengthen migratory bird conservation through enhanced collaboration between the agencies (MMS and USFWS 2009, Section A). One of the underlying tenets identified in the MOU is to evaluate potential impacts on migratory birds and design or implement measures to avoid, minimize, and mitigate such impacts as appropriate (MMS and USFWS 2009, Sections C, D, E(1), F(1-3, 5), G(6)).

The offshore waters and adjacent coastal areas of Virginia provide habitat for migratory avian species with special state and federal conservation status. Many of these species use coastal, estuarine, and nearshore marine habitats, including Important Bird Areas, National Wildlife Refuges, and other conservation areas (e.g., the Maryland-Virginia Barrier Islands Western Hemisphere Shorebird Reserve Network site). Portions of the Mid-Atlantic coast are considered critical stopover habitat for many species of waterfowl, shorebirds, raptors, and wading birds migrating between breeding sites in the northern latitudes and wintering areas farther south (Steinkamp 2008). Migration routes for pelagic species are difficult to define and may depend on a variety of factors and interactions (Drewitt and Langston 2006; Gonzalez-Solis et al. 2009; Amélineau et al. 2021).

In the Atlantic Flyway along the North American Atlantic coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the shoreline and several kilometers out onto the OCS, whereas land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). Although both groups may occur over land or water in the flyway and may extend considerable distances from shore, the highest diversity and density are centered on the shoreline. However, some of these species can be exposed to offshore wind developments during departure and arrival to their shoreline staging areas (Watts et al. 2022). The qualitative exposure assessment conducted for the Project area, as presented in COP, Appendix O-1 (Dominion Energy 2023), is supported by the assessment of Normandeau Associates, Inc. (2014) where the sensitivity of bird populations to collision and/or displacement due to future wind development on the Atlantic OCS was evaluated. In many cases, high collision sensitivity was driven by high occurrence on the OCS, low avoidance rates with high uncertainty, and time spent in the RSZ. Many of the bird populations addressed in Normandeau Associates, Inc. (2014) had low collision sensitivity and included passerines that spend very little time on the Atlantic OCS during migration and typically fly above the RSZ.

Bird populations in the Offshore Project area that are more susceptible to impacts from collision with WTGs include gulls, terns, jaegers, phalaropes, cormorants, northern gannet, and scoters (*Melanitta* spp.). These populations are more susceptible because of their higher occurrence in the OCS, their at-risk population status, and/or their relatively high proportion of flights in the RSZ, although exposure for most species is still expected to be minimal to low (COP, Appendix O-1; Dominion Energy 2023; RAP 2015) because these species are most abundant in 1 to 2 nautical miles of the shoreline (Northeast Regional Ocean Council 2021). Populations with the lowest vulnerability to collision risk include passerines that would only cross the OCS during migration and would typically fly above the RSZ, i.e., approximately 869 feet (265 meters).

3.7.1.4 Special-Status Species

There are no critical habitats for birds listed in the ESA in the Project area (offshore or onshore), and no ESA-listed bird species were previously detected during offshore and onshore surveys in the vicinity of the Project area (RAP 2015, Appendix L). Three species of federally endangered or threatened birds can occur onshore and in coastal and marine waters offshore during part of the year, although these species are expected to have limited exposure to the Project and, thus, risk to individuals is unlikely (COP, Appendix O-1; Dominion Energy 2023). The northeastern United States population of roseate tern is listed as endangered, and the piping plover and red knot are listed as threatened. These species use coastal habitats including beaches, marshes, and intertidal wetlands. Two additional avian species, either listed or candidates for listing, may occur in the Offshore Project area. The Bermuda petrel (*Pterodroma cahow*; also known as cahow) is federally listed as endangered (35 *Federal Register* 6069) and can occur offshore Virginia. The black-capped petrel is a candidate species to be listed as threatened or endangered and may also occur offshore Virginia. The roseate tern, piping plover, and red knot may pass through the marine portion of the Project area during migration while the cahow and black-capped petrel could pass through the marine part of the Project area during the non-breeding season.

The Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. § 668 et seq.) prohibits the “take” and trade of bald and golden eagles. However, golden eagles are not expected to occur in or adjacent to the Project area because golden eagles do not nest in Virginia and migrate mostly along the Appalachian ridgelines that are located far from the Project area. Thus, the Project would have no effect on golden eagles. Bald eagles occur near wetlands such as seacoasts, rivers, large lakes, or marshes but not in the open ocean, thus the marine portion of the Project would have no effect on bald eagles, but they could be affected by activities slated to occur in the onshore portion.

BOEM has prepared a BA to address Project effects on federally listed species under USFWS jurisdiction, pursuant to Section 7 of the ESA (BOEM 2022, 2023). The BA also provides detailed accounts for each of these species.

Birds in the geographic analysis area are subject to pressure from ongoing activities, particularly accidental releases, new cable emplacement, interactions with fisheries and fishing gear, and climate change. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). Data have shown that since 1970, 30 percent of North American species have disappeared with 90 percent coming from just 12 bird families, including sparrows, warblers, finches, and swallows (NABCI 2019; Rosenberg et al. 2019). This is likely representative of the conditions of birds in the geographic analysis area. The geographic analysis area is also home to more than one-third of the human population of the United States. As a result, species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including 1) hunting pressure, e.g., from 2016 to 2020, an average of 85,000 sea ducks were harvested annually (Roberts 2021); 2) commercial fisheries by-catch, e.g., approximately 2,570 seabirds are killed annually on the Atlantic (Hatch 2018; Sigourney et al. 2019); and 3) climate change, which has the potential to have adverse impacts on bird species and habitats (National Audubon Society 2019).

According to the North American Bird Conservation Initiative (NABCI), more than half of the offshore bird species (57 percent, 31 species) have been placed on the NABCI watch list as a result of small ranges, small and declining populations, and threats to required habitats (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 Mid-Atlantic OCS. Trend analyses of North American shorebird populations indicated that many species were in decline through the 1980s and 1990s, but that some populations appear to have stabilized since that time (Andres et al. 2012). Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch list. Many of these coastal species have small population size and/or restricted distributions, making them especially vulnerable to habitat loss/degradation and other stressors (NABCI 2016). Assessments of vulnerability to climate change of all species present have estimated that, throughout Virginia, 69 out of 182 species are climate vulnerable in summer under the 3 degrees Celsius (°C) temperature increase scenario; under the 1.5°C temperature increase scenario, the number of vulnerable species is reduced to 36. Impacts are lessened in winter with 17 out of 179 species vulnerable under the 3°C temperature increase scenario and 7 species vulnerable in the 1.5°C temperature increase scenario (National Audubon Society 2019). These ongoing impacts on birds would continue regardless of regional development associated with the offshore wind industry.

Some of the main drivers of bird population declines include habitat loss; habitat fragmentation; collisions with glass windows and power lines, communication towers, power transmission lines, and cars; exposure to pesticides; losses due to domestic and feral cats (Klem 1989, 1990; Dunn 1993; Erickson et al. 2005, Longcore et al. 2013; Loss et al. 2013b; Loss et al. 2015); and effects of climate change (National Audubon Society 2019). Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are additionally vulnerable to sea-level rise and the increasing frequency of strong storms.

3.7.2 Environmental Consequences

3.7.2.1 Impact Level Definitions for Birds

Definitions of impact levels are provided in Table 3.7-1.

Table 3.7-1 Impact Level Definitions for Birds

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

3.7.3 Impacts of the No Action Alternative 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 activities 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 F.

3.7.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for birds described in Section 3.7.1, *Description of Affected Environment for Birds*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing offshore and non-offshore wind activities in 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 potential 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. Increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, sea-level rise, 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.

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on birds include.

- Continued O&M of the Block Island Project (5 WTGs) installed in state waters.
- Continued O&M of the CVOW-Pilot Project (2 WTGs) installed in OCS-A 0497.
- 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 Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect birds through the primary IPFs of light, noise, presence of structures, and cable emplacement and maintenance. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.7.3.2, *Cumulative Impacts of the No Action Alternative*, for planned offshore wind activities, but the impacts would be of lower intensity.

3.7.3.2 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).

Other planned non-offshore wind activities that may affect birds include installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, military use, marine transportation, port expansions, and installation of new structures on the OCS (see Appendix F, Section

F.2 for a complete description of ongoing and 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. See Appendix F, Table F1-4 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for birds.

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

Accidental releases: Offshore, future wind and non-wind activities could result in accidental releases of contaminants or trash into the water (see Section 3.21, *Water Quality*, for quantities and details). Following ingestion, blockages caused by both hard and soft plastic debris could result in mortality (Roman et al. 2019) or adverse health effects, such as decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Vessel compliance with USCG regulations would minimize accidental releases of trash or other debris; therefore, BOEM expects accidental trash releases from offshore wind vessels to be rare. Small exposures that result in the oiling of feathers can lead to adverse effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities (Maggini et al. 2017). Based on estimated volumes of oils, lubricants, and diesel fuel needed for other offshore wind projects (Section 3.21) and the low risk of spills due to implementation of safe handling, storage, and cleanup procedures, impacts from accidental spills and trash would represent a nominal impact on birds.

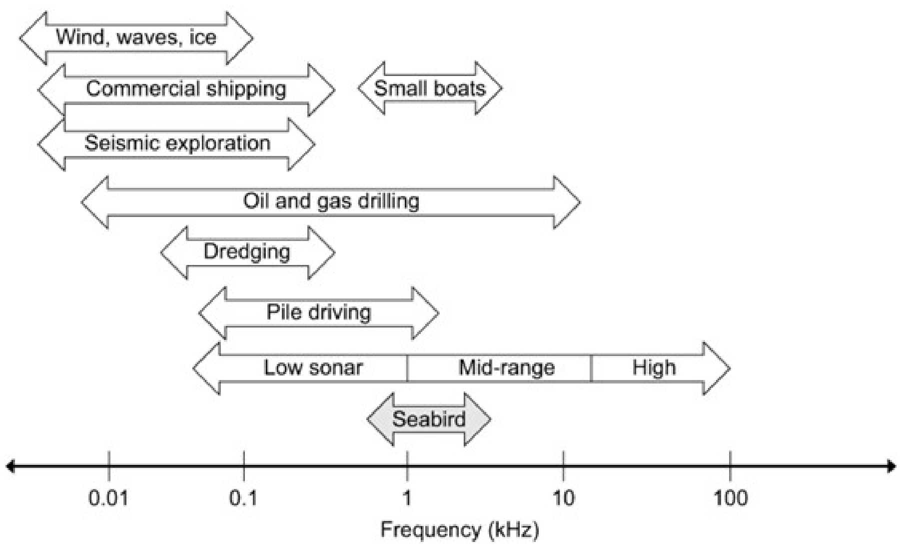
Light: Nighttime lighting associated with offshore structures and vessels could also represent a source of bird attraction. Under the No Action Alternative, over 3,287 WTGs, OSSs, and meteorological towers that could be constructed would have navigational and Federal Aviation Administration (FAA) hazard lighting in accordance with BOEM's lighting and marking guidelines and would be placed on the OCS where few lighted structures currently exist. The resulting structure-related lighting impacts would be localized but long term. Construction vessels are also a source of artificial lighting. Attraction to project vessels by birds would not be expected to result in increased risk of collision with vessels. The resulting vessel-related lighting impacts would be localized and temporary. In a maximum-case scenario, lights could be on 24 hours per day during construction. This could attract birds, and/or potential prey species, to construction zones, potentially exposing them to greater harm from other IPFs associated with construction. Lighting has some potential to result in long-term impacts and may pose an increased collision risk to migrating birds (Hüppop et al. 2006), though this risk would be minimized through the use of red-flashing FAA lighting (BOEM 2021a; Kerlinger et al. 2010). While small due to the use of red-flashing FAA lighting, some potential exists for WTG lighting to result in new collision risk, particularly to night flying migrants during low-visibility weather conditions where few lighted structures currently exist on the OCS.

New cable emplacement and maintenance: Generally, emplacement of submarine cables would result in increased suspended sediments that may impact diving birds and result in displacement of foraging individuals or decreased foraging success and have impacts on some prey species (Cook and Burton 2010). However, impacts would be temporary and localized, and no individual fitness or population-level impacts would be expected to occur because birds would be expected to successfully forage in adjacent areas not affected by increased suspended sediments. Migrating birds that are not actively foraging would not be affected. Similar impacts, but at a lesser scale, are expected for maintenance activities.

Noise: Anthropogenic noise on the OCS associated with offshore wind development, including noise from aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic, has the potential to cause temporary effects on some bird species by displacing them and changing their behavior. Additionally, onshore construction noise has the potential to result in impacts on birds. BOEM anticipates that these impacts would be localized and temporary. Potential impacts could be greater if avoidance and displacement of birds occurs during seasonal migration periods.

Aircraft flying at low altitudes may cause birds to flush, resulting in increased energy expenditure though many species have been shown to habituate to the noise and exhibit no effects on reproductive success (Black et al. 1984; Andersen et al. 1986; Conomy et al. 1998). Disturbance to birds would be temporary and localized, with impacts dissipating once the aircraft has left the area. No individual or population-level effects on birds would be expected.

During pile-driving activities, noise transmitted through water could temporarily displace diving birds in a limited space around each pile and could cause short-term stress and behavioral changes ranging from mild annoyance to escape behavior (Turnpenny and Nedwell 1994). Pile-driving noise falls within range of peak underwater hearing frequencies for seabirds (Figure 3.7-2) (McGrew et al. 2022). Vessel noise could also disturb some individual diving birds, but they would acclimate to the noise or move away due to their restricted hearing range relative to ship noise (Dooling and Popper 2007), potentially resulting in temporary displacement. Collectively, these noise sources would be temporary and localized, resulting in a minor impact on these birds.



Source: McCrew et al. 2022.

Figure 3.7-2 Overlap in Frequency Between Ambient Anthropogenic Noise and Seabird Acoustic Sensitivity

Presence of structures: The presence of structures can lead to impacts, both beneficial and adverse, on birds through fish aggregation and the associated increase in foraging opportunities, as well as entanglement and gear loss/damage, migration disturbances, and WTG strikes and displacement. These impacts may arise from buoys, meteorological towers, foundations, scour/cable protections, and transmission cable infrastructure. BOEM anticipates that structures would be added intermittently from 2023 through 2030 (Appendix F, Attachment 2, Table F2-1) and that they would remain until conceptual decommissioning of each facility is complete, approximately 33 years following construction.

The primary threat to birds from the presence of structures would be from collision with WTGs. As discussed above, the Atlantic Flyway is an important migratory pathway for up to 164 species of waterbirds (58 pelagic species and 105 species using bays, coastlines, and nearshore environments), and a similar number of land bird species, with the greatest volume of birds using the Atlantic Flyway during annual migrations between wintering and breeding grounds (Watts 2010). However, the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (COP, Appendix O-1; Dominion Energy 2023; BOEM 2015, 2021b, 2021c). Of these 58 waterbird species occurring on the Atlantic OCS from Florida to Maine, 47 taxa have sufficient survey data to calculate the modeled percentage of a species population that would overlap with the anticipated offshore wind development on the OCS (Winship et al. 2018); the relative seasonal exposure is generally very low, with the highest percentage being 5.2 percent (Winship et al. 2018, Appendix D). BOEM assumes that the 47 species with sufficient data to model the relative distribution and abundance are representative of the 55 taxa that may overlap offshore wind development on the Atlantic OCS.

The primary operational impact on bird resources from offshore wind activities would be collision with rotating turbine blades. In the contiguous United States, bird collisions with operating WTGs are a relatively rare event, with an estimated 140,000 to 328,000 birds killed annually by 44,577 onshore turbines (Loss et al. 2013a). Based on a mortality rate of 6.9 birds per turbine in the eastern United States (Loss et al. 2013a), an estimated 21,459 birds could be killed annually under the No Action Alternative. This represents a worst-case scenario that does not consider mitigating factors such as landscape and weather patterns, or bird species that are expected to occur. The actual mortality rate attributed to bird collisions with operating WTGs would be expected to be much lower. The majority (75 percent) of the documented onshore mortality is composed of bird groups (small passerines, diurnal raptors, doves, pigeons, and upland game birds) that would not frequently encounter offshore WTGs in large numbers. Secondly, factors such as landscape features and weather patterns that influence collision risk are different on the OCS compared to onshore wind facilities. Thirdly, empirical studies suggest that bird fatalities due to collision with offshore turbines is low. Unlike in Europe, offshore wind activities on the Atlantic OCS will be further offshore away from nesting colonies and not placed between large land masses, thus, limiting the likelihood of exposure. Given that the relative density of birds on the OCS is low, relatively few birds are likely to encounter wind turbines (COP, Appendix O-1: Dominion Energy 2023; Normandeau Associates, Inc. 2014; RAP 2015; Northeast Regional Ocean Council 2021).

Additionally, with the proposed 0.6- to 1-nautical mile (1.1- to 1.9-kilometer) spacing between structures associated with offshore wind development and the distribution of these anticipated projects, only a small percentage of bird species migrating over the OCS would encounter WTGs, with most flying above or below spinning turbines (Mizrahi et al. 2010, 2013; Tetra Tech, Inc. 2012; Normandeau Associates, Inc. 2014). 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 the 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, 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. 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 kilometer) 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.

The addition of WTGs to the offshore environment could result in increased functional loss of habitat for those bird species with higher displacement sensitivity. However, substantial foraging habitat for resident birds would remain available (see Section 3.6, *Benthic Resources*, for information about impacts on benthic habitats). Therefore, impacts would be minor, and no population-level impacts would occur.

In the Northeast and Mid-Atlantic waters, it is estimated that there are 2,570 seabird fatalities through interaction with commercial fishing gear each year; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2018). The addition of new WTGs could also increase the risk of entanglement with fishing gear due to the potential increase in recreational fishing activity around the structures, which could lead to bird injury or mortality. Impacts from fishing gear would be localized; however, the risk of occurrence would remain as long as structures remain. In contrast, abandoned or lost fishing nets from commercial fishing may get tangled with foundations, reducing the chance that abandoned gear would cause additional harm to birds and other wildlife if left to drift until sinking or washing ashore. A reduction in derelict fishing gear (in this case by entanglement with foundations) has a beneficial impact on bird populations (Regular et al. 2013).

WTGs and foundations could also increase pelagic productivity in local areas (English et al. 2017; Slavik et al. 2019; Dorrell et al. 2022), and new structures may also create habitat for structure-oriented and/or hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity within the first year or two after construction (English et al. 2017; Causon and Gill 2018; Degraer et al. 2020). Recent studies, including a literature review, have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Dierschke et al. 2016; Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019; Galparsoro et al. 2022), 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 long-term moderate beneficial impacts. Conversely, increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs. For details on the effects of WTGs on benthic habitat and recreational fishing, see Section 3.6 and Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*.

Traffic: From 1990 to 2020, general aviation accounted for 229,551 bird strikes (Dolbeer et al. 2021). Because aircraft flights associated with offshore wind development are expected to be minimal compared to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic would not be expected to appreciably contribute to overall impacts on birds.

Land disturbance: Onshore construction noise from other human activities could result in localized, minor, and temporary impacts on birds, including avoidance and displacement, though no population-level effects would occur. Onshore land development or port expansion activities could also result in limited loss or fragmentation of nesting and/or foraging habitat for some bird species. However, such minor impacts would be limited in extent, and would not measurably affect bird population abundance or viability as most construction would be expected to generally occur in previously disturbed habitats. Overall, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities.

Climate change: Several sub-IPFs related to climate change, including increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, sea-level rise, and increased erosion and sediment deposition, have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing. Section 3.4, *Air Quality*, provides more details on the expected contribution of offshore wind to climate change.

3.7.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, birds would continue to be affected by existing environmental trends and ongoing activities.

Ongoing activities and offshore wind activities are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion, habitat loss) on birds primarily through accidental releases, anthropogenic noise, presence of structures, and climate change. Ongoing activities, especially interactions with commercial fisheries, anthropogenic light in the coastal environment, and climate change, would be **moderate**. In addition to ongoing activities, the impacts of planned actions other than offshore wind development, including new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and the installation of new structures on the OCS would be **minor**. The combination of ongoing activities and reasonably foreseeable activities other than offshore wind would result in **moderate** impacts on birds in the geographic analysis area.

Cumulative impacts of the No Action Alternative. 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 impacts on birds due to habitat loss from increased onshore construction. Considering all of the IPFs together, the overall impacts associated with offshore wind activities in the geographic analysis area would result in **moderate** adverse impacts but could include **moderate beneficial** impacts because of the presence of structures. Most of the offshore structures in the geographic analysis area would be attributable to the 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 would have long-term functional habitat loss due to behavioral avoidance and displacement from WDAs on the OCS. The offshore wind development would also be responsible for most of the impacts related to new cable emplacement and pile-driving noise but impacts on birds resulting from these IPFs would be localized and temporary and would not be biologically notable.

3.7.4 Relevant Design Parameters and Potential Variances in Impacts

The proposed Project design parameters that would influence the magnitude of the impact on birds are provided in Appendix E, *Project Design Envelope and Maximum-Case Scenario*, and include the following.

- The number, size, and location of WTGs.
- The routing variants in the selected onshore cable export/interconnection route which could require the removal of forested habitat.
- The time of year during which construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E. 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 birds.

- Season of construction: The active season for birds in this area is generally during spring and fall migrations. Construction outside of this window would have a lesser impact on birds than construction during the active season.

3.7.5 Impacts of the Proposed Action on Birds

Accidental releases: Some potential for mortality, decreased fitness, and health effects exists due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with the Proposed Action (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016; Roman et al. 2019).

Vessels associated with the Proposed Action could generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris; while operational controls, monitoring equipment, and industry best practices would be applied, accidental losses could occur. All vessels associated with the Proposed Action would comply with the USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Additionally, training and awareness of best management practices proposed for waste management and mitigation of marine debris would be required of Project personnel, reducing the likelihood of occurrence to a very low risk. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time. As such, BOEM expects localized and temporary impacts on birds to constitute a negligible impact. Offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazardous materials exposure. The contribution from offshore wind and the Proposed Action would be a low percentage of the overall spill risk from ongoing activities.

Light: The Proposed Action's incremental contribution of 202 WTGs ranging from 14 MW to 16 MW and three OSSs would all be lit with navigational and FAA hazard lighting. Per BOEM guidance (2021a) and outlined in COP, Section 3.5.3 (Dominion Energy 2023), each WTG would be lit in accordance with USCG, FAA, and BOEM requirements; these lights have some potential to attract birds and result in increased collision risk (Hüppop et al. 2006). However, red-flashing aviation-obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010; Orr et al. 2013). Additionally, marine navigation lighting would consist of multiple flashing-yellow lights on each WTG and on the corners of each OSS. To further reduce impacts on birds, when practicable, Dominion would use lighting technology (e.g., low-intensity strobe lights, flashing red aviation lights) that minimize impacts on birds. As such, BOEM expects impacts to be long term but negligible from lighting. Vessel lights during construction, operations, and conceptual decommissioning would be minimal and likely limited to vessels transiting to and from construction areas.

The expected negligible impact of the Proposed Action would not noticeably increase the impacts of light beyond the impacts described under the No Action Alternative (Section 3.7.3, *Impacts of the No Action Alternative on Birds*). Under the expanded planned action scenario, over 3,135 offshore structures would have lights, which would be incrementally added over time beginning in 2023 and continuing through 2030. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021a) guidance.

New cable emplacement and maintenance: The Proposed Action would result in the disturbance of up to 8,018.2 acres (3,244.9 hectares) of seafloor via cable installation (including anchoring and cable protection), resulting in turbidity effects that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species (COP, Table 4.2-17; Dominion Energy 2023). Cable emplacement disturbance under the Proposed Action is expected to be temporary and localized to the emplacement corridor. However, individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement. Only negligible impacts on individuals or populations would be expected, given the localized and temporary nature of the potential impacts. Based on the assumptions in the planned activities scenario (Appendix F), no other offshore wind project cable installation has the potential to overlap in time with the Proposed Action. Therefore, given the localized nature of these impacts, impacts associated with the emplacement of the Proposed Action export and inter-array cabling would be negligible. Suspended sediment concentrations during activities would be within the range of natural variability for this location.

The expected negligible incremental impact of the Proposed Action combined with the planned actions would result in seafloor disturbance from the offshore export cable and inter-array cables.

Noise: The expected negligible impacts of aircraft, G&G survey, construction, and pile-driving noise associated with the Proposed Action alone would not increase the impacts of noise beyond the impacts described under the No Action Alternative (Section 3.7.3). Effects on onshore and offshore bird species could occur during the construction phase of the Proposed Action because of equipment noise (including pile-driving noise as shown in Figure 3.7-2). The pile-driving noise impacts would be short term (4 hours per pile), minimized, and mitigated through a combination of soft starts, shut-down procedures, and real-time monitoring systems (COP, Section 4.2; Dominion Energy 2023). Vessel and construction noise could disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (Black et al.1984; Andersen et al. 1986; Conomy et al. 1998; BOEM 2012).

Onshore construction for the Proposed Action could also disturb birds. Noise associated with use of DSPT for the installation of the offshore export cables to the cable landing location would result in temporary noise impacts from installation of the cofferdam, from DSPT in the sea-to-shore transition, and at beach work areas, and could result in temporary, localized disturbance or displacement of birds. While the total acreage of the cable landing location footprint is 11.1 acres (4.5 hectares), most of the area would be used for equipment laydown and staging and would not require any vegetative clearing or grading, and permanent impacts would only occur within a 2.27-acre (0.92-hectare) area that would be a parking lot. Disturbance impacts at the cable landing location would be short term and limited because the landing is located in a proposed parking lot. The onshore export cable predominately follows developed corridors and previously disturbed land to a common location north of Harpers Road. The onshore export cable route would pass through several habitat types, including open space, developed, forested, agricultural, and wetlands (Section 3.8, *Coastal Habitat and Fauna,* Tables 3.8-2, 3.8-3, and 3.22-3) that may support avian species, resulting in temporary disturbance impacts on birds. From that point, onshore clearing and construction (and associated noise) would be required at the Harpers Switching Station and for the overhead lines from Harpers Switching Station to Fentress Substation, resulting in impacts on varying acreages of wetlands and NLCD land cover classes, as shown in Tables 3.8-2 and 3.22-3. The Harpers Switching Station would require approximately 5.52 acres (2.23 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the adjacent golf course, 0.9 acre (0.4 hectare) for relocation of Dewey Road Drive, and 12.5 acres (5.1 hectares) for workspace, fence relocation, and tree removal. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station (Dominion Energy 2023). Impacts at the Harpers Switching Station would be on previously developed areas in the Aeropines Golf Club (Tables 3.8-2 and 3.8-3) but would require a total of 27.02 acres (10.93 hectares) of tree clearing. Interconnection Cable Route Option 1 would culminate at the onshore substation, which would also require land clearing and result in impacts on wetlands and various NLCD land cover classes (Tables 3.8-2 and 3.22-3) and subsequent disturbance impacts on birds. Overall, noise from onshore clearing and construction would be localized and temporary. While the noise could disturb birds, they would likely acclimate to the noise or temporarily move away, potentially from preferred habitats (i.e., wetlands, trees). BOEM expects that no individual fitness or population-level impacts would be expected to occur, resulting in minor impacts on birds from the Proposed Action, with no lasting impacts on local breeding populations.

Because only temporary impacts, are expected to occur, BOEM anticipates impacts from the construction and installation of the offshore components to be negligible and impacts from the construction and installation of the onshore components to be minor. Normal operation of the onshore substation would generate localized continuous noise, but BOEM expects negligible associated long-term impacts when considered in the context of the other commercial, agricultural, and industrial noises near the proposed substation. Similar impacts are expected relative to normal operation of the selected switching station as anticipated noise levels would be localized and low, and the Harpers Switching Station is located in an industrial district.

Placement of structures: The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, as well as entanglement and fishing gear loss/damage, migration disturbances, and WTG strikes and displacement, are described in detail in Section 3.7.3, *Impacts of the No Action Alternative on Birds*. The impacts of the Proposed Action alone as a result of the presence of structures would be minor and may include minor beneficial impacts. Due to the anticipated use of flashing red tower lights, the restricted time period of exposure during migration, and a small number of migrants that could cross the WDA, BOEM and USFWS conclude that the effects of the Proposed Action would be negligible for federally listed species (e.g., red knot, piping plover, and roseate tern), the protected bald eagles, and the black-capped petrel, which is a candidate species (COP, Appendix O-1; Dominion Energy 2023). See the Project BA (BOEM 2022, 2023) for a complete discussion of the potential collision risk to ESA-listed species as a result of operation of the proposed Project.

As described above and depicted for the Offshore Project area in COP, Figure 4.2-8 (Dominion Energy 2023), the Project was sited to minimize impacts on all resources, including birds. Operation of the Proposed Action would result in impacts on some individuals of offshore bird species, and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs and/or through behavioral avoidance and habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Millman 2016; Fox and Petersen 2019). Dominion Energy would reduce perching opportunities on offshore structures to the extent practicable and, where possible, on the WTGs and OSSs. The predicted activity of bird populations that have a higher sensitivity to collision, as defined by Robinson Willmott et al. (2013), is low in the Offshore Project area during all seasons of the year (COP, Figure 4.2-8 and Appendix O-1; Dominion Energy 2023; BOEM 2015; Winship et al. 2018, Appendix D), suggesting that bird fatalities due to collision are likely to be low. When turbines are present, many birds would avoid the turbine site altogether, especially the species that ranked “high” in vulnerability to displacement by offshore wind energy development (Robinson Willmott et al. 2013). In addition, many birds would likely adjust their flight paths to avoid wind turbines by flying above, below, or between them (Plonczkier and Simms 2012; Cook et al. 2018; Skov et al. 2018), and others may take extra precautions to avoid turbines when the turbines are moving (Johnston et al. 2014; Cook et al. 2018). Several species have very high avoidance rates; for example, the northern gannet (*Morus bassanus*), black-legged kittiwake (*Rissa tridactyla*), herring gull (*Larus argentatus*), and great black-backed gull (*Larus marinus*) have measured avoidance rates of at least 99.6 percent (Skov et al. 2018). Dominion Energy performed an exposure assessment to estimate the risk of various offshore bird species encountering the Offshore Project area (COP, Appendix O-1; Dominion Energy 2023). Based on the analysis provided in the assessment, activities occurring in the Lease Area are unlikely to affect the populations of coastal or marine birds because, with the exception of storm-petrels, annual exposure risk for most species is minimal to low; storm-petrels were rated at medium exposure risk. The risk for some species changed with the seasons but generally remained minimal to low, except gannets and loon where risk was medium in the spring. Based on the results of the exposure assessment (COP, Appendix O-1;

Dominion Energy 2023), the Lease Area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species, with avoidance of marine bird concentration areas resulting in limited exposure or collision potential.

Vattenfall (a European energy company) recently studied bird movements in an offshore wind farm situated 2 to 3 miles (3 to 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) 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 to October period. The study's calculated micro-avoidance rate (above 0.96) is similar to Skov et al. (2018).

During migration, many bird species, including songbirds, likely fly at heights well above the RSZ (approximately 869 feet [265 meters]) (Mizrahi et al. 2010, 2013; Tetra Tech, Inc. 2012; Normandeau Associates, Inc. 2014). As shown in Robinson Willmott et al. (2013), species with low sensitivity scores include many passerines that only cross the Atlantic OCS briefly during migration and typically fly well above the RSZ. Inclement weather and reduced visibility can cause changes to migration altitudes (Ainley et al. 2015) and could lead to large-scale mortality events (Newton 2007). 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 including fog (Fox et al. 2006; Hüppop et al. 2006; Panuccio et al. 2019). Further, many of these passerine species, while detected on the OCS during migration as part of BOEM's Acoustic/Thermographic Offshore Monitoring project (Normandeau Associates, Inc. 2014), they were documented in relatively low numbers. Further, most carcasses of small migratory songbirds found at land-based wind energy facilities in the northeast were within 7 feet (2 meters) of the turbine towers, suggesting that they are colliding with towers rather than moving turbine blades (Choi et al. 2020); therefore, it is possible that migrating passerines could collide into offshore structures such as the WTG towers and OSSs. Given that the relative density of birds in the OCS is low, avoidance of the WTGs by some birds, and that many passerines fly well above the RSZ, relatively few birds are likely to encounter wind turbines and BOEM expects that no individual fitness or population-level impacts would be expected to occur resulting in moderate impacts on birds from the Proposed Action.

The presence and operation of the Project may result in displacement of some waterbirds, waterfowl, seabirds, and phalaropes that use the area for foraging, resting, or nighttime roosting, leading to an effective loss of habitat (COP, Appendix O-1; Dominion Energy 2023; Drewitt and Langston 2006; Petersen et al. 2006; Dierschke et al. 2016; Welcker and Nehls 2016). While the Lease Area would no longer provide foraging opportunities to those species with high displacement sensitivity, suitable foraging habitat exists in the immediate vicinity of the proposed Project and throughout the region. BOEM expects this loss of habitat to be not notable and population-level, long-term impacts resulting from habitat loss would likely be negligible.

Traffic: The expected negligible impacts of aircraft traffic associated with the Proposed Action alone would not increase the impacts of this IPF beyond the impacts described under the No Action Alternative (Section 3.7.3, *Impacts of the No Action Alternative on Birds*).

Land disturbance: The expected impacts of onshore construction associated with the Proposed Action would not increase the impacts of this IPF beyond the impacts described under the No Action Alternative. Dominion's commitment to the use of DSPT technology to install the offshore export cables under the beach and dune and bring them to shore through a series of conduits would avoid beach habitat for nesting shorebirds. As such, temporary impacts on birds, particularly nesting shorebirds resulting from the landfall location, would be negligible. BOEM could further reduce potential impacts on nesting shorebirds near the cable landfall by implementing the mitigation measure of avoiding the installation of export cable conduits between April 1 and August 31. This would avoid impacts on nesting shorebirds, such as the piping plover. Given that the closest areas of designated critical habitat for piping plovers are located in North Carolina, no effects to designated piping plover critical habitat would be expected to occur as a result of the proposed Project.

Collisions between birds and vehicles or construction equipment have some limited potential to cause mortality. However, these temporary impacts would be negligible because most individuals would avoid the noisy construction areas (Bayne et al. 2008; Goodwin and Shriver 2010; McLaughlin and Kunc 2013). The Proposed Action would require temporary habitat alteration in or adjacent to existing public utility right-of-way. Clearing, grading, and excavations would temporarily alter existing habitat, which is primarily small areas of mixed forest and woody wetland. The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for birds or result in masking effects on bird communication for those that remain in the area (Dooling et al. 2019). Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on bird species that frequent this mixed forest and woody wetland ecosystem are not expected to be measurable and, as such, would be considered negligible.

Long-term habitat loss or alteration is expected to result from the Proposed Action. Minimal clearing is anticipated as the majority of Onshore Project components (cable landing station, switching station, and substation) are located in previously developed areas and the interconnection cable route would be constructed as an overhead transmission line. These changes would be expected to have a minimal effect on birds because the fragmented forest habitat is common across coastal Virginia. Tree/vegetation clearing would be conducted outside of the breeding season to avoid nesting bird locations to the extent practicable. Under the Proposed Action, Interconnection Cable Route Option 1 would impact various acreages of a variety of habitat types (Tables 3.8-2 and 3.22-3) and require 117 acres (47 hectares) of tree clearing. The Harpers Switching Station would require approximately 5.52 acres (2.23 hectares) for stormwater management facilities, approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Club, 0.9 acres (0.4 hectares) for relocation of Dewey Road Drive, and 12.5 acres (5.1 hectares) for workspace, fence relocation, and tree removal. Approximately 27.02 acres (10.93 hectares) of tree clearing would be required to support relocation of fairways construction of the maintenance building, relocation of Dewey Road, and construction of stormwater management facilities and the footprint of Harpers Switching Station. These acreages are included in the overall acreage of 46.48 acres (18.8 hectares) for the Harpers Switching Station, and would result in impacts predominantly on previously disturbed habitats in the Aeropines Golf Club (Tables 3.8-2 and 3.22-3; Dominion Energy 2023). Interconnection Cable Route Option 1 would culminate at the onshore substation, which is located in an existing developed area and is associated with fragmented habitat; expansion of the parcel would require clearing in forested areas and wetlands (Tables 3.8-2 and 3.22-3), resulting in subsequent impacts on birds through habitat loss/fragmentation. Refer to Section 3.21, *Water Quality,* Section 3.14, *Land Use and Coastal Infrastructure,* and Section 3.22, *Wetlands*, for additional details of potential impacts on surface waters, land use, and wetlands. No individual fitness or population-level effects would be expected from onshore construction and associated habitat loss/fragmentation. Therefore, BOEM anticipates minor impacts.

Dominion would likely leave onshore facilities in place for future use. There are no plans to disturb the land surface or terrestrial habitat during the course of the Proposed Action conceptual decommissioning. Therefore, onshore temporary impacts of conceptual decommissioning would be negligible.

3.7.5.1 Cumulative Impacts of the 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. 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, light, new cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance. 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, light, new cable emplacement and maintenance, noise, 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 in the geographic analysis area.

The expected negligible to moderate impacts of the Proposed Action alone would not increase beyond the impacts described under the No Action Alternative. Appendix F indicates that there could be 3,135 WTGs in the geographic analysis area. The Proposed Action would add up to 202 WTGs, respectively. The structures associated with the Proposed Action and the consequential impacts would remain at least until conceptual decommissioning is complete (33 years). In the context of reasonably foreseeable environmental trends, the combined impacts arising from the presence of structures from ongoing and planned actions, including the Proposed Action, would be expected to range from negligible to moderate based on the sub-IPFs and may result in moderate beneficial impacts due to the large number of structures. A majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action, because the Proposed Action would account for approximately 6.4 percent (202 of 3,135 WTGs) of the new WTGs on the Atlantic OCS.

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. In the context of reasonably foreseeable environmental trends, the Proposed Action would not contribute substantially to the cumulative accidental releases, light, new cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance impacts on birds.

3.7.5.2 Conclusions

Impacts of the Proposed Action. Project construction and installation and conceptual decommissioning would introduce noise, lighting, human activity, debris and contaminants, and new structures and vessels (increasing potential collision risk) to the geographic analysis area, as well as alter existing bird habitat affecting birds to varying degrees depending on the location, timing, and species affected by an activity.

Some species of birds migrating through the Lease Area have the potential to be disturbed or displaced temporarily during construction and operation of the offshore wind facilities. Onshore, permanent habitat loss/fragmentation and conversion would occur and include wetland areas of high ecological value; onshore conceptual decommissioning is not likely to have a noticeable effect but would require further evaluation at the Project's conceptual decommissioning. Noise, lighting, and human activity impacts from Project O&M would occur, although at lower levels than those produced during construction and conceptual decommissioning. Offshore structures would also represent a long-term collision risk, although that risk is low. BOEM anticipates the impacts resulting from the Proposed Action alone would range from **negligible** to **moderate**. Therefore, BOEM expects the overall impact on birds from the Proposed Action alone to be **moderate** because the effects would be small, no population-level effects are expected, and the resource would be expected to recover completely without remedial or mitigating action.

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

3.7.6 Impacts of Alternatives B and C on Birds

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, described in this section.

Impacts of Alternatives B and C. With the exception of the number and size of WTGs, the impacts of construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of Alternatives B and C would be similar to those described under the Proposed Action. IPFs associated with the construction and installation of up to 176 WTGs plus spare locations under Alternative B (each 14 MW) and up to 172 WTGs under Alternative C (each 14 MW), including accidental releases, pile-driving noise, temporary avoidance and displacement, turbidity, and sediment deposition, would be decreased by approximately 14 percent under Alternative B and up to approximately 16 percent under Alternative C when compared to the Proposed Action.

Although there is some correlative evidence from inland studies that bird mortality increases with tower height (Barclay et al. 2007; Thaxter et al. 2017), Thaxter et al. (2017) showed that deploying a smaller number of large turbines with greater energy output reduced total collision risk per unit energy output. Therefore, fewer WTGs may allow greater opportunity for birds to avoid WTGs. Overall, the expected moderate impacts on birds would not be materially different than those described under the Proposed Action. The use of smaller 14 MW WTGs under Alternatives B and C may have some potential to decrease collision risk based on studies of terrestrial wind facilities (Barclay et al. 2007), and use of fewer WTGs in Alternatives B and C may also decrease collision risk compared to the Proposed Action (Johnston et al. 2014; Thaxter et al. 2017). Functional habitat loss to those species populations with higher displacement sensitivity would also be slightly smaller due to the reduced Project area. More recent research indicates that avian mortality rate is correlated with the amount of energy produced (a metric that accounts for both turbine size and operating time), rather than simply the size or spacing, indicating the need for additional research (Huso et al. 2021). Nevertheless, the overall expected moderate impacts and potential moderate beneficial impacts on birds would not be expected to be materially different for Alternatives B and C than those described under the Proposed Action.

Cumulative Impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.7.6.1 Conclusions

Impacts of Alternatives B and C. Although Alternatives B and C would decrease the number and potential size of WTGs, which would have an associated decrease in potential collision risk, BOEM expects that the impacts resulting from Alternatives B and C would be similar to the Proposed Action and would range from temporary to long term with individual IPFs leading to impacts ranging from **negligible** to **moderate** with **minor beneficial** impacts and with overall impacts being **moderate**.

Cumulative impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on birds from ongoing and planned actions, including Alternatives B and C, would be similar to those described under the Proposed Action, with individual IPFs leading to impacts ranging from **negligible** to **moderate** and potentially **moderate beneficial** impacts. While Alternatives B and C may be slightly less impactful to birds due to the reduction in number and potential size of WTGs than described under the Proposed Action, the overall impacts of these alternatives on birds would be the same as under the Proposed Action and would remain **moderate**. This impact rating is driven primarily by ongoing activities, such as climate change, as well as the presence of operating WTGs on the OCS. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.7.7 Impacts of Alternative D on Birds

Impacts of Alternative D. All offshore components of Alternative D are the same as the Proposed Action (202 WTGs and 3 OSSs) and impacts on birds from the Offshore Project components would be the same as evaluated under the Proposed Action. Onshore, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under sub-alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same.

In contrast to the Proposed Action, Alternative D-2 involves approval of only Hybrid Interconnection Cable Route Option 6 (Alternative D-2), which would be approximately 14.3 miles (23.0 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods including open trench, micro tunneling, and HDD. The route would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.8 miles (15.8 kilometers) to the onshore substation (Fentress).

Noise and land disturbance from onshore construction activities of Interconnection Cable Route Option 6 would result in behavioral and habitat loss/fragmentation impacts on birds as a result of temporary disturbance and clearing of a total of 77.1 acres (31.2 hectares) of NLCD land cover classes (Tables 3.8-4 and 3.8-5) whereas the Proposed Action would result in impacts on a total of 78.3 acres (31.7 hectares) (Tables 3.8-2 and 3.8-3). Permanent impacts resulting in the loss of potential habitat would be 116.3 acres (47.1 hectares) for Interconnection Cable Route Option 6 and 127.2 acres (51.5 hectares for Interconnection Cable Route Option 1. While the NLCD does include wetland land cover classes, refer to Table 3.22-4 for wetland impacts on the Onshore Project components based on wetland delineation survey data. Total estimated tree clearing is 117 acres (47 hectares) with Interconnection Cable Route Option 1 and 101 acres (41 hectares) with Interconnection Cable Route Option 6. Approximately 76 percent of Interconnection Cable Route Option 1 (Proposed Action) and 70 percent of Interconnection Cable Route Option 6 (Alternative D-2) would be collocated with existing linear development. The Chicory Switching Station (Interconnection Cable Route Option 6) is in an area identified as general ecological integrity (C5), and would be built in a forested parcel, with potential for habitat loss/fragmentation for birds due to tree clearing in multiple forest NLCD land cover classes (Table 3.8-4). The Chicory Switching Station would have a footprint of 35.5 acres (14.4 hectares) but would result in a greater area of impact on undeveloped NLCD land cover classes than the Harpers Switching Station, which would be located entirely within the existing Aeropines Golf Club and permanently impact 35.3 acres (14.3 hectares) of NLCD land cover classes. Overall, impacts at the Chicory Switching Station (Alternative D-2) would predominantly occur on previously undisturbed forest/wetland habitats (Tables 3.8-4 and 3.8-5), whereas impacts at the Harpers Switching Station (Proposed Action) would be on portions of developed areas (Tables 3.8-2 and 3.8-3). Similar to the Proposed Action, impacts associated with onshore clearing and construction would be localized and temporary. While Alternative D-2 would result in a slight increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates the difference in potential impacts on birds would be nominal.

The impacts resulting from noise and land disturbance under Alternative D-1would be the same as those described under the Proposed Action. Alternative D-2 would have a slightly increased potential to permanently affect forested and wetland habitats when compared to the Proposed Action. As described for the Proposed Action, and based on wetland and NLCD cover class mapping, Alternative D-1 (Interconnection Cable Route Option 1) would have the least potential to permanently affect forested and wetland habitats as compared to Alternative D-2 (Hybrid Interconnection Cable Route Option 6). No individual fitness or population-level effects would be expected from onshore construction and associated loss/fragmentation of foraging associated with Alternative D-1 or D-2, and as a result, BOEM anticipates minor impacts. While Alternative D-2 would result in an increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates impacts of Alternative D-1 or D-2 to be similar on birds to those described under the Proposed Action: negligible to moderate impacts with overall moderate impacts on birds.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.7.7.1 Conclusions

Impacts of Alternative D. The Proposed Action only considers Interconnection Cable Route Option 1 while Alternatives D-1 and D-2 consider Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2). BOEM anticipates the impacts on birds resulting from Alternative D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be slightly greater than under the Proposed Action due to construction and clearing occurring on a larger area of undisturbed forest/wetland habitats; however, the impacts are not expected to change under Alternatives D-1 or D-2 relative to the Proposed Action. Impacts on birds would result in the same impacts on birds as those of the Proposed Action and would remain **moderate** with **minor beneficial** impacts. Impact ratings associated with individual IPFs would not change.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the impacts of ongoing and planned actions, including Alternatives D-1 or D-2, would be the same as those described under the Proposed Action, ranging from temporary to long term (with individual IPFs leading to impacts ranging from **negligible** to **moderate** but that could include **moderate beneficial** impacts). The overall impacts on birds of ongoing and planned actions, including Alternative D-1 or D-2, would be the same as those under the Proposed Action, with impacts remaining **moderate**. This impact rating is driven primarily by ongoing activities, such as climate change, as well as the presence of operating WTGs on the OCS. As described for the Proposed Action, Dominion's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.7.8 Agency-Required Mitigation Measures

The measures listed in Table 3.7-2 are recommended for inclusion in the Preferred Alternative. If these measures are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced.

Table 3.7-2 Measures Resulting from Consultations: Birds[1]

Measure	Description	Effect
Adaptive mitigation for birds and bats	BOEM will require that Dominion Energy develops and implements a Post-Construction Monitoring (PCM) plan based on Dominion Energy's Proposed Bird and Bat Monitoring Framework in coordination with USFWS and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring. Prior to commencing offshore construction activities, Dominion Energy must submit the PCM for BOEM and USFWS review. BOEM and USFWS will review the PCM and provide any comments on the plan within 30 calendar days of its submittal. Dominion Energy must resolve all comments on the PCM to BOEM and USFWS's satisfaction before implementing the plan. a. Monitoring. Dominion Energy must conduct monitoring as outlined in Dominion Energy's Proposed Bird and Bat Monitoring Framework, which will include acoustic monitoring of bat presence, the use of motus receivers and tags to monitor bird and bat movements, and others to be determined. b. Annual Monitoring Reports. Dominion Energy must submit to BOEM (at renewable_reporting@boem.gov), USFWS, and BSEE (at OSWSubmittals@bsee.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 6 months of completion of the last avian survey. The report must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. BOEM, USFWS, and BSEE will use the annual	If the reported post-construction bat monitoring results indicate bat impacts deviate substantially from the impact analysis included in this EIS, then Dominion Energy must make recommendations for new mitigation measures or monitoring methods.

Measure	Description	Effect
	monitoring reports to assess the need for reasonable revisions (based on subject matter expert analysis) to the PCM. BOEM, BSEE, and USFWS reserve the right to require reasonable revisions to the PCM and may require new technologies as they become available for use in offshore environments. c. Post-Construction Quarterly Progress Reports. Dominion Energy must submit quarterly progress reports during the implementation of the PCM to BOEM (at renewable_reporting@boem.gov) and the USFWS by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The progress reports must include a summary of all work performed, an explanation of overall progress, and any technical problems encountered. d. Monitoring Plan Revisions. Within 15 calendar days of submitting the annual monitoring report, Dominion Energy must meet with BOEM and USFWS to discuss the following: the monitoring results; the potential need for revisions to the PCM, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If BOEM or USFWS determines after this discussion that revisions to the PCM are necessary, BOEM may require Dominion Energy to modify the PCM. If the reported monitoring results deviate substantially from the impact analysis included in the Final BA, Dominion Energy must transmit to BOEM recommendations for new mitigation measures and/or monitoring methods. e. Operational Reporting (Operations). Dominion Energy must submit to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) an annual report summarizing monthly operational data calculated from 10-minute SCADA data for all turbines together in tabular format: the proportion of time the turbines were operational (spinning at >x rpm) each month, the average rotor speed (monthly rpms) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the impact analysis included in the Final BA. f. Raw Data. The Lessee must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to BOEM, BSEE, and USFWS upon request for the duration of the Lease. The Lessee must work with BOEM to ensure the data are publicly available. The USFWS may specify third-party	

Measure	Description	Effect
	data repositories that must be used, such as the Motus Wildlife Tracking System or MoveBank, and such parties and associated data standards may change over the duration of the monitoring plan.	
Annual bird and bat mortality reporting	Dominion Energy must provide an annual report to BOEM and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with federal or research bands must be reported to the USGS Bird Band Laboratory, available at https://www.pwrc.usgs.gov/bbl/. Any occurrence of a dead ESA-listed bird or bat must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state.	Annual bat mortality reporting can inform the Avian and Bat Post-Construction Monitoring Plan (see previous measure), which could lead to Dominion Energy recommending new mitigation measures or monitoring methods to reduce impacts on bats. In addition, mortality data can inform future BOEM offshore wind EIS analyses for proposed wind farms on the Atlantic OCS.
Bird-perching deterrent	To minimize attracting birds to operating turbines, Dominion Energy must install bird perching-deterrent devices on WTGs and OSSs. The location of bird-deterrent devices must be proposed by Dominion Energy based on best management practices applicable to the appropriate operation and safe installation of the devices. Dominion Energy must confirm the locations of bird perching-deterrent devices with a monitoring plan to track the efficacy of the deterrents as part of the as-built documentation it must submit with the Facility Design Report.	While bird presence on the OCS is anticipated to be low, potential collision impacts with offshore WTGs and OSS could be reduced by requiring installation of bird perching–deterrent devices to minimize bird attraction to operating WTGs and on the OSS.
Light impact reduction	Dominion Energy must use an FAA-approved vendor for the ADLS, which will activate the FAA hazard lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night. Dominion Energy must confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the Facility Design Report. (Tentative)	While the presence of birds on the OCS is anticipated to be low, implementation of ADLS would reduce bird attraction to and potential collisions with offshore WTGs and OSS, given the limited amount of time that lights would actually be illuminated.
Light impact reduction	Dominion Energy must light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc around the WTG and OSS. To minimize the potential of attracting migratory birds, the top of each light shall be shielded to minimize upward illumination (conditional on USCG approval).	While the presence of birds on the OCS is anticipated to be low, shielding of light downward could minimize the potential for light attraction and collision.

[1] Also Identified in Appendix H, Table H-2.

3.7.8.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.7-2 and Table H-2 in Appendix H, *Mitigation and Monitoring*, are incorporated in the Preferred Alternative. These measures would further define how the effectiveness and enforcement of APMs would be ensured and improve accountability for compliance with APMs by requiring monitoring, reporting, and adaptive management of potential bird impacts on the OCS. In addition, implementation of collision and light reduction measures on the Offshore Project components would ensure interactions between birds and the offshore wind infrastructure would be minimized. However, given bird use of the OCS is anticipated to be low, offshore wind activities are unlikely to appreciably contribute to impacts on birds regardless of measures intended to address potential offshore bird impacts. In the onshore environment, conducting surveys and coordinating with VDWR and USFWS would ensure impacts on birds would be avoided and minimized to the extent practicable. Because most of these measures ensure the effectiveness of and compliance with APMs that are already analyzed as part of the Proposed Action, and because added measures are not anticipated to appreciably reduce impacts on birds, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.7.2, *Environmental Consequences*.

3.8 Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitat and fauna resources from the Proposed Action, alternatives, and ongoing and planned activities in the coastal habitat and fauna geographic analysis area. Coastal habitat includes flora and fauna 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 coastal habitat and fauna geographic analysis area, as shown on Figure 3.8-1, 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 substation, and the connection from the onshore substation to the point of interconnection at the Fentress Substation. 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. The affected environment and environmental consequences of Project activities that are within the geographic analysis area and extend into state waters (i.e., HDD for cable landfalls and cable laying within 1 mile [1.6 kilometers] of cable landfalls) are presented in Sections 3.6, *Benthic Resources*; 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*; 3.15, *Marine Mammals*; 3.19, *Sea Turtles*; and 3.21, *Water Quality*. Additional information on birds, bats, and wetlands is presented in Section 3.7, *Birds*; Section 3.5, *Bats*; and Section 3.22, *Wetlands*, respectively.

3.8.1 Description of the Affected Environment for Coastal Habitat and Fauna

This section discusses existing coastal habitat and fauna resources in the geographic analysis area, The geographic analysis area for coastal habitat, as described in Appendix F, *Planned Activities Scenario,* Table F-1, includes the coastal shoreline and submerged habitat extending out 3 miles (5 kilometers) (the boundary of state territorial waters of the Commonwealth of Virginia), and the onshore geographic analysis area is shown in Figure 3.8-1.

Detailed descriptions of coastal habitat and fauna occurring in and offshore Virginia can be found in COP Section 4.2.1.2, Section 4.2.2.1, and Appendix U (Dominion Energy 2023a). A more detailed discussion of potential impacts on aquatic and marine habitat and fauna is provided in Sections 3.6, *Benthic Resources;* 3.7, *Birds*; 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*; 3.15, *Marine Mammals;* 3.19, *Sea Turtles;* 3.21, *Water Quality*, and 3.22, *Wetlands*, of this Final EIS. In addition, future information on federally listed Threatened and Endangered (T&E) species potentially present in coastal habitat is provided in the BA prepared for USFWS (BOEM 2022, 2023).

3.8.1.1 Coastal Habitat

Shorelines in the geographic analysis area consist of barrier islands, sand spits, beaches, dunes, tidal and non-tidal wetlands, mudflats, and estuaries (Bilkovic et al. 2019). Much of the Virginia shoreline has been altered to some degree due to development, agriculture, vessel and ground traffic, industry, agriculture, beach replenishment, and shore protection activities such as jetties (MMS 2007). One fundamental property of the Virginia coastal zone is that it is composed entirely of unconsolidated sediments, such as sand and silt, with no exposures of bedrock or hard, consolidated sediments (Hobbs 2008). Consequently, sedimentary processes (i.e., erosion, transport, and deposition) are active on timescales of minutes to millennia and are constantly reshaping the coast. There is no record of submerged aquatic vegetation habitats along Virginia Beach. Rates of local sea level rise in the Atlantic Coastal Plain, especially in the Chesapeake Bay region, are greater than the global average, and ecosystems adjacent to the Chesapeake Bay are already heavily degraded and vulnerable to climate related impacts. Global sea level is conservatively projected to rise by at least 1 foot above 2000 levels by 2100 (Cassotta et al. 2019), whereas sea level in Chesapeake Bay is predicted to rise another 1.3 to 5.2 feet [0.4 to 1.6 meters] over the next 100 years (Chesapeake Bay Program 2020). Sea level rise in the mid-Atlantic region may cause flooding and erosion that could affect coastal infrastructure including ports and harbors (USEPA 2009).

Submerged habitats seaward to 3 miles (5 kilometers) from the shoreline are representative of the Mid-Atlantic Bight with primarily soft-bottom sediments characterized as fine sand punctuated by gravel and silt/sand mixes (Steimle and Zetlin 2000). Within the offshore export cable route corridor, substrates are typically fine- to medium-grain sand, with some gravel and small sand ridges and waves no higher than 8.2 feet (2.5 meters) in the deeper portions. No hard-bottom habitats were observed or detected in the offshore survey area (COP, Appendix D; Dominion Energy 2023a).

3.8.1.2 Land Cover

Land use within and adjacent to the Onshore Project area was assessed using the 2016 NLCD. NLCD land cover classifications for the entire Onshore Project area and vicinity are shown on COP Figure 4.2-5 (Section 4.2.2.1; Dominion Energy 2023a). The NLCD demonstrates that the northeastern portion of the Onshore Project area is composed predominantly of urban developed areas, with agricultural lands dedicated to cultivated crops becoming increasingly more frequent to the southwest. Large swathes of woody wetlands associated with the Chesapeake Albemarle Canal, Gum Swamp, Northwest River, and West Neck Creek also are present. Temporary and permanent impacts of each onshore component to NLCD land cover classes are provided in Table 3.8-2 and Table 3.8-4.

The Virginia Department of Conservation and Recreation Division of Natural Heritage (VDCR-DNH) Program performed a Virginia Natural Landscape Assessment in 2017, which used NLCD to identify large patches of natural land with at least 100 acres (41 hectares) of interior cover, and small patches with 10 to 99 acres (4 to 40 hectares) of interior cover, identified as “ecological cores.” The ecological cores were ranked using a variety of parameters into five categories representing ecological integrity. Ecological core areas of all rankings may occur within the Onshore Project area (VDCR-DNH 2018a). Locations ranked as C1, C2, and C3 generally correspond with various significant natural heritage communities. Locations ranked as C4 and C5 correlate to areas of moderate and general ecological integrity, respectively. The North Landing River and surrounding wetland communities are ranked C1; lower West Neck Creek and surrounding wetland communities on the east side of the North Landing River are ranked C2; Gum Swamp and surrounding wetland communities to the north and south of the Chesapeake Albemarle Canal are ranked C2 (east side) and C3 (west side); and the Pocaty River and adjacent wetland communities are ranked C3, as are the upper sections of West Neck Creek. Temporary and permanent impacts of each onshore component to ecological core areas are provided in Table 3.8-3 and Table 3.8-5.

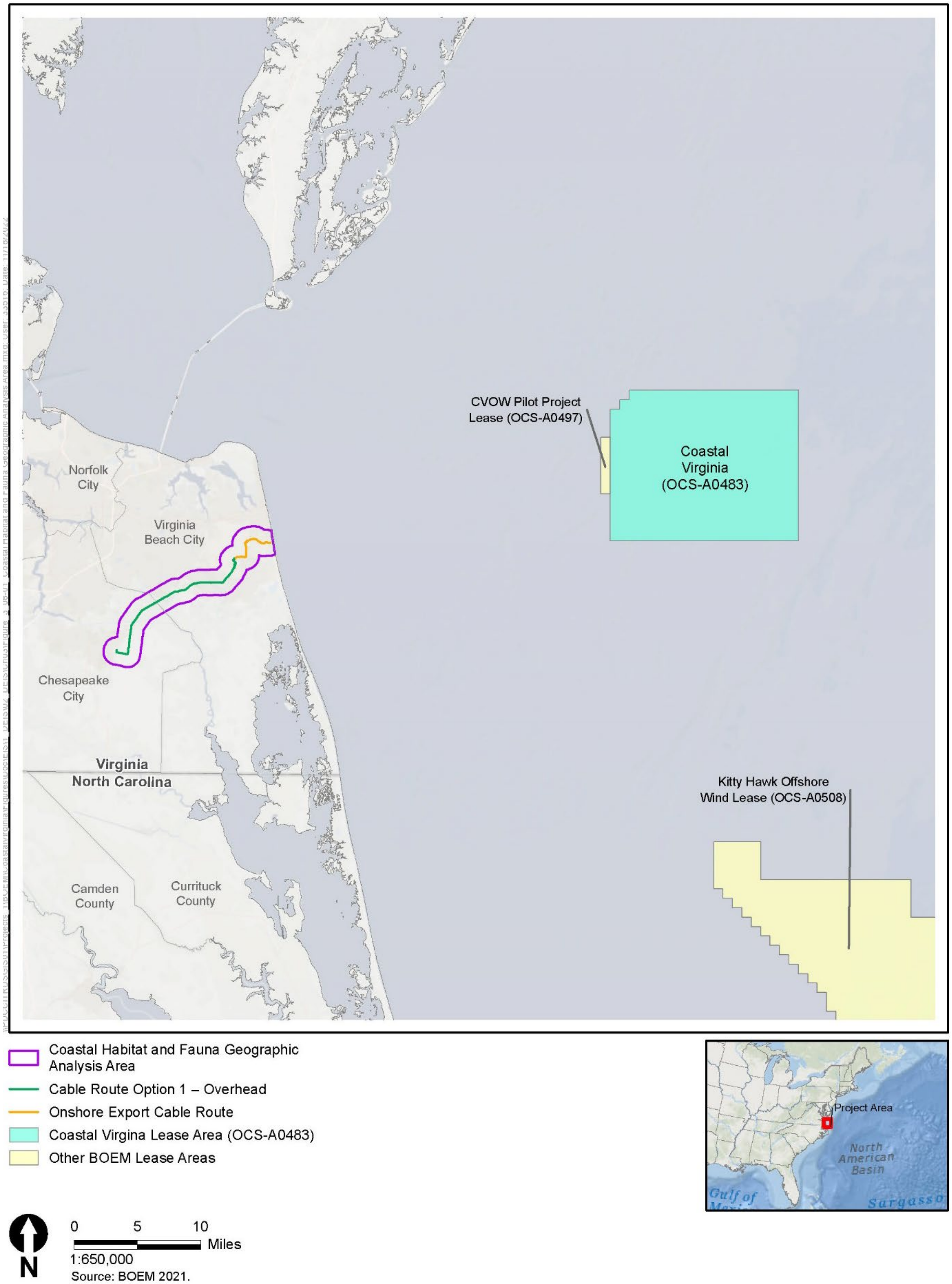


Figure 3.8-1 Onshore Coastal Habitat and Fauna Geographic Analysis Area

3.8.1.3 Terrestrial Flora and Fauna

Terrestrial vegetation and wildlife are discussed in COP Section 4.2.2 (Dominion Energy 2023a). Vegetation can be found in urban areas, agricultural areas, and natural areas. Urban vegetation within the Onshore Project area consists predominantly of mowed/maintained turf areas, roadside and median landscape trees and shrubs, and mixed shrubs and herbaceous vegetation typical of disturbed easements. Active and fallow agricultural fields are common throughout the rural areas within and surrounding the Onshore Project area. Active fields in the area are most commonly used for cultivating commercial crops such as soybean, cotton, corn, and wheat. Vegetation in natural areas in or around the Onshore Project area consists predominantly of mixed forested uplands, wetlands typical of the region, and freshwater tidal marshes. Dominant vegetation typically includes species such as red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), willow oak (*Quercus phellos*), loblolly pine (*Pinus taeda*), bald cypress (*Taxodium distichum*), tulip poplar (*Liriodendron tulipifera*), and wax myrtle (*Morella cerifera*) (COP, Section 4.2.2.1; Dominion Energy 2023a). Notable natural habitats and/or rare natural communities (as defined by VDCR-DNH [2018a]) are in or adjacent to the Onshore Project components. These include areas of the North Landing River, Gum Swamp, Pocaty River, and West Neck Creek (COP, Section 4.2.2.1; Dominion Energy 2023a).

Terrestrial wildlife in the developed areas of the Onshore Project area may typically consist of species adapted to living in urban environments. These species are commonly encountered in previously altered landscapes prone to noise, lights, and other disturbances. The most common interactions with urban wildlife reported to VDWR generally involve fur-bearing mammals, including fox (*Vulpes* and *Urocyon cinereoargenteus*), raccoon (*Procyon lotor),* coyote (*Canis latrans*), bobcat (*Lynx rufus*), skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), beaver (*Castor canadensis*), weasel (*Mustela* spp.), mink (*Neovison vison*), nutria (*Myocastor coypus*), and muskrat (*Ondatra zibethicus*) (COP, Section 4.2.2.1; Dominion Energy 2023a).

Portions of the Onshore Project area cross large contiguous forested wetland areas that also may provide valuable habitat for various species of insects, reptiles, amphibians, birds, and mammals. Fur-bearing mammals such as beaver, black bear (*Ursus americanus*), bobcat, river otter (*Lontra canadensis*), mink, common muskrat, and other small mammals are known to occur regionally (Chesapeake Bay Program 2020). Additional mammals known to occur at the Back Bay National Wildlife Refuge, which is located east of the Onshore Project area, include eastern cottontail (*Sylvilagus floridanus*), marsh rabbit (*Sylvilagus palustris*), white-tailed deer (*Odocoileus virginianus*), gray squirrel (*Sciurus carolinensis*), rice rat (*Oryzomys palustris*), and a variety of mice, voles, shrews, and bats (COP, Section 4.2.2.1; Dominion Energy 2023a).

3.8.1.4 Exemplary Natural Communities and Rare, Threatened, and Endangered Terrestrial Species

State-listed species that may be found in the Onshore Project area include the canebrake rattlesnake (*Crotalus horridus atricaudatus*) (state endangered), the eastern chicken turtle (*Deirochelys reticularia*) (state endangered), and the barking treefrog (*Hyla gratiosa*) (state threatened). In addition, the Project may impact two rare plant species: the long beach seedbox (*Ludwigia brevipes*), state-ranked as S2 (imperiled); and the multiflowered mud plantain (*Heteranthera multiflora*), state-ranked as S1 (critically imperiled). The long beach seedbox and the multiflowered mud plantain have been documented at the proposed Project's onshore export cable route and at the Navy's Oceana Ponds and Forest Special Interest Area at NAS Oceana; however, the state rare plant species status is a non-regulatory category that does not grant special legal protection.

State-endangered canebrake rattlesnakes have been documented in the Onshore Project area. This species is known to inhabit hardwood or mixed hardwood-pine forests, canefields, and the ridges and glades of swampy areas.

The VDCR-DNH Program manages an inventory of exemplary natural communities, as well as rare T&E plant and animal species across the Commonwealth of Virginia. The relative density of these natural heritage resources, or elemental occurrences, in Virginia Beach has been found by VDCR- DNH to be very high, and the relative density in the city of Chesapeake has been found to be high (VDCR- DNH 2018b). This high diversity is associated with the mosaic of large undisturbed wetland habitats that spread contiguously across the two cities (COP, Section 4.2.2; Dominion Energy 2023a).

The Oceana Ponds and Forest Special Interest Area, the West Neck Creek Natural Area, and the North Landing River Preserve (Gum Swamp) are in the geographic analysis area.

The Oceana Ponds and Forest Special Interest Area has been given a biodiversity significance ranking of 2, which represents a site of very high significance and is considered as an irreplaceable conservation site. The natural heritage resources of concern at this site are *Ludwigia brevipes*: Long beach seedbox (G2G3/S2/NL/NL), and *Perimyotis subflavus*: tri-colored bat (G2G3/S1S3/SOC/LE). Long beach seedbox is a state rare herb in the evening-primrose family that inhabits interdunal swales, low wet places, pond shores, gravel pits, and wetlands underlain by sand. There has been a significant decline in population numbers (greater than 90 percent) for the tri-colored bat since 2008 due to white nose syndrome. The tri-colored bat was state-listed as endangered on April 1, 2016, by the Virginia Department of Wildlife Resources (DWR). Rare, threatened, and engendered bat species are further discussed in Section 3.5, *Bats.*

The West Neck Creek Natural Area has been given a biodiversity significance ranking of B5, which represents a site of general significance. The natural heritage resource of concern at this site is *Trillium pusillum* var. *virginianum*: Virginia least trillium (G4T3/S2/SOC/NL). Occurrences of Virginia least trillium at West Neck Creek Natural Area have been confirmed based on recent survey work conducted by a Virginia Department of Conservation and Recreation biologist. This species is currently tracked as a species of concern by the USFWS; however, this designation has no official legal status.

The North Landing River Preserve (Gum Swamp) has been given a biodiversity significance ranking of B1, which represents a site of outstanding significance. The natural heritage resources of concern at this site are *Euphyes dukesi*: Dukes' skipper (G3/S2/NL/NL), *Trillium pusillum var. virginianum*: Virginia least trillium (G3T2/S2/SOC/NL), Non-riverine Swamp Forest (Tupelo – Bald Cypress Type) (G2G3/S1S2/NL/NL), and Bald Cypress – Mixed Tupelo Intermediate Swamp (G3G4/S3S4/NL/NL). Multiple occurrences of Virginia least trillium have been documented in the Onshore Project area within the North Landing River Preserve (Gum Swamp). There is a potential for little metalmark (*Calephelis virginiensis*, G4/SH/NL/NL) and additional populations of Dukes' skipper (*Euphyes dukesi*, G3/S2/NL/NL) to occur within the proposed route if suitable habitat exists on site. The little metalmark is a butterfly of the southeastern United States, from Virginia to Florida and west to Texas (Cech and Tudor 2005). In Virginia, it is documented only in three southeastern counties (VDCR-DNH and VDGIF 2013). The Dukes' skipper is a small, orange-brown and yellow butterfly species that ranges along coastal areas from southeastern Virginia to central Florida, and up the Mississippi River valley from Louisiana to Illinois, and with a pocket in northwestern Ohio and northeastern Indiana (Glassberg 1999). In Virginia, it is only recorded from the southeastern outer coastal plain.

Potential habitat for both the eastern chicken turtle and the barking treefrog have been documented at NAS Oceana during surveys conducted in 2013 (Dominion Energy 2023a). Virginia's 2015 Wildlife Action Plan indicates that the loss of suitable wetland habitat constitutes the greatest threat to the barking tree frog. Wetlands are further discussed in Section 3.22, *Wetlands*.

There are no State Natural Area Preserves under Virginia Department of Conservation and Recreation jurisdiction in the Project vicinity. The Project is located outside of the locally designated Chesapeake Bay Preservation Areas in both the City of Chesapeake and City of Virginia Beach and, as such, is not subject to the Chesapeake Bay Preservation Act and its regulations.

3.8.1.5 Coastal Fauna

Coastal habitat including beaches and dunes provide habitats for many different types of fauna and flora. Sea turtles are commonly found off the shores of Virginia Beach with loggerhead sea turtle (*Caretta caretta*) as the primary species that has been documented nesting in Virginia (Parker 2020); there has been a single green turtle nest observed in Virginia in 2005 and two Kemp's ridley nests observed in 2012 and 2014. Most of the turtles in the area are most likely migrating or foraging and spending the majority of their time below the surface rather than on the beach.

Beaches and dunes are important habitats for migrating and nesting shorebirds and songbirds. The beaches, dunes and scrub-shrub habitats along the shoreline may support avian species, including the double-crested cormorant (*Phalacrocorax auritus*), ring-billed gull (*Larus delawarensis*), great blue heron (*Ardea herodias*), sanderling (*Calidris alba*), and brown pelican (*Pelecanus occidentalis*).

Common macrofauna of the inner continental shelf include species from several taxa, including echinoderms (e.g., sea stars, sea urchins, sand dollars), cnidarians (e.g., sea anemones, soft corals), mollusks (e.g., bivalves, cephalopods, gastropods), bryozoans, sponges, amphipods, and crustaceans (BOEM 2012).

Three species of federally T&E species of birds can occur onshore and in coastal and marine waters offshore Virginia Beach during part of the year. The northeastern U.S. population of the roseate tern (*Sterna dougallii dougallii*) is listed as Endangered, and the piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*) are listed as Threatened. These species use coastal habitat including beaches, marshes, and intertidal wetlands (Section 3.7, *Birds*).

Coastal habitat and fauna in the geographic analysis area are subject to pressure from ongoing activities, generally associated with onshore development activities, military uses, and climate change. Potential impacts from these activities have the potential to cause mortality, alter habitat and vegetation, encroach with structures, generate noise, cause accidental releases, affect water quality, and influence sea level rise. Sandy beaches in the geographic analysis area are subject to erosion and vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015) including ocean acidification and ocean warming. Coastal habitat and fauna would be expected to decline in line with current trends related to the effects of climate change. If sea levels rise approximately 2 feet (0.6 meter) by the end of the century, over 167,000 acres (67,582 hectares) of undeveloped dry land and approximately 161,000 acres (65,154 hectares) of brackish marsh would be lost, replaced in part by over 266,000 acres (107,646 hectares) of newly open water and 50,000 acres (20,234 hectares) of saltmarsh; ocean and estuarine beaches also fare poorly, declining by 58 and 69 percent, respectively, by 2100 (Glick et al. 2008).

Onshore development activities and associated impacts are expected to continue at current trends and have the potential to result in impacts on coastal habitat and fauna. Mainland coastal habitat in the geographic analysis area for coastal habitat and fauna mostly consists of sandy beach and dune vegetation; much of this is developed for the public beach and private residences. Any new structures along the coast, including developments, roads, utilities, marinas and ports, and shoreline protection measures, are anticipated to increase incrementally over the next 37 years, altering coastal habitat. Development is likely to continue as resident and vacationer populations expand. Noise generated from ongoing onshore construction of commercial and residential developments and at military installations is a frequent occurrence in the coastal habitat. Noise generated from construction nearshore is expected to gradually increase over the next 37 years in line with human population growth along the coast of the geographic analysis area.

If the Project is not approved, then impacts from the proposed Project (Section 3.8.2, *Environmental Consequences*) would not occur. Impacts from ongoing, future non-offshore wind, and offshore wind activities would likely still occur resulting in similar impacts on coastal habitat and fauna, but the nature and extent of the impacts would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area.

3.8.2 Environmental Consequences

3.8.2.1 Impact Level Definitions for Coastal Habitat and Fauna

Definitions of impact levels are provided in Table 3.8-1. There are no beneficial impacts on coastal habitat and fauna.

Table 3.8-1 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.

3.8.3 Impacts of the No Action Alternative 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 activities 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 and offshore wind activities, as described in Appendix F.

3.8.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for coastal habitat and fauna described in Section 3.8.1, *Description of the Affected Environment for Coastal Habitat and Fauna*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing offshore wind and non-offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on coastal habitat and fauna are generally associated with onshore impacts, including onshore residential, commercial, and industrial development, and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect coastal flora and fauna through temporary and permanent habitat removal or conversion, temporary noise impacts during construction, and lighting, which could cause avoidance behavior and displacement of animals, as well as injury or mortality to individual animals or loss and alteration of vegetation and individual plants. However, population-level effects would not be anticipated. Climate change and associated sea level rise results in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides (Sacatelli et al. 2020). 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. Reptile and amphibian populations may experience shifts in distribution, range, reproductive ecology, and habitat availability. Increased temperatures could lead to changes in mating, nesting, reproductive, and foraging behaviors of species, including a change in the sex ratios in reptiles with temperature-dependent sex determination.

There are no ongoing offshore wind activities within the geographic analysis area that contribute to impacts on coastal habitat and fauna.

3.8.3.2 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).

Other planned non-offshore wind activities that may affect coastal habitat and fauna primarily include increasing onshore development activities (see Appendix F, Section F.2 for a description of ongoing and planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in temporary and permanent impacts on animals and vegetation, including disturbance, displacement, injury, mortality, habitat and plant degradation and loss, and habitat conversion. See Appendix F, Attachment 1, Table F1-5 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for terrestrial and coastal fauna.

Appendix F*,* Table F-3 depicts future construction of offshore wind projects from Maine to North Carolina. Also included are all of the projects that are currently in various stages of planning within BOEM's offshore leases in the U.S. Exclusive Economic Zone (EEZ) from Massachusetts to North Carolina. A total of 36 offshore wind projects with construction start dates after 2022 are projected, all of which will require a NEPA process with an EIS or EA. However, the only planned offshore wind activities in the geographic analysis area likely to affect coastal habitat and fauna would be those associated with the operation and maintenance of the CVOW-Pilot Project; and site characterization surveys, construction, and operation and maintenance of Avangrid Renewables, LLC – Kitty Hawk Offshore Wind Projects (Appendix F, Tables F-9 and F2-1).

BOEM expects offshore wind activities to affect coastal habitat and fauna through the following primary IPFs.

Accidental releases: Offshore, future wind and non-wind activities could result in accidental releases of contaminants or trash into the water (see Section 3.21, *Water Quality*, for quantities and details). Following ingestion, blockages caused by both hard and soft plastic debris could result in mortality or adverse health effects on coastal fauna. Accidental releases of fuels, lubricating oils, and other petroleum compounds may increase as a result of offshore wind activities, specifically the Kitty Hawk Offshore Wind Projects. The risk of any type of accidental release would increase primarily during construction, but also could occur during operations and conceptual decommissioning of offshore wind facilities.

Accidental releases of fuel, fluids, or hazardous materials nearshore during future wind and non-wind activities may cause habitat contamination from releases, cleanup activities, or both, and cause harm to the species that build biogenic coastal habitat. Accidental releases of chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach nearshore coastal habitat. Larger spills, though unlikely, could have larger impacts on coastal habitat and fauna due to adverse impacts on water quality.

Onshore, the use of heavy construction equipment during future wind and non-wind activities could result in releases of fuel and lubricating and hydraulic oils during equipment use or refueling.

There is no evidence that the anticipated volumes and extents combined with cleanup measures would have measurable impacts on coastal habitat and fauna. See Section 3.21.1, *Description of the Affected Environment for Water Quality*, for quantities and details.

Anchoring: Installation and support vessels used during construction of offshore future wind and non-wind projects incorporate various methods for maintaining position and providing stabilization including anchoring. The bulk of the vessels including wind turbine installation vessels, feeder support vessels, jack-up/liftboats and cable-laying vessels employ spuds or dynamic positioning (DP) rather than anchoring. Anchors could be used to position barges and other support vessels during construction that are without their own means of propulsion. Vessels used during O&M of offshore wind projects, such as crew-transfer vessels and service-operations vessels, primarily use DP. Any impacts on coastal habitat from anchoring would be temporary and localized. There could be increased anchoring during survey activities and during the construction, installation, maintenance, and conceptual decommissioning of offshore wind projects (although most vessel positioning and stabilization is assumed to be done with spuds and DP). There may also be increased anchoring/mooring of metocean buoys. Most disturbance and water quality impacts on coastal habitat would be temporary and localized. There are no eelgrass beds in the Project area; therefore, the Project activities would have no effect on eelgrass and hard-bottom habitat can be easily avoided.

The Lease Area is within the Virginia Capes Range Complex and the Virginia Capes Operating Area is actively used by the military. Anchoring from vessels related to ongoing commercial, recreational activities, and military use would continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Sessile and slow-moving species (e.g., corals, sponges, and sedentary shellfish) would be most affected, as physical contact would cause mortality of benthic species. Impacts from anchoring would be localized with temporary elevated turbidity and mortality of soft-bottom benthic resources that are likely to recover relatively quickly (Dernie et. al. 2003). Anchoring on hard-bottom (i.e., gravelly) substrates may impart somewhat longer impacts. Given the relatively small amount of seafloor affected by anchoring and short-term turbidity, benthic impacts would be negligible.

Electromagnetic fields: EMFs continuously emanate from existing telecommunications and electrical power transmission cables. EMFs would emanate from offshore export cables of offshore wind. The Kitty Hawk Offshore Wind Projects export cable routes are within Commonwealth of Virginia state waters with a proposed cable landing location on Sandbridge Beach (Virginia Beach). However, potential EMF effects would be reduced by cable shielding and burial to an appropriate depth. The maximum magnetic field expected for an offshore wind energy project's export cable EMF is about 165 milligauss, dropping to 40 milligauss 3.26 feet (1 meter) above the cable, a decrease in field strength of 76 percent (CSA and Exponent 2019). EMF strength diminishes rapidly with distance, and potentially meaningful EMF would likely extend less than 50 feet (15.2 meters) from each cable (McCormick et al. 2008). Export cables would be buried during installation, shielding the adverse impacts of EMF emissions on coastal fauna. Since EMFs decrease rapidly with distance from the cable, cable burial significantly reduces the extent of impacts from the cable EMF, and the intensity of impacts on coastal habitat would likely be unmeasurable.

EMF would continue to result from existing and new transmission or communication cables. Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. Transitory exposures to magnetic fields at the seabed above the buried cables were found to be at levels below reported thresholds for effects on the behavior of magnetosensitive marine organisms that have been studied. Due to the small footprint of existing undersea transmission lines in the geographic analysis area and the fact that EMF decreases rapidly with distance from the cable, impacts from EMF would be negligible.

Light: Nighttime lighting associated with non-wind and wind-related offshore structures (e.g., the existing CVOW-Pilot Project and the proposed Kitty Hawk Offshore Wind Projects) and navigation and deck lighting on vessels would result in lighting impacts in the geographic analysis area. Light emissions from vessels are expected to continue to increase gradually with increasing marine transportation and vessel traffic over the next 37 years. Lights from offshore wind projects (Kitty Hawk Offshore Wind Projects) would produce short-term and localized light emissions from vessels transiting and working in nearshore coastal areas; however, this vessel lighting would be intermittent and negligible at a distance of 20 miles (32 kilometers) from the geographic analysis area. The extent of impacts would likely be limited to the immediate vicinity of the vessels, and the intensity of impacts on coastal habitat would likely be unmeasurable.

New cable emplacement and maintenance: New cable emplacement and maintenance would result from offshore wind projects (the Kitty Hawk Wind Projects and existing CVOW-Pilot Project). Maintenance activities for offshore transmission and telecommunications cables would infrequently disturb bottom sediments; these disturbances are local and limited to the areas of cable repair within the emplacement corridor. The proposed ocean-to-land cable transition at the landfall for the Kitty Hawk Offshore Wind North Project (parking lot at Sandbridge Beach, Virginia) and Kitty Hawk Offshore Wind South Project (City of Virginia Beach, Virginia, and Dare, Carteret and Craven Counties in North Carolina) will be installed using HDD, which will avoid or minimize impacts on the beach, intertidal zone, and nearshore areas and achieve a burial significantly deeper than any expected erosion (Kitty Hawk Offshore Wind North COP Chapter 3, *Description of Proposed Activity*; Avangrid Renewables 2021; Kitty Hawk Offshore Wind South COP Chapter 3, *Description of Proposed Activity*).

The cable landing location for the CVOW-Pilot Project is located within the State Military Reservation along Rifle Range Road (adjacent Camp Pendleton Beach). Maintenance of the export cable within coastal habitat for the CVOW-Pilot Project may infrequently disturb bottom sediments but would be localized and limited to the areas of cable repair within the emplacement corridor.

Noise: Anthropogenic underwater sounds come from many different sources including vessel traffic, seismic surveys, and active sonar used for navigation of large vessels, and chart plotting. The extent of the impact depends on equipment used, noise levels, and local acoustic conditions. Construction noise occurs frequently along populated areas in the mid-Atlantic nearshore, but infrequently offshore. Noise generated from offshore wind activities (Kitty Hawk Offshore Wind Projects) would not likely produce sound levels in nearshore coastal areas that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area. The intensity and extent of noise from construction is difficult to generalize but impacts on coastal fauna would be temporary and localized, as the land-based construction noise is likely sufficient to drive away local motile fauna such as wading birds from the immediate area.

G&G surveys and scientific surveys are proposed for the Kitty Hawk Offshore Wind Projects and for the CVOW-Pilot Project. The intensity and extent of the resulting noise impacts on coastal fauna are difficult to generalize but would be temporary and localized. These site characterization surveys and scientific surveys are anticipated to occur infrequently over the next 37 years. High-resolution geophysical surveys employed during site characterization (shallow and medium-penetration sub-bottom profilers, side-scan sonar, multibeam echosounder, and magnetometer) technologies generate sound waves that are similar to common deep-water echosounders. Impacts from vessel and equipment noise, including geotechnical sampling (e.g., coring), are expected to be unmeasurable. Noise generated from G&G activities associated with offshore wind activities (Kitty Hawk Offshore Wind Projects) would not produce sound levels in nearshore coastal areas that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area. G&G surveys of cable routes in nearshore coastal habitat would be performed intermittently over the assumed 4-year construction period. The intensity and extent of the resulting noise impacts on coastal fauna from G&G surveys are difficult to generalize but would likely be temporary and localized.

Noise from pile driving would not occur in nearshore areas as part of offshore wind construction projects. Noise generated from pile driving associated with offshore wind activities (Kitty Hawk Offshore Wind Projects) would not produce sound levels in nearshore coastal areas that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area.

Noise generated from installation and trenching of offshore export cables associated with offshore wind activities (Kitty Hawk Offshore Wind Projects) would not likely produce sound levels in nearshore coastal areas that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area. The noise generated from installation and trenching would be temporary and localized and would extend only a short distance beyond the emplacement corridor.

Presence of structures: The presence of offshore structures including shipwrecks, artificial reefs, and meteorological buoys or towers could lead to impacts on coastal resources through entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation, and habitat conversion. Offshore wind activities (Kitty Hawk Offshore Wind Projects) would not include the construction of any aboveground structures within coastal habitat (Kitty Hawk Offshore Wind North and Kitty Hawk Offshore Wind South COP Chapter 3; Avangrid Renewables 2021). These existing structures may or may not alter the function of the coastal habitat. The result of the habitat conversion is either habitat loss or creation an artificial reef effect, attracting a different community of organisms.

Offshore wind activities (Kitty Hawk Offshore Wind Projects) conservatively estimate that up to 8 percent of the offshore export cable route will require additional cable protection. This translates into approximately 9.5 acres (38,445 square meters) of seabed disturbance under the maximum design scenario (Kitty Hawk Offshore Wind North and Kitty Hawk Offshore Wind South COP Chapter 3; Avangrid Renewables 2021). Where cables are buried deeply enough that protection is not used, presence of the cable has no impact on coastal habitat.

Land disturbance: Periodic ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but usually not to a degree that affects coastal fauna, assuming that industry standard best management practices are implemented. Land disturbance from erosion and sedimentation associated with offshore wind activities (Kitty Hawk Offshore Wind Projects export cable and landfall) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 7 miles (11 kilometers) from the geographic analysis area.

Land disturbance from onshore construction associated with offshore wind activities (Kitty Hawk Offshore Wind Projects export cable and landfall) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 7 miles (11 kilometers) from the geographic analysis area.

Land disturbances related to the onshore construction of wind and non-wind facilities periodically cause removal of vegetation and conversion of natural coastal habitat to developed space. These land use changes are a frequent occurrence in coastal habitat. Onshore construction noise from other human activities could result in localized, minor, and temporary impacts on coastal fauna, including avoidance and displacement, though no population-level effects would occur. Onshore land development or port expansion activities could also result in limited loss or fragmentation of habitat for some coastal species. However, such minor impacts would be limited in extent, and would not measurably affect coastal population abundance or viability as most construction would be expected to generally occur in previously disturbed habitats.

Seabed profile alterations: Dredging, mechanical trenching, or both used in the course of offshore construction would cause localized short-term impacts (habitat alteration, injury, and mortality) on coastal resources through seabed profile alterations, as well as through the *Sediment deposition and burial* IPF. The level of impact from seabed profile alterations would depend on the time of year that they occur, particularly in nearshore locations, and especially if they overlap temporally and spatially with sites characterized by high benthic organism abundance and diversity. Seabed profile alterations associated with wind and non-wind activities can result in temporary and localized impacts on coastal habitat. These activities typically occur in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance (Wilber and Clarke 2007). Therefore, such impacts, while locally intense, would have an unmeasurable effect on the general character of coastal habitat. Seabed profile alterations associated with offshore wind activities (Kitty Hawk Offshore Wind Projects) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 20 miles (32 kilometers) from the geographic impact analysis area.

Sediment deposition and burial: Cable emplacement and maintenance activities (including dredging) in or near the geographic analysis area during construction projects could cause sediment suspension for 1 to 6 hours at a time, after which the sediment would be deposited on the seafloor. Sediment deposition can result in adverse impacts on coastal habitat, including smothering. Benthic organisms' tolerance to being covered by sediment (sedimentation) varies among species (Section 3.6, *Benthic Resources*). The level of impact from sediment deposition and burial could depend on the time of year that it occurs, especially if it overlaps with times and places of high benthic organism abundance. Maintenance of existing submarine cables also infrequently disturbs bottom sediments; these disturbances are local and limited to the areas of repair within the emplacement corridor. Seabed deposition and burial resulting from installation of export cables associated with offshore wind activities (Kitty Hawk Offshore Wind Projects) would not produce water quality or turbidity impacts on coastal habitat and fauna that would be measurable at a distance of 20 miles (32 kilometers) from the geographic analysis area.

Climate change: Human accelerated climate change, influenced in part by GHG emissions, is expected to continue to contribute to a widespread loss of shoreline habitat from rising seas and erosion. Ocean acidification caused by atmospheric CO_2 may contribute to reduced growth or the decline of reefs and other habitats formed by shells. Warming, sea level rise, and altered habitat/ecology could also affect coastal habitat and fauna. Because climate change is a global phenomenon, impacts on coastal habitat and fauna resources would be practically the same in the expanded planned action scenario as they would be with only ongoing activities. See Section 3.4, *Air Quality*, for details on the expected contribution of offshore wind development to climate change.

3.8.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, coastal habitat and fauna would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continued temporary and permanent impacts on coastal habitat and fauna. Coastal habitat and fauna would continue to be subject to current regional development and encroachment pressures, and impacts are anticipated to gradually increase over the next 30 years in line with human population growth along the coast of the geographic analysis area. The impacts of ongoing activities, especially climate change, new cable emplacement and maintenance, and land disturbance, would be **moderate**, as climate change is predicted to cause notable impacts to coastal habitat. The combination of ongoing activities and reasonably foreseeable activities other than offshore wind would result in **moderate** impacts on coastal habitat and fauna in the geographic analysis area.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and coastal habitat and fauna would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on coastal habitat and fauna due to habitat loss from increased onshore construction.

Considering all of the IPFs and due to the extent and distance away from the Proposed Action, the impacts on coastal habitat and fauna of offshore wind activities would be **negligible**. The overall impacts associated with offshore wind activities in the geographic analysis area would generally result in **negligible** adverse impacts on coastal habitat and fauna. Offshore wind activities are expected to contribute considerably to several IPFs, primarily new cable emplacement and the presence of structures, namely cable protection, but would occur over 20 miles (32 kilometers) away and would not overlap with impacts in the geographic analysis area of the Proposed Action.

3.8.4 Relevant Design Parameters and Potential Variances in Impacts

The primary proposed Project design parameters that would influence the magnitude of the impacts on coastal habitat and fauna are provided in Appendix E, *Project Design Envelope and Maximum-Case Scenario*, and include the following.

- The routing variants within the selected export cable corridor, which could require the disturbance of coastal habitat and cable landing location.
- The total amount of long-term habitat alteration from offshore export cable and associated cable-protection measures.
- The total amount of habitat temporarily altered by construction and operation of onshore facilities (within coastal zone), and installation method of the export cables.
- The extent of pre-cable-laying operations (pre-lay grapnel run, sandwave removal, and boulder removal), if any, and its location.

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

- Duration and time of year of cable landing location construction and HDD operations in nearshore areas: The greatest impact would occur if installation activities coincided with sensitive life stages for coastal fauna.

3.8.5 Impacts of the Proposed Action on Coastal Habitat and Fauna

The construction, operation, maintenance, and conceptual decommissioning of the offshore export cable under the Proposed Action would occur within the geographic analysis area for coastal habitat and fauna (Figure 3.8-1).

Maximum potential short-term and long-term habitat disturbances by the Proposed Action are presented in the COP (Tables 4.2-6, 4.2-7, and 4.2-17; Dominion Energy 2023a).

Accidental releases: The Proposed Action would increase the risk of accidental releases of fuels, lubricating oils, and other petroleum compounds, primarily during construction but also during operations and conceptual decommissioning. Accidental releases of fuel, fluids, or hazardous materials nearshore may cause habitat contamination from releases and/or cleanup activities and harm to the species that build biogenic coastal habitat. Accidental releases of chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach nearshore coastal habitat. Larger spills, though unlikely, could have larger impacts on coastal habitat and fauna due to adverse impacts on water quality (Appendix F, Attachment 1, Table F1-3). Onshore, the use of heavy construction equipment could result in releases of fuel and lubricating and hydraulic oils during equipment use or refueling. As such, the potential accidental releases would be low and of small quantity, and combined with the cleanup measures in place, the impacts of accidental releases of fuel, fluids and hazmat on coastal habitat and fauna are expected to be minor.

Trash and debris may be released from vessels primarily during construction of the Proposed Action but also during operations and conceptual decommissioning. All vessels would be required to comply with laws and regulations to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of Project activities. There is a higher likelihood of trash and debris from nearshore Project activities (e.g., transmission cable installation, transportation of equipment and personnel to and from ports). However, there does not appear to be evidence that the volumes and extents anticipated would have any measurable impact on coastal habitat and fauna. Therefore, the expected impacts of trash and marine debris on coastal habitat and fauna would be negligible.

Additionally, construction vessels would comply with USCG regulations and the discharge limits outlined by the Vessel Incidental Discharge Act of 2018. Vessel chemical releases are considered unlikely and would yield only short-term, localized impacts.

Anchoring: Vessel anchoring to assist with positioning and stabilization could occur during survey activities and during the construction, installation, maintenance, and conceptual decommissioning of offshore construction activities. Anchoring could cause temporary turbidity, permanent impacts, or both where anchors and chains meet the seafloor. For the Proposed Action, the COP states construction vessels will use spud- or jack-up barges or DP systems (COP, Section 3.4.1.1; Dominion Energy 2023a); therefore, the impacts of anchoring on coastal habitat and fauna would be negligible.

Electromagnetic fields: The Proposed Action would include the installation of nine 230-kV offshore export cables. EMFs would emanate from operating transmission cables within coastal habitat. Although acknowledging that little is known about potential impacts of EMF on coastal resources, conservative calculations of magnetic-field and induced electric-field levels based on the Project’s cable specifications and peak and average load levels indicate that the fields produced by the Project’s cables would be below the detection thresholds for magnetosensitive and electrosensitive marine organisms (COP, Appendix AA; Dominion Energy 2023a). EMF strength diminishes rapidly with distance, and potentially meaningful EMF would likely extend less than 50 feet (15.2 meters) from each cable (McCormick et al. 2008). EMFs would be further minimized by shielding and by burying the offshore export cables to the target depth of 3.3 to 16.4 feet (1 to 5 meters). Based on the extent and the intensity, the impacts from EMF on coastal fauna would be expected to be negligible.

Light: The Proposed would involve light emissions from vessels transiting and working in nearshore coastal areas. These light emissions would be highly localized and would exist only as long as the lights were in use. Navigation lights during construction, operations, and conceptual decommissioning would be minimal. Therefore, the impacts of light emissions from vessels on coastal fauna would be negligible.

The Proposed Action would also involve light emissions from construction equipment and operational lighting associated with construction at the cable landing location. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal fauna would likely be unmeasurable at a distance. Therefore, the impacts from light emissions from structures on coastal habitat and fauna would be expected to be negligible.

New cable emplacement and maintenance: Installation of the offshore export cable for the Proposed Action would use HDD or DSPT methods to install the nine 230-kV offshore export cables under the beach and dune and avoid affected sensitive, shallower, nearshore intertidal coastal habitat. Trenchless installation would occur from an offshore trenchless installation punch-out location approximately 730 to 3,280 feet (223 to 1,000 meters) offshore of the cable landing location. The offshore export cables would be brought to shore through a series of conduits at the cable landing location. These conduits would be established at depths ranging from 10 to 125 feet (3 to 38 meters) below grade under the shoreline. The cable landing location would be in a previously disturbed area west of the firing range at State Military Reservation (east of Regulus Avenue and north of Rifle Range Road) adjacent to Camp Pendleton Beach. In addition, construction vehicles would not be driven on the beach or dunes.

Temporary disturbance to the seabed sediment would occur during installation of the offshore export cables. The nine offshore export cables would be installed within corridors ranging in size from approximately 9,400 feet (2,865 meters) down to 1,970 feet (600 meters) wide. The offshore export cables would be buried approximately 3.3 feet (1 meter) to 16.4 feet (5 meters) below stable seabed elevation to minimize the risk of cable exposure or damage. Cable-laying speed of the nearshore cables would be approximately 656 feet per hour (200 meters per hour) (COP, Sections 3.4.1.4 and 3.4.2; Dominion Energy 2023a). The offshore export cable route within coastal habitat would run parallel to the CVOW-Pilot Project export cable (in-service since October 2020), as well as cross three in-service telecommunications cable systems (MAREA, BRUSA, and DUNANT). All three of the telecommunications cable systems approach from the east and land at the Croatan Beach parking lot (COP, Section 2.1.1.2: Dominion Energy 2023a). The impacts from new cable emplacement and maintenance on coastal habitat and fauna would be expected to be minor.

Operation would require maintenance and inspections (COP, Section 3.5.1; Dominion Energy 2023a). The offshore export cables would be monitored through distributed temperature sensing equipment. The distributed temperature sensing system would provide real-time monitoring of temperature along the offshore export cables, alerting Dominion Energy should the temperature change, which could be the result of scouring of material and cable exposure. Cable repairs, if required, would temporarily affect coastal habitat and fauna in a localized area. Assuming repairs would be infrequent and affecting small sections of the cables, impacts are expected to be minor.

The expected negligible incremental impact of the Proposed Action combined with the planned actions would result in temporary seafloor disturbance from the offshore export cables approach and landing.

Noise: The Proposed Action would generate noise during construction of both onshore and offshore facilities. Onshore construction noise levels would primarily be limited to daytime hours. The construction sound levels during the trenchless installation operations at the cable landing location could reach 58 decibels (COP, Appendix Y; Dominion Energy 2023a). Onshore construction noise and vibration could lead to the disturbance and temporary displacement of mobile species. The noise generated by construction activities, as well as the physical changes to the space, could render an area temporarily unsuitable for fauna or result in masking effects on communication for fauna that remain in the area (Dooling et al. 2019). However, Dominion Energy states that the results of the underwater acoustic assessment (COP, Appendix Z; Dominion Energy 2023a) would be used to inform development of noise mitigation measures that would be applied during construction and operation of the Proposed Action , in consultation with BOEM and NMFS to address potential impacts on marine mammals, sea turtles, and fisheries resources from underwater noise, which would include some coastal fauna. Impacts would be short term and occur in the daytime only from onshore construction noise resulting in minor impacts on coastal fauna. Noise generated by construction of the WTGs and OSS are not expected to reach the geographic analysis area; therefore, would have no impact on coastal habitat.

The Proposed Action would produce noise from vibratory pile driving during installation of nearshore cofferdams at the associated offshore trenchless installation punch-out location. In general, vibratory pile driving is less noisy than impact pile driving and would cause temporary and localized acoustic impacts.

In-air noise levels from the vibratory pile driving would reach 66 decibels at the nearest onshore receptor (COP, Appendix Y; Dominion Energy 2023a). Fish and invertebrates in the nearshore Project area may be directly and indirectly affected by operational noise and vibrations (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). This vibratory pile-driving noise impact on coastal fauna is expected to be minor. Noise from offshore pile driving associated with the WTG and OSS platform foundations is not expected to be noticeable in the geographic analysis area and would have no impact on coastal fauna.

Noise from G&G surveys during inspection, monitoring, or both of the offshore export cable may occur during construction and operations. G&G noise resulting from cable route surveys can disturb coastal habitat in the immediate vicinity of the investigation high-resolution geophysical surveys include high-frequency sound sources from medium-penetration sub-bottom profilers (e.g., sparkers, boomers) and shallow-penetration, non-parametric sub-bottom profilers (e.g., Compressed High-Intensity Radiated Pulses) that generate less-intense sound waves than the seismic surveys used for oil and gas exploration that create high-intensity impulsive sound that penetrates deep into the seabed (Erbe and McPherson 2017). Impacts from vessel and equipment noise from these geophysical surveys of cable routes could disturb coastal fauna in the immediate vicinity of the investigation and cause temporary behavioral changes (Sivle et al. 2014). Impacts from vessel and equipment noise, including geotechnical sampling (e.g., coring) are expected to be unmeasurable. The intensity and extent of the resulting noise impacts from G&G surveys are difficult to generalize but would likely be temporary and localized; therefore, the impacts of G&G surveys on coastal fauna would be temporary and minor.

Noise from trenching of offshore export cables may occur during construction, although most of the export cables would be installed using a trenchless jet plowing method. The jet plowing method also creates noise. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise would typically be less prominent than the impacts of physical disturbance and sediment suspension. The noise impacts from cable laying or trenching on coastal fauna would be expected to be negligible.

Onshore construction for the Proposed Action could also disturb coastal habitat and fauna. Noise associated with the use of DSPT for the installation of the offshore export cables to the cable landing location would result in temporary noise impacts from installation of the cofferdam, from DSPT in the sea-to-shore transition, and at beach work areas and could result in temporary, localized disturbance or displacement of fauna. Disturbance impacts at the cable landing location would be short term and limited because the landing is located in a proposed parking lot. The onshore export cable predominately follows developed corridors and previously disturbed land to a common location north of Harpers Road. The onshore export cable route would pass through several habitat types, including open space, developed, forested, agricultural, and wetlands (Table 3.8-2 and Table 3.22-3), that support several species resulting in temporary disturbance impacts on coastal habitat and fauna. From that point, onshore clearing and construction (and associated noise) would be required at the Harpers Switching Station and for the overhead lines from Harpers Switching Station to Fentress Substation, resulting in impacts on varying acreages of wetlands and NLCD land cover classes as shown in Table 3.8-2. Onshore clearing and construction would result in disturbance to coastal habitat and fauna at the Harpers Switching Station. The Harpers Switching Station would require approximately 5.52 acres (2.23 hectares) for stormwater management facilities and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Club. These acreages are included in the overall acreage of 46.48 acres (18.81 hectares) for the Harpers Switching Station (Dominion Energy 2023a).

Interconnection Cable Route Option 1 would be approximately 14.3 miles (23.0 kilometers) long and would result in approximately 78.27 acres (31.67 hectares) of temporary disturbance to various NLCD land cover classes (Table 3.8-2). While the NLCD does include wetland land cover classes, refer to

Section 3.22, *Wetlands*, Table 3.22-3 for wetland impacts on the onshore Project components based on wetland delineation survey data. The interconnection cable route would culminate at the onshore substation, which would also require land clearing and result in impacts on various NLCD land cover classes and wetlands (Table 3.8-2 and Table 3.22-3) and related disturbance impacts on fauna and associated habitats. Impacts on wetlands are discussed in Section 3.22.

Fauna species potentially affected by construction noise include fur-bearing mammals, including fox, raccoon, coyote, bobcat, skunk, opossum, beaver, weasel, mink, nutria, and muskrat as well as various species of insects, reptiles, amphibians, birds, and mammals. Fur-bearing mammals such as beaver, black bear, bobcat, river otter, mink, common muskrat, and other small mammals may also be affected.

State-listed species that may be affected by noise in the Onshore Project area include the canebrake rattlesnake (state endangered), the eastern chicken turtle (state endangered), and the barking treefrog (state threatened). There is also potential for little metalmark and populations of Dukes' skipper to occur within the proposed route if suitable habitat exists on site, which could also be affected by Project-related noise.

Overall, noise from onshore clearing and construction would be localized and temporary. While the noise could disturb fauna, they would likely acclimate to the noise or temporarily move away, potentially from preferred habitats. BOEM expects that no individual fitness or population-level impacts would be expected to occur, resulting in minor impacts on coastal habitat and fauna from the Proposed Action; lasting impacts on local breeding populations are not anticipated.

Because only temporary noise impacts are expected to occur, BOEM anticipates impacts from the construction and installation of the offshore components to be negligible and impacts from the construction and installation of the onshore components to be minor. Normal operation of the onshore substation would generate localized continuous noise, but BOEM expects negligible associated long-term impacts when considered in the context of the other commercial, agricultural, and industrial noises near the proposed substation. Similar impacts are expected relative to normal operation of the selected switching station because anticipated noise levels would be localized and low, and the Harpers Switching Station is located in an industrial district while Chicory Switching Station is located in an agricultural district.

Presence of structures: The Proposed Action would not include the construction of any aboveground structures within coastal habitat; therefore, the impacts of habitat conversions in coastal habitat are expected to be negligible.

Installation of cable protection (dumped rocks, geotextile sand containers, and/or concrete mattresses) atop cables that can create uncommon hard-bottom habitat may be necessary under the Proposed Action. Where cables are buried deeply enough that protection is not used, presence of the cable would have no impact on coastal habitat. Approximately 0.1 percent of the offshore export and inter-array cables would be covered with cable-protection material (dumped rocks, geotextile sand containers, and/or concrete mattresses) to ensure that they remain covered during storms and other events that disturb the seafloor (COP, Section 4.2.4.3; Dominion Energy 2023a). Although some of this would occur outside of the geographic analysis area for coastal habitat, cable protection could remain permanently after cable installation. The conversion of soft-bottom habitat to a more reef-like structure would have potential minor beneficial impacts on the surrounding biological community but would also have minor adverse impacts on the soft-bottom coastal habitat and fauna as discussed in Section 3.6, *Benthic Resources*.

Land disturbance: Land disturbance, especially shoreline parcels, can cause short-term erosion and sedimentation impacts in coastal habitat. Altering dune and beach habitat could increase erosion and sedimentation because dune habitat serves as a crucial buffer zone against flooding. The Proposed Action would use DSPT to install the offshore export cables (nine) through a series of conduits under the beach and dune to avoid impacts on these sensitive coastal resources (COP, Section 3.2; Dominion Energy 2023a). These conduits would be established at depths ranging from 10 to 125 feet (3 to 38 meters) below grade under the shoreline. The cable landing location would be within a previously disturbed area west of the Firing Range at Sate Military Reservation (east of Regulus Avenue and north of Rifle Range Road) adjacent to Camp Pendleton Beach. In addition, construction vehicles would not be driven on the beach or dunes (COP, Section 3.3.2.1; Dominion Energy 2023a). The Proposed Action would include installing erosion control devices in accordance with the Dominion Energy's Erosion and Sediment Control Plan to minimize impacts of erosion and sedimentation on coastal habitat (COP, Sections 3.4.2.3 and 4.1.2.2; Dominion Energy 2023a). Therefore, the impacts of erosion and sedimentation on coastal habitat are expected to be negligible.

Land disturbance associated with onshore construction (grading, excavation and trenching), especially shoreline parcels, could cause removal of vegetation, temporary disturbance to adjacent land uses (light, noise, and traffic) and disruption of shoreline access. Temporary and permanent land disturbance under the Proposed Action across all land cover classes is provided by project component in Table 3.8-2. In total, the Proposed Action would result in approximately 26.6 acres of temporary land disturbance and 70.39 acres of permanent land disturbance.

The Proposed Action would include land disturbance from onshore construction at the cable landing location within coastal habitat. The maximum workspace area associated with construction at the cable landing location would be 11.1 acres (4.5 hectares). However, the majority of that 11.1 acres (4.5 hectares) would be used for equipment laydown and staging and would not require any clearing or grading, and temporary impacts would only occur within the 2.27 acres (0.12 hectare) where the proposed parking lot would be built. The permanent disturbance associated with the proposed parking lot to be built at the cable landing location is anticipated to be 2.27 acres (0.92 hectare). The maximum temporary workspace at the Nearshore Trenchless Installation Area is 8.8 acres (3.6 hectares) (COP, Section 3.4.2; Dominion Energy 2023a). The final footprint for the cable landing location would be 2.27 acres (0.92 hectare). Because no surface trenching or grading would occur for the cable landing, no temporary disturbance would occur at this location.

Under the Proposed Action, Interconnection Cable Route Option 1 would be installed entirely overhead from Harpers Switching Station to the Fentress Substation. Interconnection Cable Route Option 1 passes through a variety of habitat types, including freshwater wetlands (Table 3.22-3). The Harpers Switching Station would require approximately 5.5 acres (2.2 hectares) for stormwater management facilities, and approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Course. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station, which are all within the existing Aeropines Golf Club in NLCD land cover classes of open space, forested and woody wetland habitats (COP, Table 4.2-7; Dominion Energy 2023a), and includes 12.5 acres (5.0 hectares) of workspace and fence relocation. Approximately 27.0 acres (10.9 hectares) of tree clearing would be required to support relocation of the fairways, construction of the maintenance building, relocation of Dewey Road, construction of stormwater management facilities, and the footprint of the Harpers Switching Stations (COP, Section 3.3.2.3; Dominion Energy 2023a). The onshore substation, which is located in an existing developed area and is associated with fragmented habitat would require expansion and clearing within forested and wetland NLCD land cover classes (Table 3.8-2) resulting in subsequent impacts on coastal habitat and fauna through habitat loss/fragmentation. While portions of Interconnection Cable Route Option 1 would be located in areas of very high (C2) and high (C3) ecological integrity, the majority of permanent impacts from the onshore components would either occur outside of ecological core areas or within areas of moderate and general ecological integrity (Table 3.8-3). Refer to Section 3.21, *Water Quality*, Section

3.14, *Land Use and Coastal Infrastructure*, and Section 3.22, *Wetlands,* for additional details of potential impacts on surface waters, land use, and wetlands.

The Oceana Ponds and Forest Special Interest Area, the West Neck Creek Natural Area, and the North Landing River Preserve (Gum Swamp) have been given biodiversity significance rankings of 2, B5, and B1, respectively. These sites contain suitable canebrake rattlesnake habitat, and forest loss in the Northwest River drainage could be particularly impactful for this state endangered species. These sites also support the state endangered eastern chicken turtle and state threatened barking treefrog. The Oceana Ponds and Forest Special Interest Area also include the long beach seedbox and the multiflowered mud plantain in select areas. The multiflowered mud plantain has been documented in the silty substrate within a utility right-of-way northeast of the Oceana Pond. In 2019, over 100 individuals were documented at the Oceana Pond site (COP Table 4.2-8; Dominion Energy 2023a); however, these areas are managed by the Navy to protect and enhance those resources and would not be affected by Project activities. There is also potential for little metalmark and populations of Dukes' skipper to occur if suitable habitat exists on site.

Onshore Project construction and operation would not affect the Oceana Ponds and Forest Special Interest Area as none of the construction footprints for onshore Project components overlap this conservation area (Dominion Energy 2023b). Project activities associated with Interconnection Cable Route Option 1 would temporarily affect 4.94 acres (2.0 hectares) in the North Land River Preserve (Gum Swamp), the majority of which are anticipated to occur in 3.33 acres (1.35 hectares) of existing right-of-way. Permanent impacts in the North Landing River (Gum Swamp) are anticipated to be 0.01 acre (0.004 hectare) (Dominion Energy 2023b). Holland Pines Park is the only conservation area mapped around West Neck Creek that would be affected under the Proposed Action. Approximately 2.9 acres (1.17 hectares) of temporary disturbance associated with Interconnection Cable Route Option 1 would occur in an existing right-of-way of Holland Pines Park; no permanent impacts would result (Dominion Energy 2023b). Dominion Energy would coordinate with the VDWR and the Virginia Natural Heritage Program prior to construction on impacts to conservation areas and would and implement avoidance, minimization, and mitigation measures for state-listed reptile and amphibian species, including the canebrake rattlesnake (COP, Section 4.2.2.3, Table 4.2-9; Dominion Energy 2023a).

Non-listed fauna species potentially affected by land disturbance include fox, raccoon, coyote, bobcat, skunk, opossum, beaver, weasel, mink, nutria, and muskrat, as well as various species of insects, reptiles, amphibians, birds, and mammals. Fur-bearing mammals such as beaver, black bear, bobcat, river otter, mink, common muskrat, and other small mammals may also be affected. Please see Section 3.7, *Birds,* and Section 3.5, *Bats,* for impacts specific to those species.

No individual fitness or population-level effects would be expected from onshore construction and associated habitat loss/fragmentation. Furthermore, given the nature of the existing coastal habitat, its abundance on the landscape, and the temporary nature of construction, the temporary impacts on coastal habitat and fauna are expected to be moderate.

Collisions between fauna and vehicles or construction equipment have some limited potential to cause mortality. However, these impacts, if any, would be infrequent, as most individuals would avoid the noisy construction areas (Bayne et al. 2008; Goodwin and Shriver 2010; McLaughlin and Kunc 2013). Therefore, the impacts of land disturbance from onshore construction on coastal habitat and fauna would be short term and minor.

Table 3.8-2 Land Cover Types and Estimated Impacts in the Onshore Project Area

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	NLCD Cover Class[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]	Temporary Disturbance (acres)[4]	Permanent Disturbance (acres)[4]
Interconnection Cable Route							
Option 1	14.3 (OH)	269.4	Planted/ Cultivated Crops	78.27	0.10	0	0.42
			Forest	0	9.11		
			Open Space	0	0.04		
			Woody Wetlands[5]	0	117.92		
			Total:	**78.27**	**127.18**		
Switching Station							
Harpers (Option 1)	N/A	46.5	Open Space	0	4.34	0	46.48
			Forest	0	0.56		
			Woody Wetlands	0	2.60		
			Total:	**0**	**7.51**		
Onshore Export Cable Route							
Cable Landing to Harpers	4.41	57.9	Planted/ Cultivated Crops	2.25	0.01	26.60	1.00
			Forest	0	2.16		
			Developed	12.20	3.16		
			Open Space	9.02	1.45		
			Woody Wetlands	0	5.60		
			Total:	**23.48**	**12.38**		
Onshore Substation							
Fentress Substation and Proposed Expansion	N/A	32.1	Open Space	0	1.61	0	20.23
			Emergent Herbaceous Wetlands	0	0.31		
			Planted/ Cultivated	0	0.54		
			Forest	0	2.60		
			Woody Wetlands	0	8.49		
			Total:	**0**	**13.55**		
Cable Landing Location							
Proposed Parking Lot and Temporary	N/A	11.1	Developed	0	0.16	0	2.27
			Open Space	0	0.74		
			Total:	**0**	**0.90**		

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	NLCD Cover Class[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]	Temporary Disturbance (acres)[4]	Permanent Disturbance (acres)[4]
Construction Easement, West of the Firing Range at SMR							

Source: Dominion Energy 2023a; Dominion Energy 2023c.
[1] NA = not applicable; OH = overhead; UG = underground.
[2] From the NLCD.
[3] Comparison of permanent and temporary impacts was estimated based on cross referencing NLCD class with feature type. These are strictly estimations that are indicative of vegetation clearing activities and will be further refined upon development of design specifications.
[4] Physical land disturbance from activities such as grading, excavation and trenching.
[5] The calculations for impacts for the interconnection cable route based on NLCD indicate an increase in woody wetlands and forested land uses; however, the NLCD data does not accurately represent field conditions. Based on field survey results, the route shift at Princess Anne will result in an overall decrease to forested wetlands as reflected in our wetland impact estimates provided.

Table 3.8-3 Ecological Cores and Estimated Impacts in the Onshore Project Area

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	Ecological Core[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Interconnection Cable Route					
Option 1	14.3 (OH)	273.2	C1	0.00	0.00
			C2	0.00	3.62
			C3	0.00	0.36
			C4	0.00	0.01
			C5	0.00	13.07
			Total:	**0.00**	**17.06**
Switching Station					
Harpers (Option 1)	N/A	46.5	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**
Onshore Export Cable Route					
Cable Landing to Harpers	4.41	57.9	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	4.67
			C5	0.00	1.12
			Total:	**0.00**	**5.79**

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	Ecological Core[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Onshore Substation					
Fentress Substation and Proposed Expansion	N/A	32.1	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**
Cable Landing Location					
Proposed Parking Lot and Temporary Construction Easement, West of the Firing Range at SMR	N/A	11.1	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**

Source: Dominion Energy 2023a.
[1] OH = overhead; UG = underground
[2] From the Virginia Department of Conservation and Recreation Natural Heritage Program Virginia Natural Landscape Assessment ecological cores. C1=Outstanding, C2=Very High, C3=High, C4=Moderate, C5=General.
[3] Comparison of temporary and permanent impacts is estimated strictly based on feature type (route, laydown area, switching station, etc.). Because ecological cores encompass multiple parameters (abiotic and biotic), the ecological core ranking was not cross referenced against the feature type. This estimation assumes the most impact possible within the routing and may not be indicative of actual impacts.

Seabed profile alterations: Installation of the offshore export cable would involve preconstruction grapnel runs, seafloor preparation, and plowing or trenching for cable installation and armoring that would alter seabed profiles.

As is standard practice when installing submarine cabling, pre-lay grapnel runs would be completed prior to cable installation to clear any unknown obstructions along the route. Towing this equipment along the seafloor would result in localized seabed profile alternations but impacts would expect to recover completely naturally without mitigation.

Prior to installation of the offshore export cables, seabed preparation activities would also include sandwave removal to create a flat surface for the cable installation tools and stable seabed elevation to prevent cable exposure occurring over time. Sandwave removal would require clearing the area, most likely using subsea excavation methods or controlled flow excavation. Controlled flow excavation would employ a tool suspended above the seabed from a vessel, to induce a controlled flow of water directed at the seabed to be displaced. Induced water currents would, therefore, force the local seabed into suspension, where it would be directed into the immediately surrounding area and, in the absence of the induced flow, the suspended sediment would settle back to the seabed around the area of excavation (COP, Section 3.4.1.4; Dominion Energy 2023a). Alterations to seabed profiles would be expected to occur but would recover completely naturally without mitigation.

Short-term disturbance to the seabed sediment would occur during installation of the offshore export cables within coastal habitat. The offshore export cables would be buried approximately 3.3 to 16.4 feet (1 to 5 meters) below stable seabed elevation to minimize the risk of cable exposure or damage. In addition, the Proposed Action would use trenchless installation (HDD or DSPT) to install the nine export cables that would occur from an offshore trenchless installation punch-out location approximately 1,000 to 1,800 feet (305 to 549 meters) offshore of the cable landing location, further reducing seabed profile alterations in the nearshore area.

As stated previously, the Proposed Action would include approximately 0.1 percent of the offshore export and inter-array cables be covered with cable-protection material (dumped rocks, geotextile sand containers, and/or concrete mattresses) to ensure that they remain covered during storms and other events that disturb the seafloor (COP, Section 4.2.4.3; Dominion Energy 2023a). Although some of this would occur outside of the geographic analysis area for coastal habitat, cable protection could remain permanently after cable installation. Therefore, such impacts, while locally intense, would have unmeasurable effect on the general character of coastal habitat. Overall, the impacts of seabed profile alternations on coastal habitat and fauna would be expected to be minor.

Seabed deposition and burial: Cable laying and construction would result in the temporary resuspension and nearby deposition of sediments. In areas where displaced sediment is thick enough, organisms may be smothered, which would result in mortality (see Section 3.6, *Benthic Resources,* for additional details on benthic resources). Additional protective rock or other hard material would be placed atop 0.1 percent of the offshore export and inter-array cables for added protection where cable burial is insufficient. Because most lightly sedimented areas would recover naturally, and most coastal benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally, impacts on coastal resources would be minor.

The Proposed Action would include installation of the offshore export cable that would involve preconstruction grapnel runs, seafloor preparation, and plowing or trenching for cable installation and armoring. These activities in coastal habitat would cause temporary and localized increases in turbidity and total suspended sediment in the water column.

The installation of the offshore export cable would mostly be done by jet or mechanical plow. Each of the nine offshore export cables would be installed separately in space and time during construction with enough time between installations for disturbed sediment to resettle on the seafloor. Cable installation activities would cause short-term disturbance of nearshore coastal habitat and an increase in suspended sediments along the cable trench. The silt and clay sediment particles are predicted to remain in suspension for about 4 hours after being mobilized in the water column. Coarser particles (fine sand) settle at a faster rate, about 1 minute after being mobilized (COP, Appendix J; Dominion Energy 2023a). Based on the predicted results of the sediment transport modeling for the Proposed Action, the suspended sediment concentrations would diminish rapidly away from the offshore export cable trench and at most stations, over 85 percent of the suspended particles would deposit within 16.4 feet (5 meters) of the trench centerline. In addition, the suspended sediment concentrations would drop rapidly with time. At most locations, the concentration would drop by 75 percent or greater within 4 minutes of jet plowing activity (COP, Appendix J; Dominion Energy 2023a). Although turbidity is likely to be high in the affected areas, sediment deposition would have no long-term impact on coastal habitat or fauna.

Mobile benthic species are anticipated to move out of the area and return once installation activities are complete. Because most lightly sedimented areas would recover naturally, and most benthic coastal habitat and fauna are adapted to the turbidity and periodic sediment deposition that occur naturally. Therefore, the impacts of sediment deposition and burial on coastal habits and fauna are expected to be minor.

3.8.5.1 Cumulative Impacts of the 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 (of which there are none). Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on coastal habitat and fauna through the IPFs of accidental releases, anchoring, emfs, light, new cable emplacement and maintenance, noise, presence of structures, land disturbance, seabed profile alterations, and seabed deposition and burial. BOEM is not aware of any future offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for coastal habitat and fauna.

The cumulative impact on coastal habitat and fauna would likely be minor. Offshore wind activities are expected to contribute considerably to several IPFs, primarily new cable emplacement and the presence of structures, namely cable protection, but would occur over 20 miles (32 kilometers) away.

3.8.5.2 Conclusions

Impacts of the Proposed Action. The Proposed Action would likely result in local impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) that would not alter the overall character of coastal habitat and fauna resources in the geographic analysis area.

Project construction, installation, and conceptual decommissioning would result in new cable emplacement, noise, land disturbance, seabed profile alterations, and sediment deposition and burial to the geographic analysis area, as well as alter existing coastal habitat affecting fauna to varying degrees depending on the location, timing, and species affected by an activity. Noise, lighting, and human activity impacts from Project operation and maintenance would occur, although at lower levels than those produced during construction and conceptual decommissioning. The impacts resulting from the Proposed Action alone would range from **negligible** to **moderate**. Therefore, the overall impacts on coastal habitat and fauna (excluding wetlands; impacts for wetlands can be found in Section 3.22, *Wetlands*) from the Proposed Action alone are expected to be **minor** because the effects would be small, and the resources would be expected to recover completely without remedial or mitigating action. Impacts for wetlands are analyzed separately and are anticipated to be major; analysis can be found in Section 3.22.

Cumulative impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action, would range from **negligible** to **moderate**. Considering all of the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action, would be **moderate** on coastal habitat and fauna in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and the associated impacts on coastal habitat from ocean acidification, warming, sea level rise and altered habitat/ecology. The Proposed Action would contribute to the overall impact rating primarily through the impacts of new cable emplacement and maintenance, noise, land disturbance, and the presence of structures (cable-protection measures). While some of the Project-related impacts on coastal habitat and fauna are measurable, the resource would likely recover completely when construction is completed and best management practices and mitigating actions are taken. While recovery can begin in 1 to 2 years, a time span of 15 to 20 years is recommended to specifically measure parameters that describe ecological recovery of the ecosystem (including vegetation structure and diversity) as well as the associated functions (including ecological processes) and services (Bayraktarov et al. 2016).

3.8.6 Impacts of Alternatives B and C on Coastal Habitat and Fauna

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, described in this section.

Impacts of Alternatives B and C. Alternatives B and C would decrease the number and size of WTGs and result in reduced impacts from the associated decrease in construction and installation, O&M, non-routine activities, and conceptual decommissioning compared to the Proposed Action. However, Alternatives B and C would have the same impact determinations on coastal habitat and fauna as those described under the Proposed Action. The decreased number and size of WTGs (up to 176 WTGs plus spare locations for Alternative B, each 14 MW; up to 172 WTGs under Alternative C, each 14 MW) would not influence impacts on coastal habitat and fauna when compared to the Proposed Action. The elements of Alternatives B and C would be at the same distance from the boundary of the geographic analysis area as the Proposed Action (approximately 20 miles [32 kilometers]). As a result, BOEM does not anticipate impacts to be different than those described under the Proposed Action and anticipates that impacts would remain minor.

Cumulative impacts of Alternatives B and C. The cumulative impacts on coastal habitat and fauna would be **minor** for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, impacts contributed by Alternatives B and C to the cumulative impacts on coastal habitat and fauna would be the same as those described for the Proposed Action.

3.8.6.1 Conclusions

Impacts of Alternatives B and C. The impacts potentially resulting from Alternatives B and C would be practically identical to those associated with the Proposed Action. The overall impacts on coastal habitat and fauna of ongoing and planned actions, Alternatives B and C, would be the same as under the Proposed Action and would remain **negligible** to **moderate**, or **minor** overall.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the impacts of ongoing and planned actions, including Alternatives B and C, would be no different than to those described under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate**).

3.8.7 Impacts of Alternative D on Coastal Habitat and Fauna

Impacts of Alternative D. All offshore components of Alternative D are the same as the Proposed Action (202 WTGs and 3 OSSs), and impacts on coastal habitat and fauna from the Offshore Project components would be the same as evaluated under the Proposed Action. Onshore, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under sub-alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same.

In contrast to the Proposed Action, Alternative D-2 involves approval of only Hybrid Interconnection Cable Route Option 6 (Alternative D-2), which would be approximately 14.3 miles (23.0 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods and installed via open trench, micro tunneling, and HDD. It would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.7 miles (15.6 kilometers) to the onshore substation (Fentress).

As under the Proposed Action, land disturbance under Alternative D-2 associated with onshore construction (grading, excavation, and trenching), especially shoreline parcels, could cause removal of vegetation, temporary disturbance to adjacent land uses (light, noise, and traffic) and disruption of shoreline access. Temporary and permanent land disturbance under Alternative D-2 across all land cover classes is provided by project component in Table 3.8-4. In total, Alternative D-2 would result in approximately 55.6 acres of temporary land disturbance (29.0 acres more than the Proposed Action). Permanent land disturbance under Alternative D-2 would total approximately 62.85 acres (7.54 acres less than the Proposed Action).

Noise and land disturbance from onshore construction activities of Interconnection Cable Route Option 6 would result in behavioral and habitat loss/fragmentation impacts on coastal habitat and fauna as a result of temporary disturbance and clearing to a total of 72.08 acres (29.17 hectares) of NLCD land cover classes (Table 3.8-4) whereas the Proposed Action would result in temporary impacts on 78.27 acres (31.67 hectares) (Table 3.8-2). While the NLCD does include wetland land cover classes, refer to Section 3.22, *Wetlands*, Table 3.22-4 for wetland impacts on the onshore Project components based on wetland delineation survey data. Approximately 76 percent of Interconnection Cable Route Option 1 (Proposed Action) and 70 percent of Interconnection Cable Route Option 6 (Alternative D-2) would be collocated with existing linear development. The Chicory Switching Station (Interconnection Cable Route Option 6) is in an area identified as having general ecological integrity (C5), and would be built within a forested parcel, with potential for habitat loss/fragmentation on coastal habitat and fauna due to tree clearing within multiple forest NLCD land cover classes (Table 3.8-4). One forest-inhabiting species of particular concern is the state endangered canebrake rattlesnake, and forest loss in the Northwest River drainage could be particularly impactful. Other potentially affected fauna include fox, raccoon, coyote, bobcat, skunk, opossum, beaver, weasel, mink, nutria, and muskrat as well as various species of insects, reptiles, amphibians, birds, and mammals. Black bear, bobcat, river otter, and other small mammals may also be affected. See Section 3.7, *Birds,* and Section 3.5, *Bats,* for impacts specific to those species.

The Chicory Switching Station would have a footprint of 35.5 acres (14.4 hectares) but would result in a greater area of impact on undeveloped NLCD land cover classes than the Harpers Switching Station, which would be located entirely within the existing Aeropines Golf Club. Overall, impacts at the Chicory Switching Station (Alternative D-2) would predominantly occur on previously undisturbed forest/wetland habitats (Table 3.8-4), whereas impacts at the Harpers Switching Station (Proposed Action) would be on portions of developed areas (Table 3.8-2). Similar to the Proposed Action, impacts associated with onshore clearing and construction would be localized and temporary. Alternative D-2 would result in greater permanents impacts to ecological cores (approximately 42.67 acres) than Alternative D-1 (approximately 22.85 acres) (Dominion Energy 2023a). While Alternative D-2 would result in an increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates the difference in potential impacts on coastal habitat and fauna would be nominal.

Under Alternatives D-1 and D-2, temporary and permanent impacts on the North Landing River Preserve (Gum Swamp) would be the same as described for the Proposed Action. Impacts on the Holland Pines Park near West Neck Creek associated with Interconnection Cable Route Option 6 (Alternative D-2) would be similar to the Proposed Action (Interconnection Cable Route Option 1). However, Alternative D-2 would result in fewer temporary but greater permanent impacts. In total, Alternative D-2 would result in 0.24 acre (0.10 hectare) of temporary impacts and 1.07 acres (0.43 hectare) of permanent impacts on Holland Pines Park (Dominion Energy 2023b). The Oceana Ponds and Forest Special Interest Area would not be affected by either Alternative D-1 or Alternative D-2.

Because impacts associated with onshore clearing and construction would be localized and temporary, no individual fitness or population-level effects would be expected from onshore construction and associated loss/fragmentation of foraging associated with Alternative D-1 or D-2, and, as a result, BOEM anticipates minor impacts. Therefore, BOEM anticipates impacts of Alternative D-1 or D-2 to be the same on coastal habitat and fauna as those described under the Proposed Action, with impacts remaining minor.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

Table 3.8-4 Land Cover Types and Estimated Impacts in the Onshore Project Area

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	NLCD Cover Class[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]	Temporary Disturbance (acres)[4]	Permanent Disturbance (acres)[4]
Interconnection Cable Route							
Option 6	14.3 (OH = 9.8; UG = 4.5)	240.5	Planted/ Cultivated Crops	68.65	2.15	29.00	3.85
			Forest	0	9.13		
			Developed	0	0		
			Open Space	3.43	0.60		
			Woody Wetlands	0	104.46		
			Total:	**72.08**	**116.33**		
Switching Station							
Chicory (Option 6)	N/A	35.5	Planted/ Cultivated Crops	0	0.22	0	35.50
			Forest	0	11.17		
			Open Space	0	0.25		
			Shrub/Scrub	0	1.42		
			Woody Wetlands	0	22.27		
			Total:	**0**	**35.33**		
Onshore Export Cable Route							
Cable Landing to Harpers	4.41	57.9	Planted/ Cultivated Crops	2.25	0.01	26.60	1.00
			Forest	0	2.16		
			Developed	12.20	3.16		
			Open Space	9.02	1.45		
			Woody Wetlands	0	5.60		
			Total:	**23.48**	**12.38**		

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	NLCD Cover Class[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]	Temporary Disturbance (acres)[4]	Permanent Disturbance (acres)[4]
Onshore Substation							
Fentress Substation and Proposed Expansion	N/A	32.1	Open Space	0	1.61	0	20.23
			Emergent Herbaceous Wetlands	0	0.31		
			Planted/ Cultivated	0	0.54		
			Forest	0	2.60		
			Woody Wetlands	0	8.49		
			Total:	**0**	**13.55**		
Cable Landing Location							
Proposed Parking Lot and Temporary Construction Easement, West of the Firing Range at SMR	N/A	11.1	Developed	0	0.16	0	2.27
			Open Space	0	0.74		
			Total:	**0**	**0.90**		

Source: Dominion Energy 2023a; Dominion Energy 2023c.
[1] NA = not applicable; OH = overhead; UG = underground.
[2] From the NLCD.
[3] Comparison of permanent and temporary impacts was estimated based on cross referencing NLCD class with feature type. These are strictly estimations that are indicative of vegetation clearing activities and will be further refined upon development of design specifications.
[4] Physical land disturbance from activities such as grading, excavation, and trenching.

Table 3.8-5 Ecological Cores and Estimated Impacts in the Onshore Project Area

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	Ecological Core[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Interconnection Cable Route					
Option 6	14.3 (OH=9.8; UG=4.5)	240.5	C1	0.00	0.00
			C2	0.00	3.62
			C3	0.00	0.36
			C4	0.00	0.01
			C5	0.00	6.39
			Total:	**0.00**	**10.38**

Onshore Project Component	Route Length (miles)[1]	Total Project Area (acres)	Ecological Core[2]	Temporary Impacts (acres)[3]	Permanent Impacts (acres)[3]
Switching Station					
Chicory (Option 6)	N/A	35.5	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	26.50
			Total:	**0.00**	**26.50**
Onshore Export Cable Route					
Cable Landing to Harpers	4.41	57.9	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	4.67
			C5	0.00	1.12
			Total:	**0.00**	**5.79**
Onshore Substation					
Fentress Substation and Proposed Expansion	N/A	32.1	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**
Cable Landing Location					
Proposed Parking Lot and Temporary Construction Easement, West of the Firing Range at SMR	N/A	11.1	C1	0.00	0.00
			C2	0.00	0.00
			C3	0.00	0.00
			C4	0.00	0.00
			C5	0.00	0.00
			Total:	**0.00**	**0.00**

Source: Dominion Energy 2023a.
[1] OH = overhead; UG = underground
[2] From the Virginia Department of Conservation and Recreation Natural Heritage Program Virginia Natural Landscape Assessment ecological cores. C1=Outstanding, C2=Very High, C3=High, C4=Moderate, C5=General.
[3] Comparison of temporary and permanent impacts is estimated strictly based on feature type (route, laydown area, switching station, etc.). Because ecological cores encompass multiple parameters (abiotic and biotic), the ecological core ranking was not cross referenced against the feature type. This estimation assumes the most impact possible within the routing and may not be indicative of actual impacts.

3.8.7.1 Conclusions

Impacts of Alternative D. The Proposed Action only considers Interconnection Cable Route Option 1, while Alternatives D-1 and D-2 consider Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2). BOEM anticipates the impacts on coastal habitat and fauna resulting from Alternative D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be slightly greater than under the Proposed Action due to construction and clearing occurring on a larger area of undisturbed forest/wetland habitats; however, the impacts are not expected to change under Alternatives D-1 or D-2 relative to the Proposed Action. Impacts on coastal habitat and fauna would result in the same impacts on coastal habitat and fauna as the Proposed Action and would remain **negligible to moderate**, or **minor** overall. Impact ratings associated with individual IPFs would not change.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the impacts of ongoing and planned actions, including Alternative D-1 or D-2, would be the same as those described under the Proposed Action (with individual IPFs leading to impacts ranging from **negligible** to **moderate**). The overall impacts on coastal habitat and fauna of ongoing and planned actions, including Alternative D-1 or D-2, would be the same as those under the Proposed Action, with impacts remaining **moderate**. This impact rating is driven primarily by ongoing activities such as climate change, as well as limited disturbance and habitat removal associated with onshore construction.

3.8.8 Agency-Proposed Mitigation Measures

No additional measures to mitigate impacts on coastal habitat and fauna have been proposed for analysis.

3.9 Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial fisheries and for-hire recreational fishing from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for commercial fisheries and for-hire recreational fishing. The commercial fisheries and for-hire recreational fishing geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.9-1 and Figure 3.9-2. The geographic analysis area boundaries include the management areas of the South Atlantic Fishery Management Council (SAFMC) from the South Carolina/Georgia border northward, the Mid-Atlantic Fishery Management Council (MAFMC), and the New England Fishery Management Council (NEFMC) for all federal fisheries within the EEZ (from 4 to 230 miles [6 to 370 kilometers] from the coastline) and all adjacent state waters (from 0 to 4 miles [0 to 6 kilometers] from the coastline). For for-hire recreational fisheries, this includes all areas managed by the NEFMC south of Cape Cod, Massachusetts, the MAFMC, and the SAFMC to Cape Hatteras, North Carolina, including all adjacent state waters (from 0 to 4 miles [0 to 6 kilometers] from the coastline). 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. EEZ waters surrounding the proposed Project.

Due to size of the geographic analysis area, the analysis for this EIS focuses on the commercial fisheries and for-hire recreational that would likely occur in the Project area or be affected by Project-related activities, while providing context within the larger geographic analysis area.

3.9.1 Description of the Affected Environment for Commercial Fisheries and For-Hire Recreational Fishing

Commercial fisheries refer to fishing activities that sell catch for profit, whereas for-hire recreational fishing boat owners charter fishing trips to anglers. The boundaries for the commercial fisheries geographic analysis area were developed to consider impacts on federally permitted vessels operating in all fisheries in state and EEZ waters surrounding the proposed Project, vessels from the Project area that may transit to fishing grounds in other Atlantic regions, as well as potential impacts on federally managed species of commercial importance that have ranges that overlap with the Project area. The boundaries for the for-hire recreational fishing geographic analysis area were developed to consider impacts on charter and other for-hire vessels operating in and around the proposed Project area, those transiting to other known fishing grounds along the Atlantic coast, and those potentially displaced by other WEA development activities.

3.9.1.1 Regional Setting

Fisheries in the geographic analysis area are managed at the federal, state, and regional level. At the federal level, there are three councils designated by the Magnuson Fishery Conservation and Management Act of 1976 (later renamed the Magnuson-Stevens Fishery Conservation and Management Act): the NEFMC for Connecticut, Massachusetts, Maine, New Hampshire, and Rhode Island; the MAFMC for Delaware, Maryland, North Carolina, New Jersey, New York, Pennsylvania, and Virginia; and the SAFMC for North Carolina and South Carolina (included in the geographic analysis area), as well as Georgia and Florida (not included in the geographic analysis area).

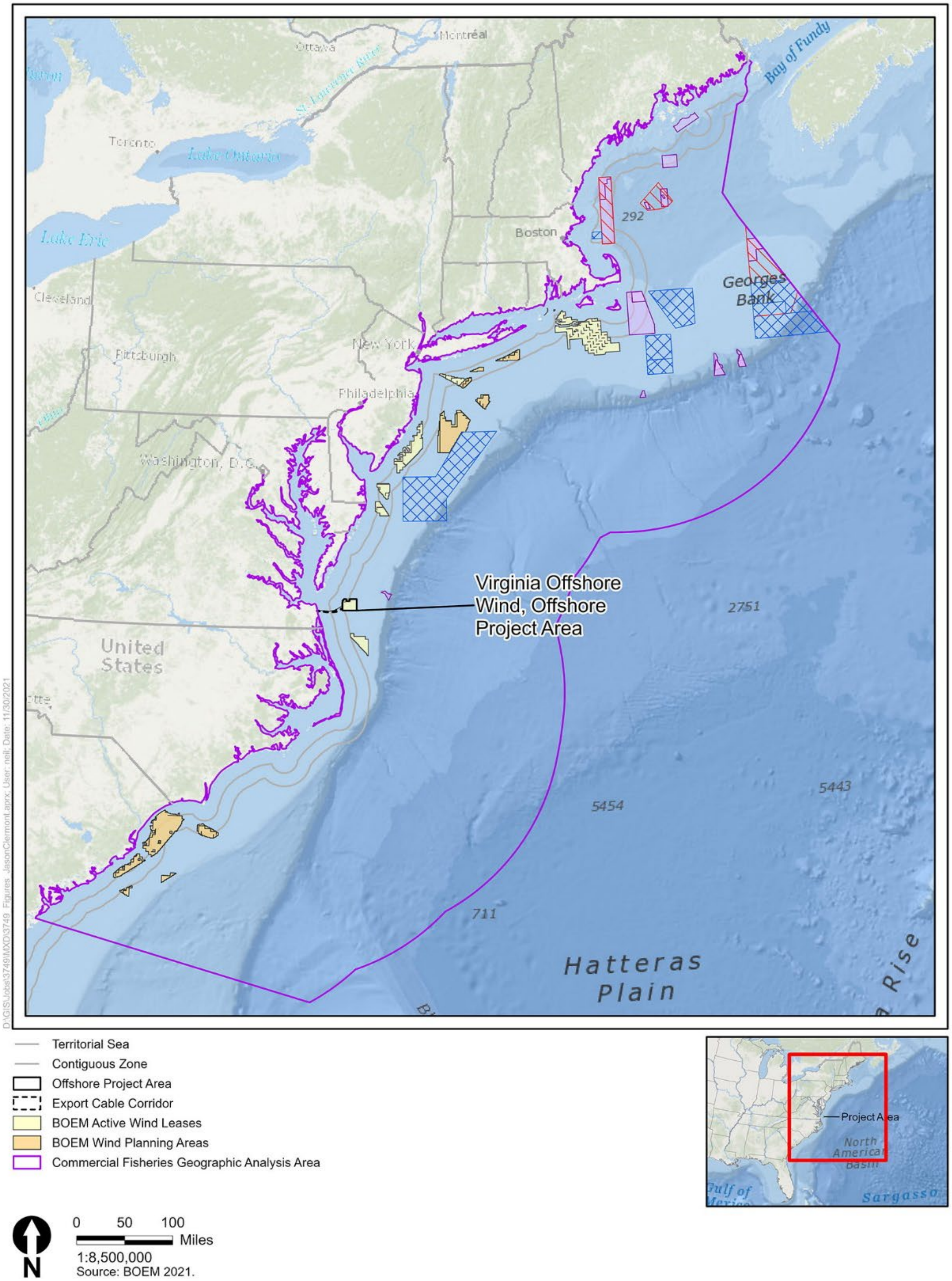


Figure 3.9-1 Commercial Fisheries Geographic Analysis Area

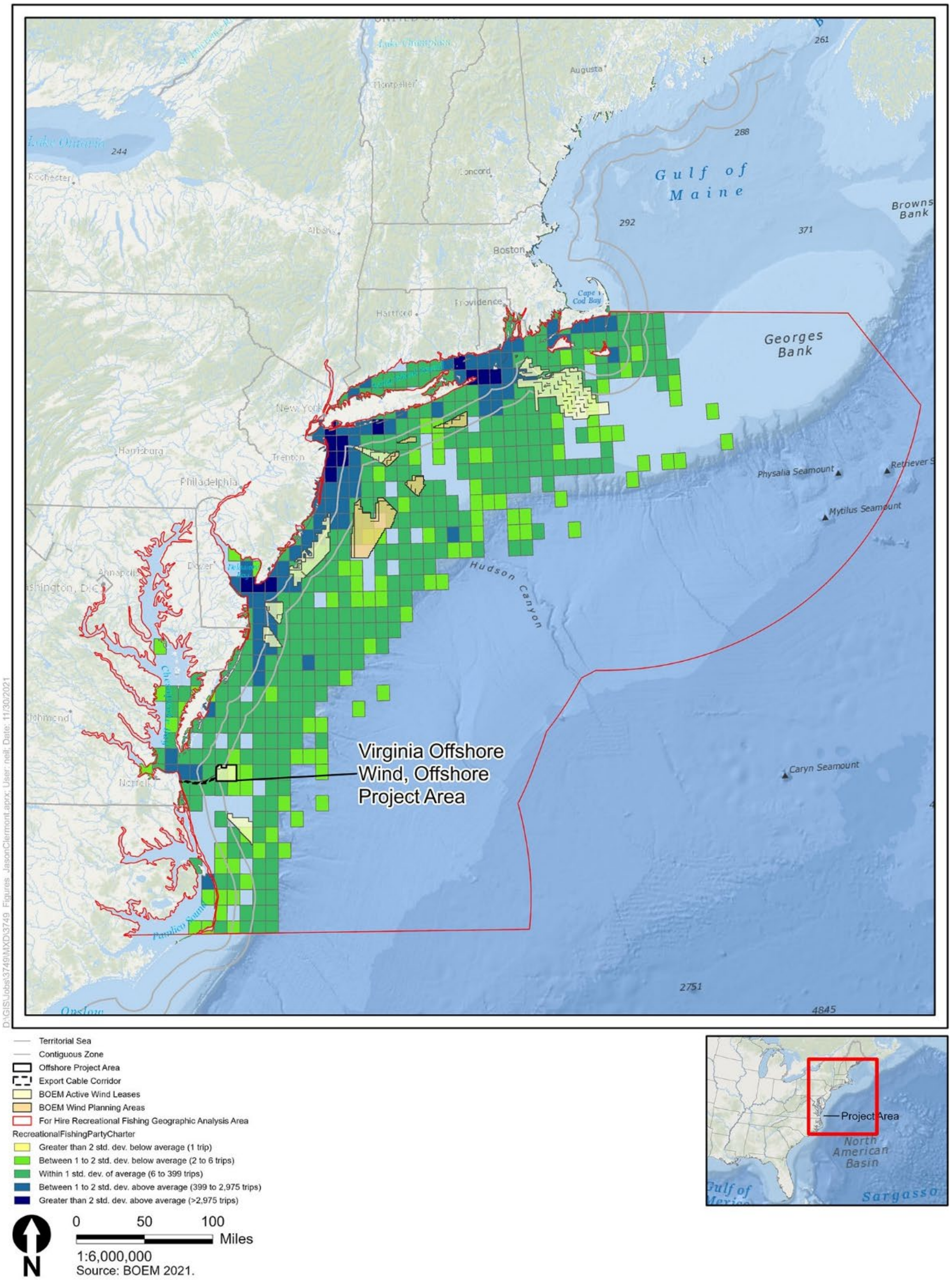


Figure 3.9-2 For-Hire Recreational Fishing Geographic Analysis Area

At the regional level, the 15 Atlantic states form the Atlantic States Marine Fisheries Commission. Species potentially present in the Offshore Project area are fully described in COP Table 4.2-16 (Dominion Energy 2023a) and in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, Table 3.13-1.

Management of commercial and for-hire recreational fisheries in the geographic analysis area relies on data from both fisheries-dependent and fisheries-independent surveys to inform stock assessments and set harvest targets, and to support various other management objectives. NOAA collaborates with numerous regional, state, and academic/scientific entities to collect data on fish and shellfish biomass, distribution, and condition; fisheries effort and landings; and other markers relative to the health and trends of fisheries resources and the commercial and recreational fishing industries.

3.9.1.2 Regional Fisheries Economic Value and Landings

A detailed description of the commercial and for-hire recreational fisheries and corresponding revenue generated from those activities in the Project area and along the export cable corridor can be found in COP Section 4.4.6 (Dominion Energy 2023a). BOEM (2021a, 2021b) examined commercial and recreational fisheries, including corresponding revenue generated from such activities, in the geographic analysis area from Cape Hatteras, North Carolina, north to the U.S.–Canadian border. Information from these reports is incorporated here by reference.

Commercial fisheries in the geographic analysis area use a variety of vessel and gear types, including scallop dredges, otter trawls, shrimp trawls, longline, gillnets (sink and floating), pots, and traps. Commercial fishing vessels range in size from small Carolina and Chesapeake skiffs to larger offshore vessels. The majority of the New England and Mid-Atlantic trawl fleet consists of vessels ranging from 33 to 98 feet (10 to 30 meters) in length; scallop vessels trend somewhat larger. The primary commercial fishery conducted in and around the Project area is the pot and trap fishery targeting black sea bass and whelk/conch (Buccinidae/Strombidae). These vessels typically work out of smaller ports along the Eastern Shore of Virginia (e.g., Cape Charles, Oyster, Willis Warf, Wachapreague, Chincoteague) and Virginia Beach area ports (COP Section 4.4.6; Dominion Energy 2023a).

NOAA maintains landings data for commercial and recreational fisheries based on year, state, and species. The top species landed by weight in recent commercial fisheries operating near the Project area (e.g., offshore Virginia) include menhaden (*Brevoortia tyrannus*), blue crab, spiny dogfish, scallop (Pectinidae), oyster (Ostreidae), croaker (*Micropogonias undulatus*), flounder (Paralichthyidae), and striped bass (*Morone saxatilis*), and a substantial commercial value was derived from harvest of oyster, scallop, blue crab, menhaden, clam, and other species (NOAA 2021a). However, it should be noted that many of the landings and associated revenue from these species occur close to the Virginia shore and that the Project area itself is considered "lightly fished." The highest value commercial landings deriving from the Project area from 2008 to 2018 were black sea bass, *Illex* sp. squid, channeled whelk (*Busycotypus canaliculatus*), summer flounder, and *Loligo* sp. squid (COP, Section 4.4.6; Dominion Energy 2023a). Commercial fisheries in the geographic analysis area provide a significant amount of regional revenue, averaging around $2 billion per year (NOAA 2021a), but most of this revenue originates from fishing outside of the Project area. The commercial fishing fleets contribute to the overall economy in the region through direct employment, income, and gross revenues, as well as through products and services to maintain and operate vessels, seafood processors, wholesalers/distributors, and retailers. Five ports in the geographic analysis area ranked in the top 20 U.S. ports for commercial landings quantity (Reedville, Virginia; New Bedford, Massachusetts; Cape May-Wildwood, New Jersey; Gloucester, Massachusetts; and Point Judith, Rhode Island) and commercial landings value (New Bedford, Massachusetts; Cape May-Wildwood, New Jersey; Point Judith, Rhode Island; Gloucester, Massachusetts; Hampton Roads, Virginia) in 2018 or 2019 (NMFS 2021a). Domestic landings in the geographic analysis area were approximately 573,000 and 542,500 metric tons in 2018 and 2019, respectively (NMFS 2021a).

The value of commercial landings in the majority of the geographic analysis area has been generally increasing since 2000, ranging from $986 million in 2001 to approximately $2.5 billion in 2021 (NOAA 2021a). The value of landings in 2020 ($1.72 billion) was the lowest reported since 2013 (NOAA 2021a), an outcome likely due to impacts on fisheries from the COVID-19 pandemic. Commercial landings in the Mid-Atlantic are dominated by menhaden, a high-volume, low value fishery that typically accounts for 50 to 65 percent of the region's landings by weight, but less than 10 percent by value. An analysis of the landings of economically important species in the Mid-Atlantic other than menhaden showed a marked decline in landed weight, but an increase in ex-vessel landed value between 2002 and 2015 (King 2017).

Commercial fisheries landings in Virginia between 2017 and 2021 ranged from 145,995 to 177,979 metric tons, with the lowest landings by weight occurring in 2020 (NMFS 2021a). The value of landings in Virginia over this period ranged from $179 million to $222 million, with the highest value occurring in 2021 (NMFS 2021a).

Table 3.9-1 shows the top five taxa by landings weight and the associated revenue by NMFS geographic region for the New England, Mid Atlantic, and South Atlantic fisheries in 2021. While most of the revenue is derived from areas outside of the immediate Project area, it is important to note that the Project's geographic analysis area includes areas under jurisdiction of the NEFMC, MAFMC, and SAFMC. In the Mid-Atlantic region where the Project area is located, menhadens and blue crab had the highest landings in 2021.

Table 3.9-1 Top Five Taxa for Commercial Fishing Landings and Associated Revenues in New England, Mid-Atlantic, and South Atlantic Regions for 2021

Taxa	**Landings (Pounds)**	**Revenue (2021 Dollars)**
New England Region		
American lobster (*Homarus americanus*)	134,266,259	$921,391,217
Illex squid	39,036,290	$19,608,775
Sea scallop (*Placopecten magellanicus*)	36,699,687	$559,850,654
Withheld for Confidentiality	29,178,127	$67,036,448
Menhadens[1] (Brevoortia)	25,832,456	$14,320,109
Mid-Atlantic Region		
Menhadens[1] (Brevoortia)	389,187,382	$126,200,848
Blue crab (*Callinectes sapidus*)	40,280,502	$91,829,679
Withheld for Confidentiality	35,128,203	$15,553,047
Atlantic surf clam (*Spisula solidissima*)	15,632,078	$10,836,427
Ocean quahog (*Arctica islandica*)	11,493,430	$12,868,001
South Atlantic Region		
Blue crab (*Callinectes sapidus*)	20,068,517	$40,633,677
Northern white shrimp (*Litopenaeus setiferus*)	18,440,544	$53,449,275
Shrimp[1] (Dendrobrnachiata)	14,705,323	$6,246,644
Spanish mackerel (*Scomberomorous maculatus*)	4,572,528	$5,055,013
Northern brown shrimp (*Farfantepenaeus aztecus*)	4,369,977	$9,241,753

Source: Developed using data from NMFS 2021a.
[1] Includes more than one species where species-specific data are not available.

3.9.1.3 Commercial Fisheries in the Lease Area

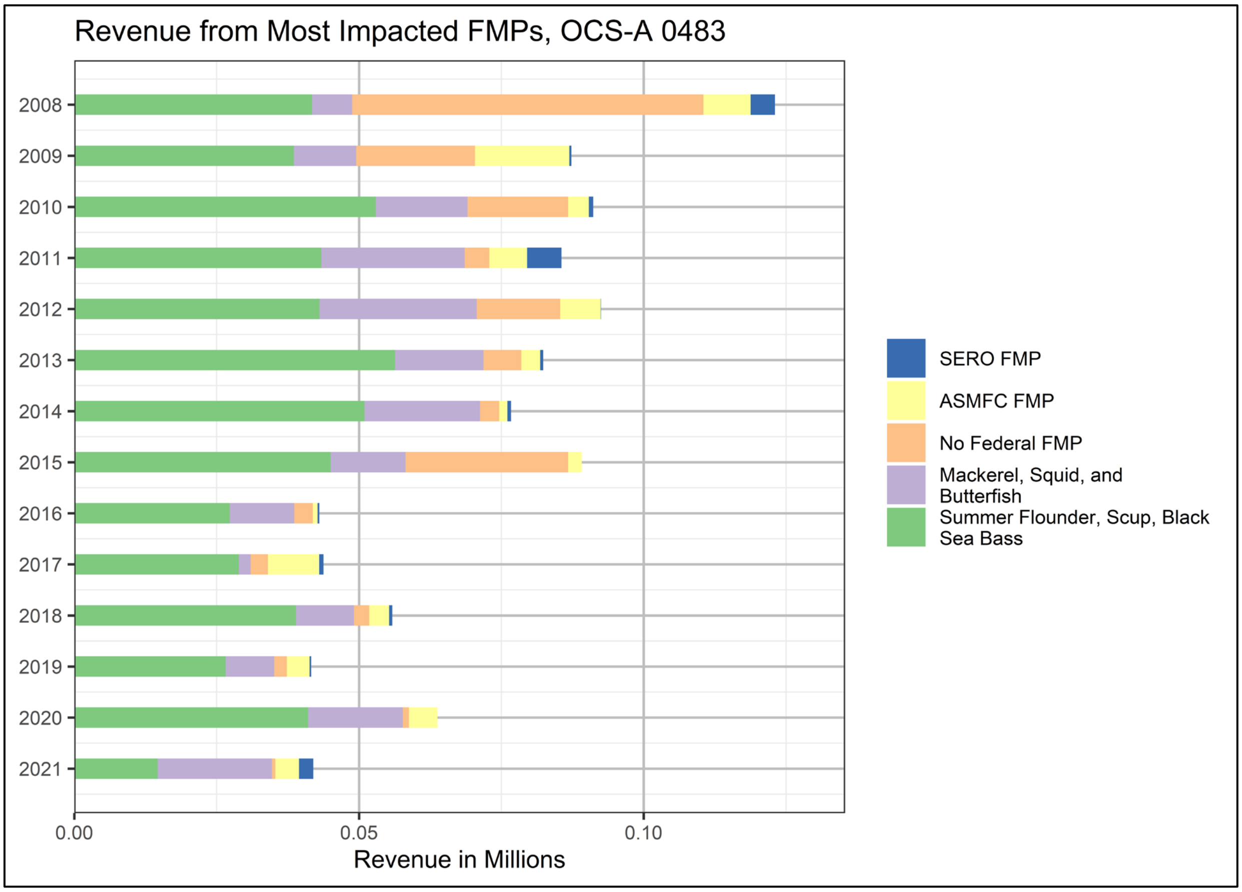
This section summarizes Project area–specific commercial fish landings and associated revenue by FMP fishery, gear type, state, and port of landing.

Commercial fisheries are an important driver of economic growth for coastal communities, contributing to local economies through dockage fees, tackle and other equipment, meals, vessel repairs, as well as from the sale of fish. COP Section 4.4.6 (Dominion Energy 2023a) reported revenue from catch in the Lease Area landed at ports along the U.S. east coast. Revenue ranged from $38,459 to $99,170 between 2008 and 2018. The Lease Area is considered “lightly fished” compared to other WEAs, ranking last in landings value based on 2014 data (Kirkpatrick 2014). However, NMFS does not track targeted whelk fishing, and the industry had indicated the Lease Area may be a reliable and heavily productive area for whelk.

NMFS (2021b) lists the most affected FMP fisheries in the Project area as being summer flounder, scup, black sea bass, mackerel, squid, and butterfish. Landings from the most affected fisheries from 2008 to 2021 are presented in Figure 3.9-3. Fourteen-year (2008 to 2021) total landings were highest for mackerel, squid, and butterfish (339,000 pounds), and summer flounder, scup, and black sea bass (162,000 pounds) (Table 3.9-2). Total revenue (2021 dollars) from those same fisheries is presented in Figure 3.9-4; revenue was highest for the summer flounder, scup, and black sea bass FMP ($549,000) (Table 3.9-2). It should be noted that landings and revenue data may be overestimates, particularly for the mackerel, squid, and butterfish FMP due to the nature of how fishery footprint data are processed. Most squid fishing in the region occurs in deep waters east of the Project area.

A government-to-government consultation was conducted between BOEM and the Upper Mattaponi Indian Tribe and the Nansemond Indian Nation because the Tribes expressed concern on the potential impacts of the Project on the glass eel stage of the American eel, a species that has spiritual, cultural, and natural resource value to the Tribes. While there is an international market for glass eels for aquaculture purposes, Maine and South Carolina (areas outside the geographic analysis area) are the only states where a commercial fishery is active, and landings have been low (approximately 1 million pounds or less annually) since the early 1990s (Dominion Energy 2023b).

A similar government-to-government consultation was conducted between BOEM and the Upper Mattaponi Indian Tribe and the Nansemond Indian Nation because the Tribes expressed concern on the potential impacts on the striped bass. Dominion Energy (2023c) indicated that offshore wind construction and operation activities are not likely to significantly affect anadromous fish populations, and it is unlikely the CVOW Project would have detectable or observable population level effects on Chesapeake Bay striped bass populations including those in the York or James Rivers.



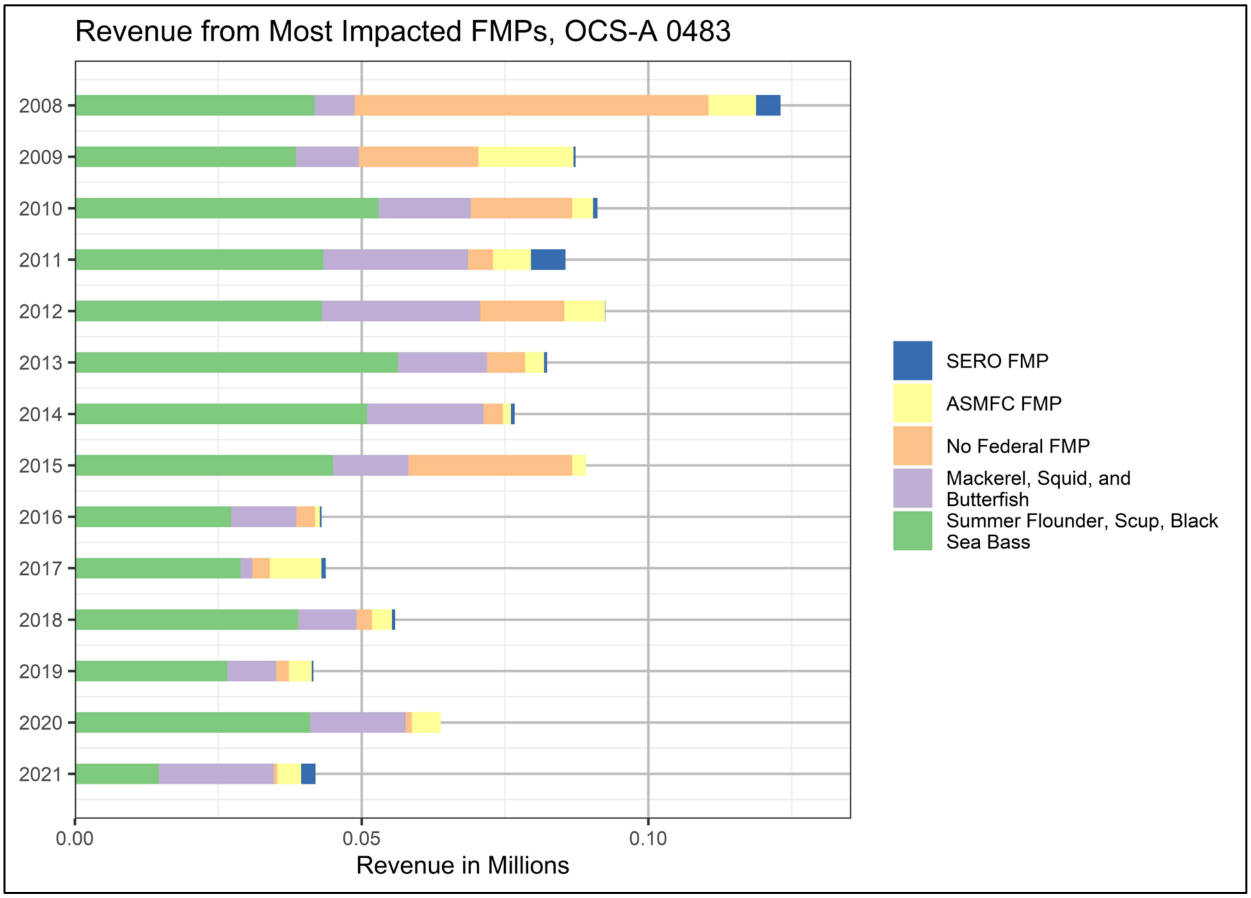
Source: NMFS 2021b.

Figure 3.9-3 Landings from the Most Affected FMPs in the Offshore Project Area, 2008–2021

Table 3.9-2 Landings and Revenue for the Most Affected FMPs in the Offshore Project Area, 2008–2021

FMP Fishery	2008–2021 Landings (Pounds)	2008–2021 Revenue (2021 dollars)
Mackerel, Squid, Butterfish	339,000	$205,000
Summer Flounder, Scup, Black Sea Bass	162,000	$549,000
ASMFC FMP	68,000	$76,000
No Federal FMP	62,000	$171,000
SERO FMP	5,000	$17,000
Total	**636,000**	**$1,018,000**

Adapted from: NMFS 2021b.
ASMPC FMP includes American lobster, cobia, Atlantic croaker, black drum, red drum, menhaden, NK sea bass, NK seatrout, spot, striped bass, tautog, Jonah crab, and pandalid shrimp. SERO FMP includes amber jack, brown shrimp, dolphinfish, greater amberjack, grouper, grunts, hogfish, king mackerel, long tail grouper, NK porgy, penaeid shrimp, red grouper, red hind, red porgy, red snapper, rock hind, sand tilefish, scamp grouper, snapper, snowy grouper, spadefish, Spanish mackerel, speckled hind, spiny American lobster, triggerfish, vermillion snapper, wahoo, wreckfish, yellowedge grouper.

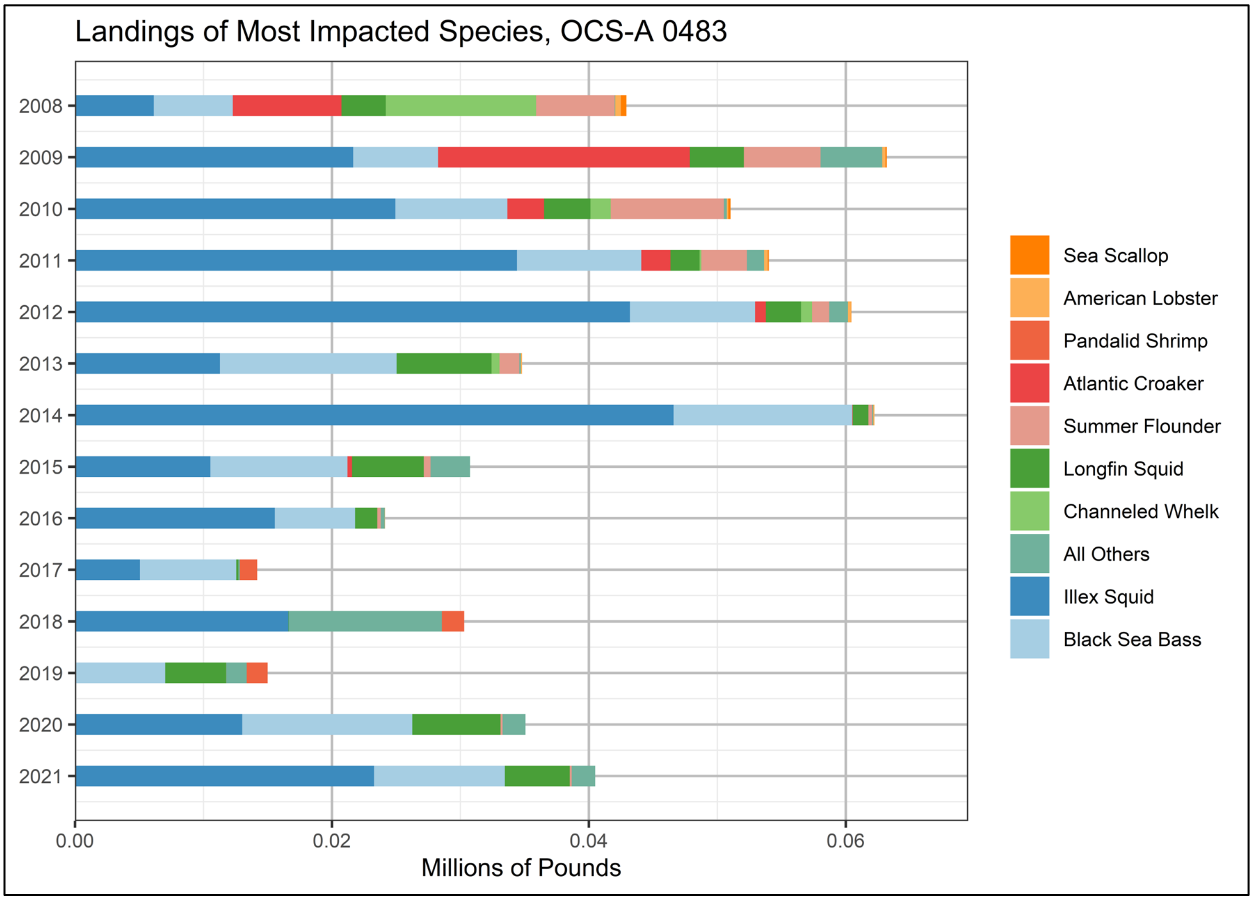


Source: NMFS 2021b.

Figure 3.9-4 Revenue (2021 Dollars) from the Most Affected FMPs in the Offshore Project Area, 2008–2021

NMFS (2021b) also presents information on other affected FMPs in the Project area, including bluefish, highly migratory species, monkfish, Northeast multispecies, sea scallop, skates, small-mesh multispecies, spiny dogfish, and tilefish. Landings for these species were relatively small, with the largest being 3,000 pounds for bluefish. Collectively, the 14-year (2008 to 2021) landings were approximately 10,500 pounds with an associated revenue of just $19,000.

The top 10 most affected species (by revenue) in the Project area from 2008 to 2021 were black sea bass, channeled whelk, *Illex* sp. squid, channeled whelk, longfin squid, summer flounder, pandalid shrimp, Atlantic croaker, red crab, all others, and brown shrimp. The “all others” category refers to species with less than three permits or dealers affected to protect data confidentiality. Landings of the most affected species between 2008 and 2021 are presented in Figure 3.9-5 and Table 3.9-3; revenue (in 2021 dollars) is presented in Figure 3.9-6 and Table 3.9-3. Overall, *Illex* sp. squid had the most landings, with 272,000 pounds over 14 years. However, the revenue was highest for black sea bass ($452,000), with *Illex* sp. squid in second place. (NMFS 2021b). Notably, landings and revenue reported in Table 3.9-3 were likely affected by COVID-19 closures in 2020 and 2021. Typical 14-year landings and revenue are likely somewhat higher than reported, especially for species such as channeled whelk, which has limited reporting requirements.



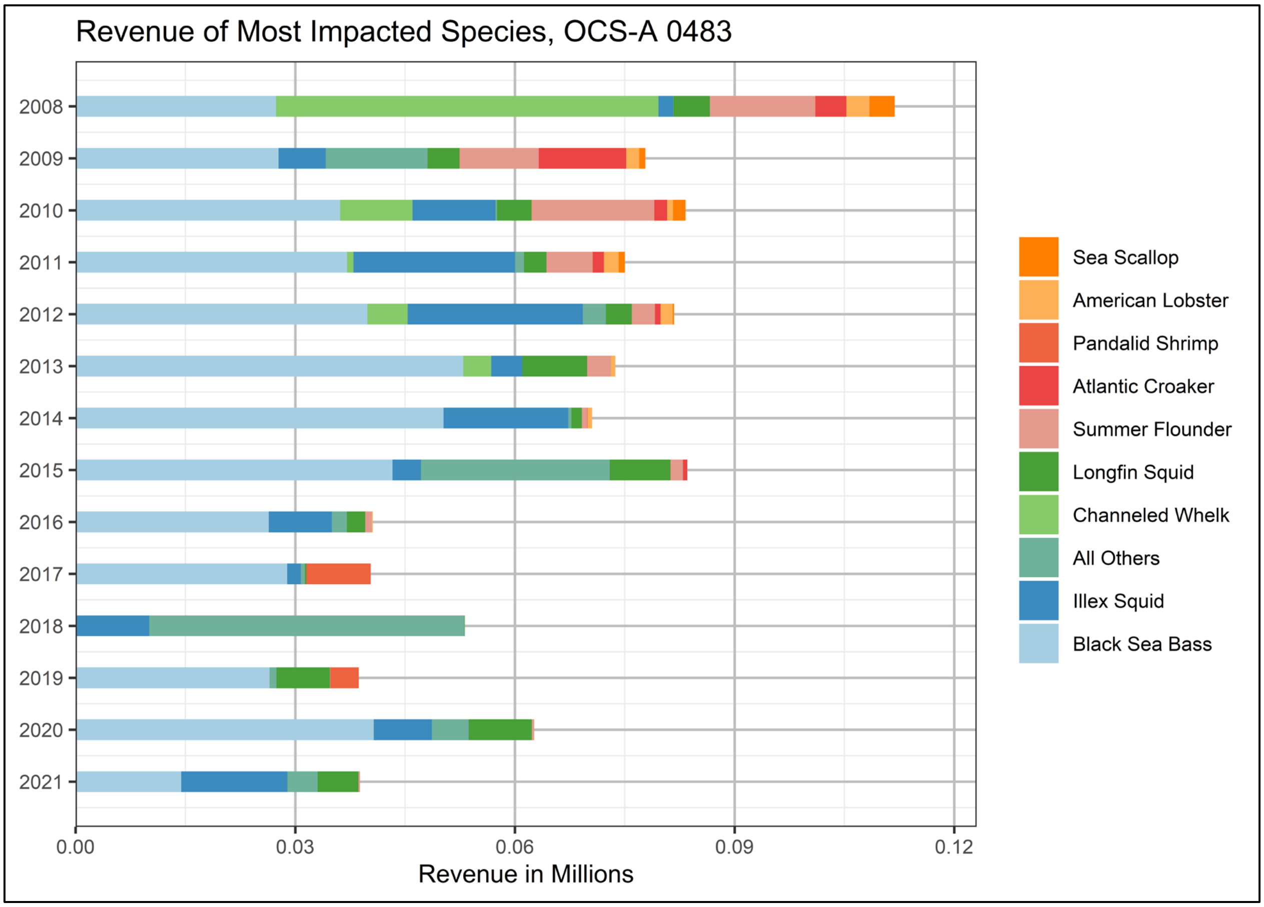
Source: NMFS 2021b.

Figure 3.9-5 Landings from the Most Affected Species in the Offshore Project Area, 2008–2021

Table 3.9-3 Landings and Revenue for the Most Affected Species in the Offshore Project Area, 2008–2021

Species	2008–2021 Landings (Pounds)	2008–2021 Revenue (2021 dollars)
Illex Squid	272,000	$134,000
Black Sea Bass	123,000	$452,000
Longfin Squid	49,000	$64,000
Atlantic Croaker	34,000	$21,000
Summer Flounder	29,000	$59,000
All Others	29,000	$101,000
Channeled Whelk	15,000	$72,000
Pandalid Shrimp	5,000	$13,000
American Lobster	2,000	$11,000
Sea Scallop	1,000	$7,000
Total	**559,000**	**$932,000**

Adapted from: NMFS 2021b.



Source: NMFS 2021b.

Figure 3.9-6 Revenue from the Most Affected Species in the Offshore Project Area, 2008–2021

NMFS (2021b) also analyzed fishing gear types used in the Project area. Both landings and revenue were dominated by bottom trawling and pot-other (i.e., non-lobster pots). Total landings (from 2008 to 2021) totaled 444,000 pounds for bottom trawl and 173,000 pounds for pot-other, with the associated 14-year revenue totaling $360,000 for bottom trawl and $587,000 for pot-other. Other gear types such as gillnet, handline, pot-lobster, and dredge-scallop all had 14-year landings totals of 10,000 pounds or less and revenue of $9,000 or less.

The total number of commercial fishing trips and vessels has decreased in recent years, dipping to a low of 111 trips and 34 vessels in 2018. Table 3.9-4 presents the number of trips and vessels operating in the Project area from 2008 to 2021. For 2021, black sea bass was the most targeted species by vessel trips (38), while the largest number of vessels (11) were devoted to the longfin squid fishery (Table 3.9-5).

Table 3.9-4 Number of Vessel Trips and Vessels in the Offshore Project Area, 2008–2021

Year	Number of Trips	Number of Vessels
2021	136	39
2020	171	53
2019	116	39
2018	111	34
2017	132	40

Year	Number of Trips	Number of Vessels
2016	159	49
2015	191	44
2014	212	41
2013	235	53
2012	251	63
2011	345	83
2010	415	101
2009	426	112
2008	449	83

Source: NMFS 2021b.

Table 3.9-5 Number of Vessel Trips and Vessels by Species in the Offshore Project Area, 2021

Species	Number of Trips	Number of Vessels
Angler	6	4
Black Sea Bass	38	4
Bluefish	8	7
Butterfish	4	3
Illex Squid	27	7
John Dory	7	5
Longfin Squid	21	11
Pandalid Shrimp	11	8
Penaeid Shrimp	9	6
Silver Hake	4	3
Summer Flounder	8	6
Swordfish	8	4

Source: NMFS 2021b.

The ports in Table 3.9-6 were estimated by NMFS (2021b) as being the top 10 most affected from commercial fishing that occurs in the Project area. The port with the highest 14-year (2008 to 2021) revenue was Virginia Beach, Virginia, with a total landings revenue of $542,000. Fourteen-year revenue from other ports ranged from $18,000 (Norfolk, Virginia) to $95,000 (North Kingstown, Rhode Island). The states with the highest landings from the Lease Area are Virginia (304,000 pounds) and Rhode Island (242,000 pounds), valued at $732,000 and $154,000, respectively (Table 3.9-7).

Table 3.9-6 Most Affected Ports and Revenue for Commercial Fishing in the Offshore Project Area

Port	2008–2021 Revenue (2021 dollars)
Virginia Beach, Virginia	$542,000
North Kingstown, Rhode Island	$95,000
Newport News, Virginia	$55,000
Davisville, Rhode Island	$53,000
Chincoteague, Virginia	$51,000
Hampton, Virginia	$48,000

Port	2008–2021 Revenue (2021 dollars)
Wanchese, North Carolina	$41,000
Cape May, New Jersey	$41,000
Engelhard, North Carolina	$33,000
Norfolk, Virginia	$18,000

Source: NMFS 2021b.

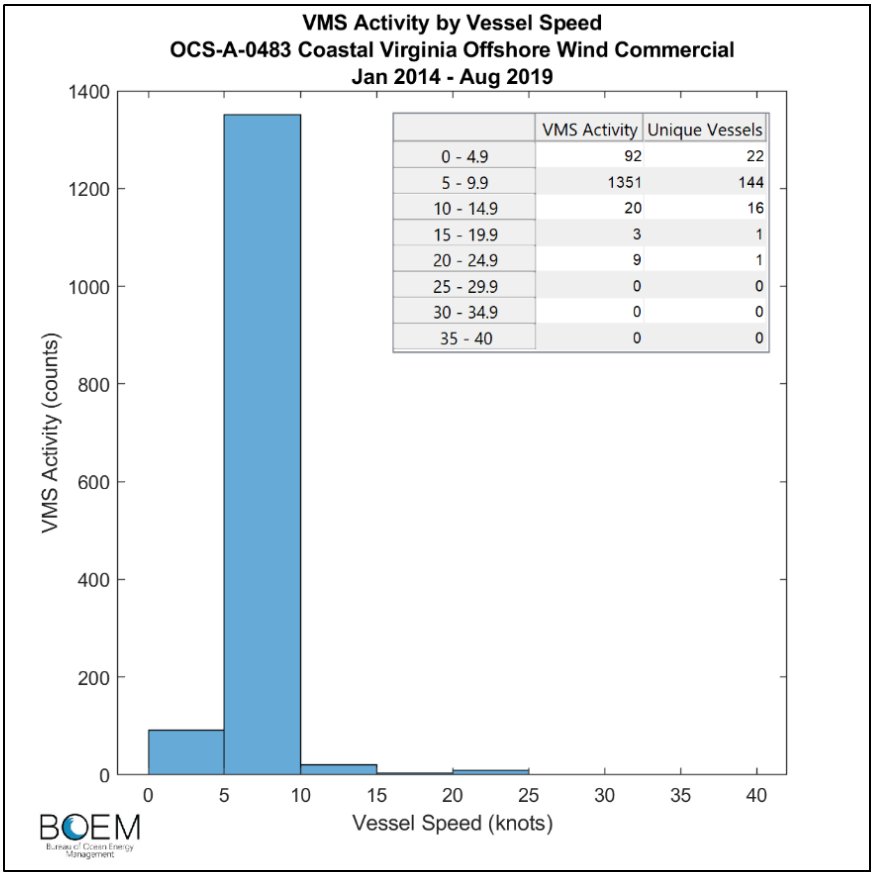
Table 3.9-7 Commercial Fishing Revenue Exposed to the Wind Farm Area by State Based on Annual Average Revenue, 2008–2021

State	Lease Area Landings (Pounds)	Lease Area Annual Average Revenue (2020 Dollars)
Virginia	304,000	732,000
Rhode Island	242,000	154,000
New Jersey	68,000	98,000
North Carolina	50,000	43,000
Massachusetts	14,000	19,000
New York	4,000	3,000
Maryland	2,000	3000
All others	<$500	<$500

Source: NMFS 2023a.

Commercial fishing regulations include requirements for VMS. A VMS is a satellite surveillance system that monitors the location and movement of commercial fishing vessels; therefore, it is a good data source for understanding the spatial distribution of fishing vessels engaged in FMP fisheries in the Northeast (Greater Atlantic) region. However, VMS coverage is not universal for all fisheries, with some fisheries (summer flounder, scup, black sea bass, bluefish, American lobster, spiny dogfish, skate, whiting, and tilefish) not covered at all by VMS. While vessels in these fisheries are not required to use VMS, they may also have fishing permits that require the use of VMS under other fishery management plans (e.g., scallops, squid). In 2018, there were 912 VMS-enabled vessels operating in the Northeast across all fisheries. These 912 vessels represented a substantial portion (71–87 percent) of summer flounder, scup, black sea bass, and skate landings, and greater than 90 percent of landings for scallops, squid, monkfish, herring, mackerel, large mesh multispecies, whiting, surfclams, and ocean quahogs. Therefore, VMS data provide a moderate level of coverage for depicting vessel operations, even for fisheries where VMS is not required.

Using VMS data conveyed in individual position reports (pings) from January 2014 to August 2019, BOEM compiled information about fishing activities within the Lease Area (NMFS 2019). From the VMS data, it is interpreted that vessels with speeds less than 5 knots (2.6 m/s) are actively engaged in fishing, although vessels may also be using slower speeds to transit or be engaged in other activities such as processing at sea. Vessels traveling faster than 5 knots (2.6 m/s) are generally interpreted to be transiting. Figure 3.9-7 indicates that only about 12 percent of the 184 unique vessels identified operating in the Lease Area during the above-referenced period were actively fishing. BOEM also developed polar histograms using the VMS data that show the directionality of VMS-enabled vessels operating in the Project area and the targeted FMP fishery (Figure 3.9-8 through Figure 3.9-12). The larger bars in the polar histograms represent a greater number of position reports showing fishing vessels moving in a certain direction within the Project area. The polar histograms differ with respect to their scales.

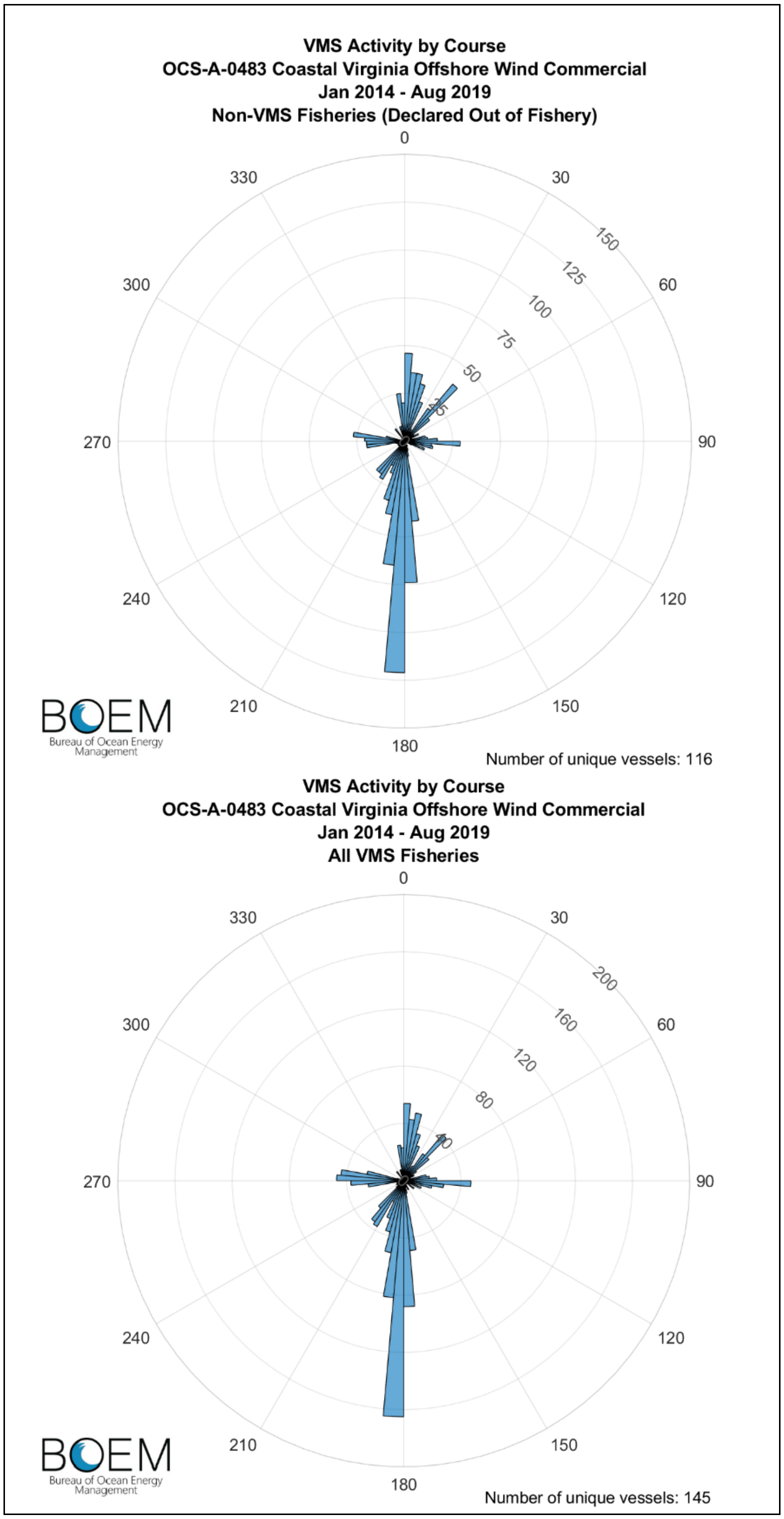


Source: Developed by BOEM using VSM data provided by NMFS (2019).

Figure 3.9-7 VMS Activity and Unique Vessels Operating in the Lease Area, January 2014–August 2019

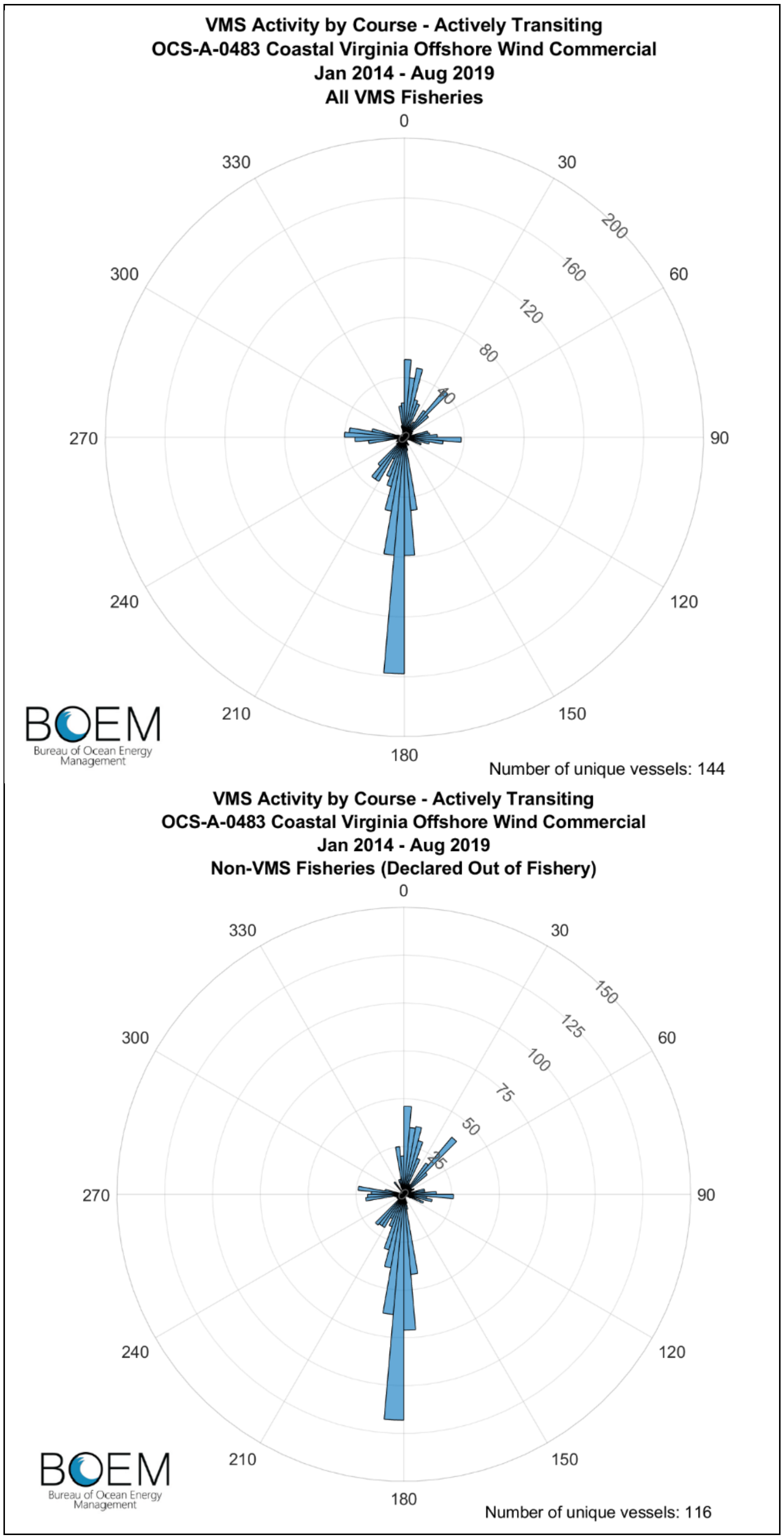
Figure 3.9-8 shows that for all activities (transiting and fishing combined), most of the 145 unique vessels participating in a VMS fishery, as well as vessels participating in a non-VMS fishery generally operated in a north–south pattern with a secondary pattern of east–west, Figure 3.9-9 shows that VMS fishery and non-VMS fishery vessels transiting the Lease Area also followed a primarily a north–south pattern with a secondary pattern of east–west. Figure 3.9-10 shows that most of the unique VMS fishery and non-VMS vessels actively fishing in the Lease Area showed no discernable pattern of orientation.

For individual FMP fisheries, Figure 3.9-11 shows that the orientation of vessels transiting the Lease Area generally followed a north–south pattern. Figure 3.9-12 shows only a single VMS vessel in the Squid, Mackerel, and Butterfish FMP Fishery was recorded in the Lease Area between January 2014 and August 2019.



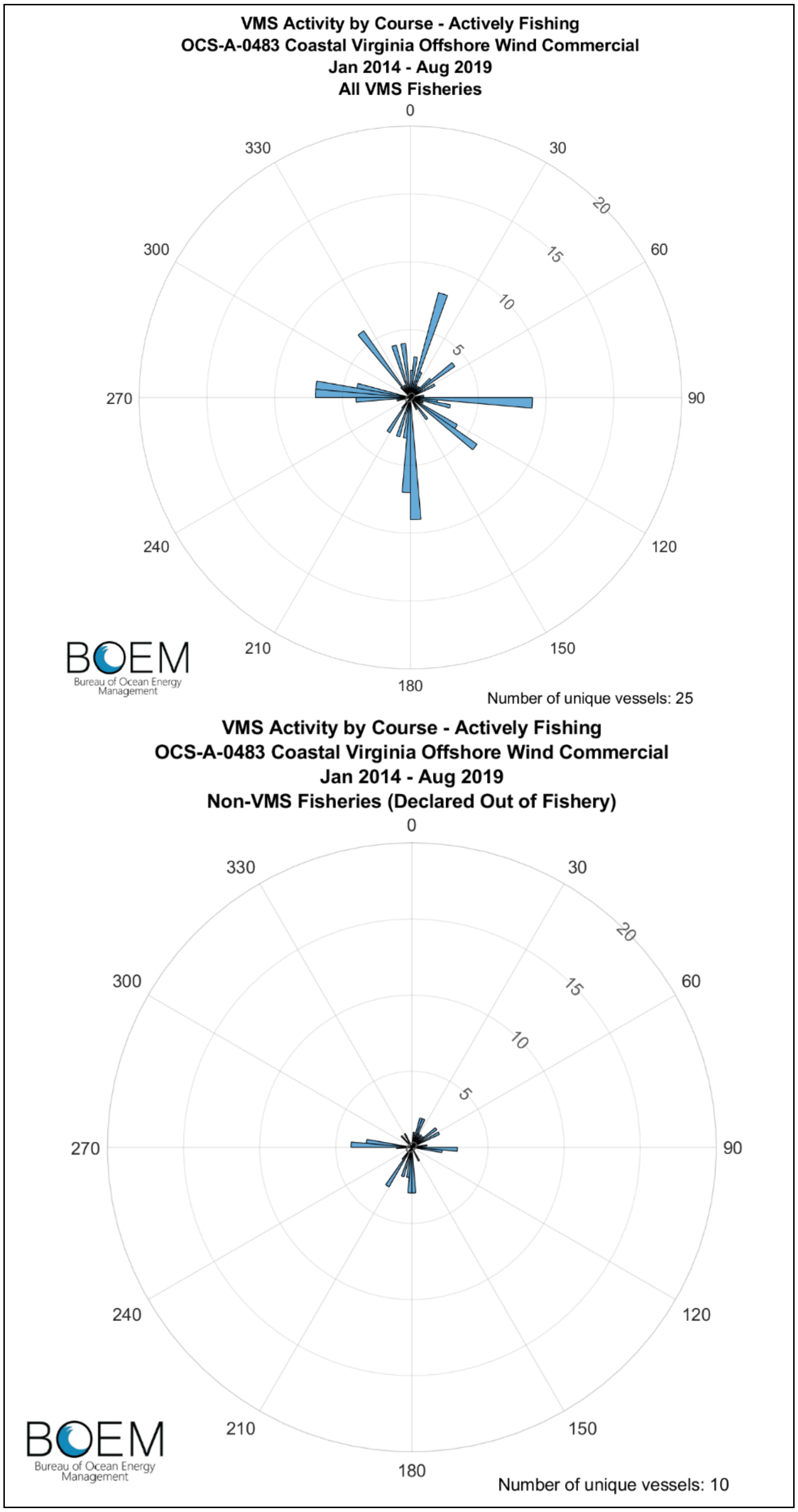
Source: Developed by BOEM using VSM data provided by NMFS (2019).

Figure 3.9-8 VMS Bearings for All Activity of VMS and Non-VMS Fisheries in the Lease Area, January 2014–August 2019



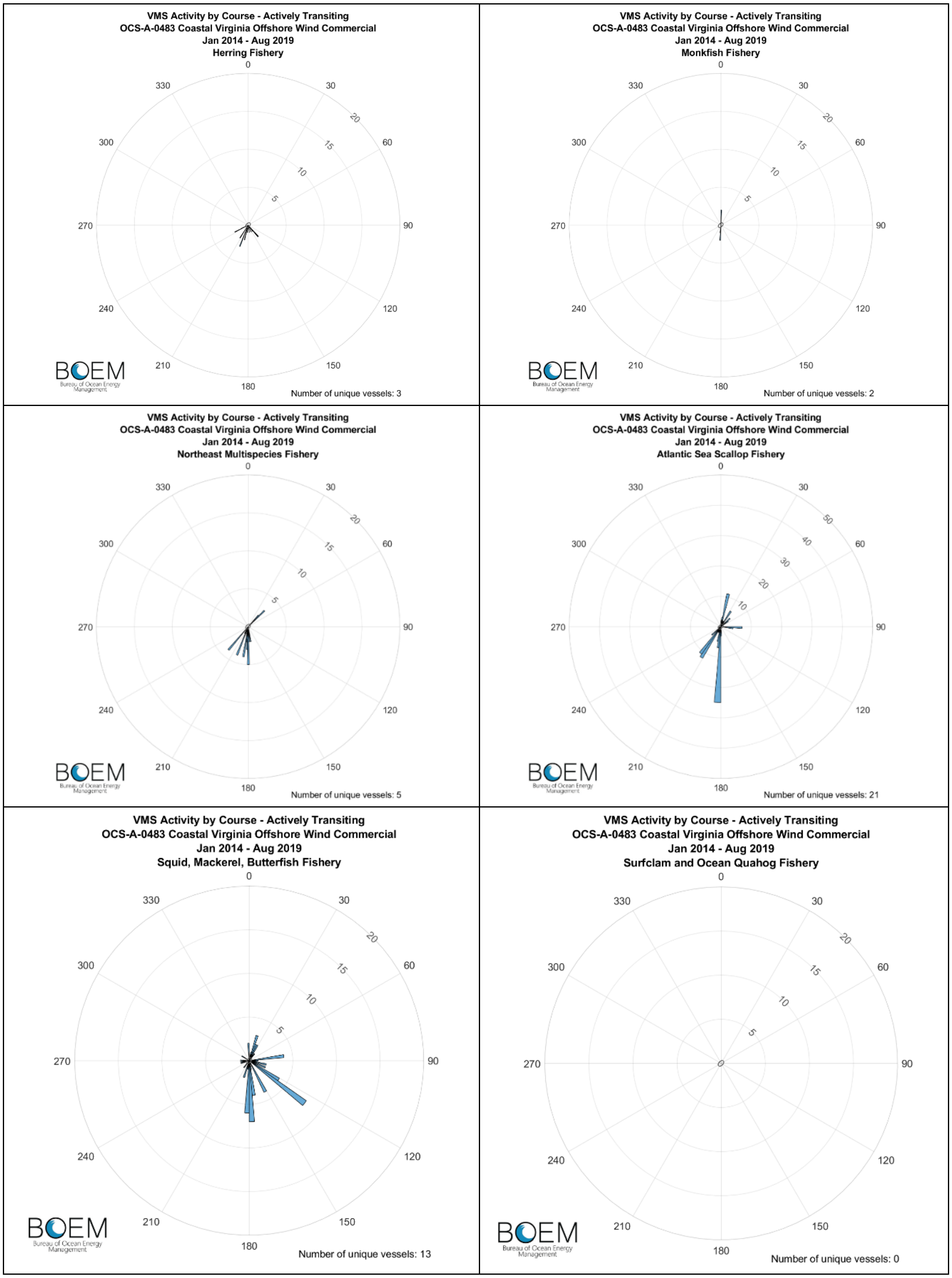
Source: Developed by BOEM using VSM data provided by NMFS (2019).

Figure 3.9-9 VMS Bearings for Transiting VMS and Non-VMS Fisheries in the Lease Area, January 2014–August 2019



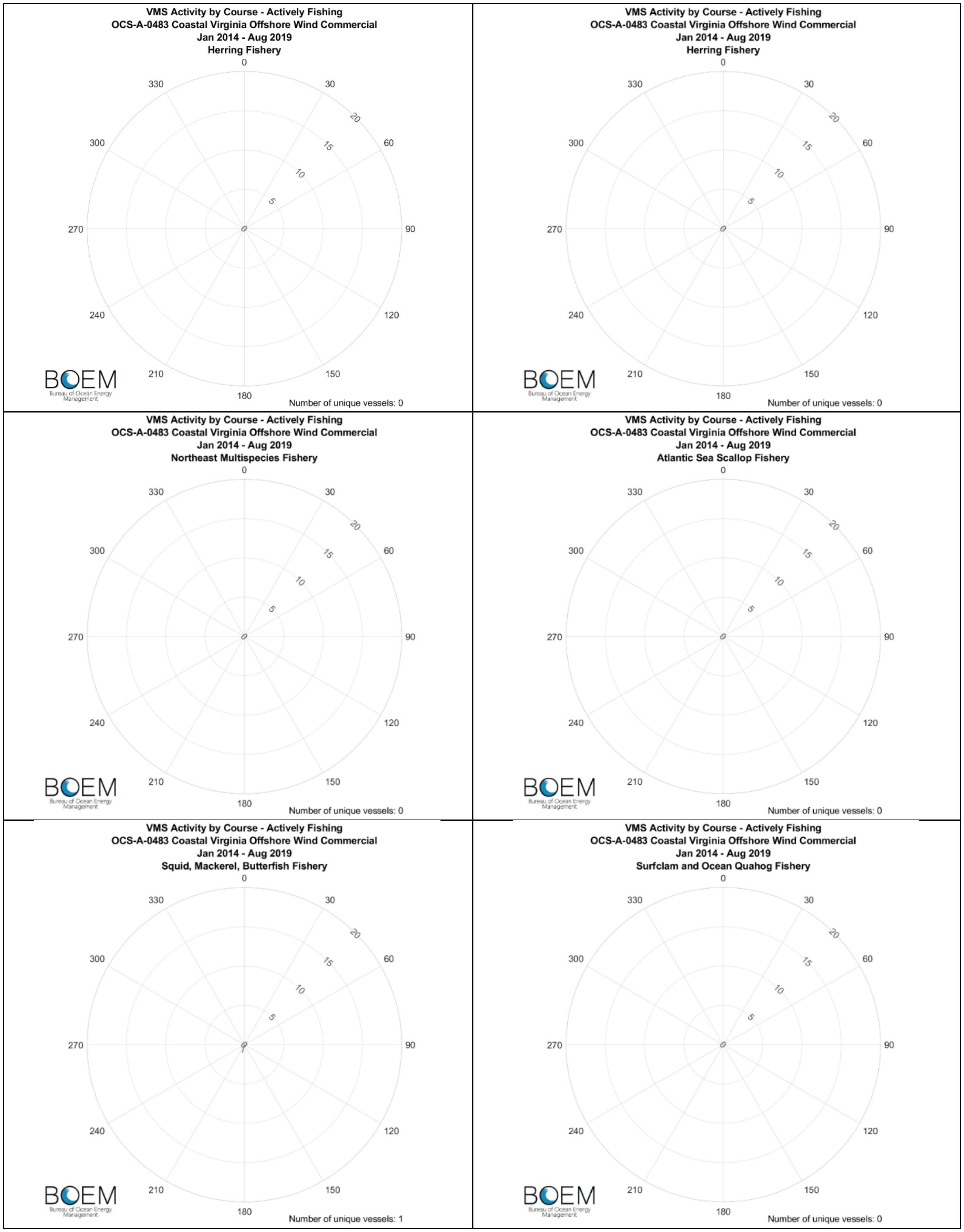
Source: Developed by BOEM using VSM data provided by NMFS (2019).

Figure 3.9-10 VMS Bearings for Fishing VMS and Non-VMS Fisheries in the Lease Area, January 2014–August 2019



Source: Developed by BOEM using VSM data provided by NMFS (2019).

Figure 3.9-11 VMS Bearings for Vessels Transiting the Lease Area by FMP Fishery, January 2014–August 2019



Source: Developed by BOEM using VSM data provided by NMFS (2019).

Figure 3.9-12 VMS Bearings for Vessels Actively Fishing in the Lease Area by FMP Fishery, January 2014–August 2019

To characterize the amount of commercial fishing revenue from the Lease Area that is generated by small businesses, NMFS conducted a small business analysis. The analysis defined a small business as a business that is independently owned and operated, is not dominant in its field of operation (including its affiliates), and has combined annual receipts not in excess of $11 million for all of its affiliated operations worldwide. The analysis was conducted on unique business interests, which can represent multiple vessel permits. The number of small businesses changes over time both because of changes in affiliated ownership and fluctuations in revenue. For this reason, the small business analysis report includes only the most recent 3 years' revenue, consistent with historical guidance provided by the Small Business Administration (NMFS 2023a). Both in the Northeast region and the Lease Area, there are more small businesses operating than large businesses.

The number of small and large businesses engaged in federally managed fishing and the revenue of those businesses from 2019 through 2021 are summarized for the geographic analysis area in Table 3.9-8 and for the Lease Area in Table 3.9-9. During this 3-year period, an annual average of 1,166 businesses fished in the geographic analysis area, of which 1,155 (99 percent) were small businesses and 11 (1 percent) were large businesses. Businesses engaged in fishing in the geographic analysis area generated an annual average revenue of more than $1 billion, of which over $777 million (77 percent) was attributed to small businesses and $232 million (23 percent) was attributed to large businesses. During this same time period, an annual average of 34 businesses, of which 30 (88 percent) were small businesses and 4 (12 percent) were large businesses, fished in the Lease Area. Businesses generated an annual average revenue of $272,000 in the Lease Area, of which $239,000 (88 percent) was attributed to small businesses and $33,000 (12 percent) was attributed to large businesses. Small businesses that fished inside the Lease Area generated 0.083 percent of their total revenue from the Lease Area, while large businesses that fished inside the Lease Area generated 0.483 percent of their total revenue from the Lease Area, demonstrating that large businesses were more reliant on revenue generated from the Lease Area.

Table 3.9-8 Number and Revenue of Small and Large Businesses Engaged in Federally Managed Fishing in the Geographic Analysis Area, 2019–2021

Year	Business Type	Number of Entities	Revenue (dollars)[1]
2019	Large Business	11	247,928,000
2019	Small Business	1130	799,249,000
2020	Large Business	11	200,342,000
2020	Small Business	1144	684,526,000
2021	Large Business	11	248,437,000
2021	Small Business	1190	849,039,000
Annual Average	Large Business	11	232,236
Annual Average	Small Business	1155	777,605

Source: Developed using data from NMFS 2023a.
[1] Revenue values have been delated to 2021 dollars and rounded to the nearest thousand.

Table 3.9-9 Number and Revenue of Small and Large Businesses Inside the Lease Area Compared to the Total Revenue of those Businesses, 2019–2021

Year	Business Type	Number of Entities	Revenue From Lease Area (thousands of dollars)[1]	Revenue (thousands of dollars)[1]	Percentage of Revenue from Lease Area
2019	Large Business	3	6	66,348	0.009
2019	Small Business	28	36	55,262	0.065
2020	Large Business	5	10	89,084	0.110
2020	Small Business	36	57	56,505	0.100
2021	Large Business	3	17	63,908	0.026
2021	Small Business	27	37	43,331	0.085
Annual Average	Large Business	4	11	73,113	0.483
Annual Average	Small Business	30	43	51,699	0.083

Source: Developed using data from NMFS 2023a.
[1] Revenue values have been delated to 2021 dollars and rounded to the nearest thousand.

3.9.1.4 For-Hire Recreational Fisheries in the Lease Area

For-hire recreational fishing in and around the Project area occurs year-round, with the majority of charter trips occurring from April through October. The for-hire recreational fishing industry in Virginia and North Carolina is primarily made up of small- to medium- sized (i.e., 25- to 50-foot [8- to 15-meter]) vessels that are chartered for half-day or full-day trips. The majority of chartered fishing vessels originating from coastal Virginia operate out of the Rudee and Lynnhaven inlets in Virginia Beach and out of various small inlets on the Virginia Eastern Shore. In North Carolina, recreation fishing charters operate out of various ports along the Outer Banks and in and along coastal towns in the Pamlico and Albemarle Sounds.

Recreational fishers use the Lease Area both as a targeted fishing location (primarily the Triangle Reef in the northern portion of the Lease Area), but also as a transit corridor to access offshore fishing along the continental shelf break (COP, Section 4.4.6.2; Dominion Energy 2023a). Highly migratory species are the primary target within the Lease Area, including tuna, various billfish (e.g., blue marlin [*Makaira nigricans*]), and tilefish. However, there is a lack of spatially precise data on for-hire recreational fishing locations. Targeted species for for-hire recreational fishing trips originating in North Carolina and Virginia, as well as offshore recreational fishing tournaments typically occurring in late summer (COP, Section 4.4.6.2; Dominion Energy 2023a).

3.9.1.4.1 Target Species

Recreational fisheries in Virginia recorded considerable landings of spot (*Leiostomus xanthurus*), Atlantic croaker, cobia, spotted sea trout (*Cynoscion nebulosus*), black seabass, Spanish mackerel (*Scomberomorus cavalla*), southern kingfish (*Menticirrhus americanus*), red drum, bluefish, and other species. Species that yielded large recreational catches in the geographic analysis area in 2019 or 2020 include striped bass, yellowfin tuna (*Thunnus albacares*), scup, bluefish, summer flounder, black seabass, tautog, dolphinfish, bluefin tuna (*T. thynnus*), spotted seatrout, and other species (NOAA 2021b). The most commonly targeted species in 2019 in Virginia from charter boats were tunas and mackerels, whereas in North Carolina, dolphinfish was the most common (as ranked by the number of individuals fishing; Table 3.9-10) (COP, Section 4.4.6.2; Dominion Energy 2023a).

Table 3.9-10 Recreational Saltwater Catch (Number of Individuals) in Virginia and North Carolina in 2019

Virginia–2019 Total Catch			
Species Group	**Charter Boat**	**Party Boat**	**Private/ Rental Boat**
Bluefish	3,151	515	54,939
Cartilaginous fishes	33	336	24,872
Dolphins	3,805	0	20,706
Drums	1,525	64	361,794
Eels	1	12	0
Flounders	32	9	76,842
Grunts	0	143	37,081
Herrings	0	0	3,989
Jacks	0	61	127
Other fishes	8,240	53	59,067
Porgies	0	196	26,813
Puffers	0	31	1,390
Sea basses	0	25,140	383,749
Sea robins	0	10	1,964
Temperate basses	0	0	0
Toadfishes	0	43	1,983
Triggerfishes/ filefishes	14	548	3,806
Tunas and mackerels	28,672	3	318,388
Wrasses	0	42	7,557

North Carolina–2019 Total Catch		
Species Group	**Charter Boat**	**Private/ Rental Boat**
Barracudas	1,782	29,406
Bluefish	52,957	987,758
Cartilaginous fishes	8,360	221,719
Catfishes	143	0
Cods and hakes	58	0
Dolphins	163,998	329,374
Drums	13,957	640,036
Eels	71	0
Flounders	1,007	101,095
Grunts	14,863	182,364
Herrings	54	257,257
Jacks	12,432	111,499
Mullets	0	43,498
Other fishes	66,325	267,342
Porgies	9,379	298,993
Puffers	52	100,467
Sea basses	69,094	1,275,236

North Carolina–2019 Total Catch		
Species Group	**Charter Boat**	**Private/ Rental Boat**
Sea robins	0	4,439
Snappers	18,785	77,632
Temperate basses	129	1,286
Toadfishes	213	34,281
Triggerfishes/filefishes	53,377	14,745
Tunas and mackerels	194,071	1,203,473
Wrasses	118	679

Source: Dominion Energy 2023a.
Note: Virginia separates “Party Boat” from “Charter Boat”; North Carolina combines these.

At Triangle Reef specifically, commonly targeted species include tautog in the wintertime, sea bass throughout the year, and triggerfish (Balistidae) and flounder in the summer, but numerous species of fish and sharks can be caught throughout the year (Young n.d.). In the broader geographic analysis area, recreational fisheries target a variety of species including highly migratory species (e.g., tunas, dolphinfish, wahoo), sharks, flounders, black seabass, Atlantic cod, haddock, pollock, scup). While the majority of for-hire recreational fishing effort is concentrated in nearshore coastal areas, a substantial portion of charter fishing effort overlaps with offshore wind lease areas (Figure 3.9-1). The Dominion Energy *CVOW-C American Eel Analysis* (2023b) noted that the American eel is an important species for recreational fishing as it is often used as bait for other game species.

Recreational saltwater fishing tournaments are likely dominated by private recreational fishing, which is discussed in Section 3.18, *Recreation and Tourism,* and examples are presented in COP Table 4.4-25 (Dominion Energy 2023a), but some for-hire activities may occur. Target species vary by tournament, but generally consist of HMS including marlins, spearfish, swordfish, and tunas; example HMS tournaments are presented in COP Table 4.4-25 (Dominion Energy 2023a). However, numerous other tournaments occur annually in the geographic analysis area targeting a wide variety of species that may attract some for-hire recreational fishing activities.

3.9.1.4.2 Gear Type

Fishing techniques used on for-hire recreational fishing vessels fishing in and around the Project area vary by target species, but include trolling, jigging, spinning, deep-dropping, spearfishing, and shellfishing (VMRC n.d.). In the Project area, spearfishing is common and is usually conducted by divers at offshore structures. Spearfishing activity has been noted at the CVOW-Pilot Project turbines and it is expected that if the full array of WTGs are installed in the Project area, spearfishing activity would likely increase.

3.9.1.4.3 Economic Value

For-hire recreational fisheries also generate revenue for coastal communities through the need for goods and services (e.g., dockage, tackle and other equipment, meals, lodging, vessel repairs). In 2018, the for-hire recreational fishery sector in Virginia supported 116 jobs and generated $10.9 million in sales, $3.6 million in income, and $6.5 million in added value to the community (NMFS 2021c).

Recreational saltwater fishing tournaments also significantly contribute to local and regional economies. Participants in tournaments spend money on food, fuel, lodging, fishing gear and bait, as well as rental/charter vessels. Tournament operators have reported an average net return per tournament of $16,045, with each participating team spending on average $13,360 per tournament (Hutt and Silva 2019). However, as previously noted, the extent to which for-hire recreational fishing contributes to recreational saltwater tournament economic value is likely limited.

NMFS conducted a small business analysis for businesses primarily engaged in for-hire recreational fishing. The business is classified as a small business if the activities are independently owned and operated, is not dominant in its field of operation (including its affiliates), and has combined annual receipts not in excess of $8 million for all its affiliated operations worldwide. This includes unique business opportunities, which can represent multiple vessel permits. The number of small business entities and revenue show an increasing trend (Table 3.9-11) in the northeast region of the geographic analysis area, noting that the COVID-19 pandemic had an impact on passenger demand for party/charter trips, resulting in unusually low number of angler trips; hence reduced revenues from passenger fees for affected party/charter entities (NMFS 2023b). There is not sufficient data to estimate small business revenue inside the Lease Area compared to the total revenue of those outside the Lease Area. However, the average annual party/charter revenue from 2008–2021, excluding the years 2009, 2010, 2017, and 2019 where data was suppressed, in the Lease Area was $61,300 (NMFS 2023b).

Table 3.9-11 Number and Revenue of Small Businesses Engaged in Federally Managed For Hire and Recreational Fisheries in the Geographic Analysis Area, 2019–2021

Year	Business Type	Number of Entities	Revenue (dollars)[1]
2019	Small Business	319	71,987,000
2020	Small Business	332	82,995,000
2021	Small Business	409	107,933,000

Source: NMFS 2023a.
[1] Revenue values have been deflated to 2019 dollars and rounded to the nearest thousand.

3.9.1.5 Current Trends

Commercial fisheries and for-hire recreational fishing in the geographic analysis area are subject to pressure from ongoing activities, including regulated fishing effort, changes in fisheries management strategies (e.g., implementation of catch-share programs), vessel traffic, and climate change. Fisheries management impacts commercial fisheries and for-hire recreational fishing in the region through management of sustainable fish stocks and measures to reduce impacts on important habitat and protected species. These management plans include spatial and temporal-based measures such as regulated fishing seasons, rotational management areas, and closed areas. The management plans also include effort-based management measures such as limitations on days-at-sea and quota allocation on a species level or on individual fishermen/vessels. These management measures constrain how the fisheries operate and adapt to change, may reduce or increase the size of available landings to commercial and for-hire recreational fisheries, and incentivize the consolidation of commercial fleets (Kuriyama et al. 2019). Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale by 60 percent (McCreary and Brooks 2019). This, coupled with management measures aimed at rebuilding severely depleted lobster stocks in southern New England, may influence fishing effort in the lobster and Jonah crab (*Cancer borealis*) fisheries in the geographic analysis area south of Cape Cod, Massachusetts, but it should be noted that these areas are relatively far removed from the Project area.

Impacts on commercial and for-hire recreational fishing industries also occurred from the recent COVID-19 pandemic, which led to the cancellation of numerous fisheries-independent surveys and a 16-month suspension of data collection mechanisms such as the Northeast observer program. COVID-related restrictions on travel, declines in consumer demand, and labor shortages in many direct and support services also had a marked impact on commercial and for-hire recreational fisheries (NOAA 2021b; Grabowski and Scyphers 2020).

Climate change is also predicted to affect Northeast and Mid-Atlantic fishery species and fishing communities (Hare et al. 2016; Rogers et al. 2019). Impacts may affect local and regional commercial and for-hire fisheries differently. For example, some commercially and recreationally important species may be subject to increases or decreases in available habitat and shifts in distribution. The ability of fisheries regulatory bodies to adapt to these changes quickly may have a direct influence on the health and sustainability of certain fish and shellfish stocks. Changing environmental and ocean conditions (currents, water temperature, etc.), increased storm magnitude or frequency, and shoreline changes can affect fish distribution, populations, and availability to commercial and for-hire recreational fisheries. See Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, for impacts on finfish, invertebrates, and essential fish habitat. Sea level rise and storm intensity may also have a direct effect on coastal infrastructure available to commercial and recreational fisheries. Impacts from other ongoing activities, including structures such as existing cables and pipelines, have been largely mitigated through burial of the infrastructure, but remain a consideration.

3.9.2 Environmental Consequences

3.9.2.1 Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

Definitions of impact levels are provided in Table 3.9-12.

Table 3.9-12 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 on the affected activity or community would be avoided and 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 a condition with no measurable effects.
	Beneficial	Small or measurable effects that would result in an economic improvement.
Moderate	Adverse	Impacts on the affected activity or community are unavoidable. The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the Project or, once the affecting agent is eliminated, the affected activity or community would return to a condition with no measurable effects if proper remedial action is taken.
	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.

3.9.3 Impacts of the No Action Alternative on Commercial and For-Hire Recreational Fisheries

When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing non-offshore wind activities and other offshore wind activities. 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 F, *Planned Activities Scenario*.

3.9.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for commercial fisheries and for-hire recreational fishing described in Section 3.9.1, *Description of the Affected Environment for Commercial Fisheries and For-Hire Recreational Fishing*, 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 are contributing or may contribute to impacts on commercial fisheries and for-hire recreational fishing resources are generally associated with activities that limit the aerial extent of where fishing can occur such as tidal energy projects, military use, dredge material disposal, and sand borrowing operations; increased vessel congestion that can pose a risk for collisions or allisions; dredging and port improvements, marine transportation, and oil and gas activities; or activities that pose a risk for gear entanglement such as undersea transmission lines, gas pipelines, and other submarine cables. Existing undersea transmission lines, gas pipelines, and other submarine cables are generally indicated on nautical charts and may also cause commercial fishermen to avoid the areas to prevent the risk of gear entanglement. Some of these activities may also result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality, resulting in a less-productive fishery or causing some vessel operators to seek alternate fishing grounds, target a different species, or switch gear types.

Activities of NMFS and fishery management councils could affect commercial and for-hire recreational fisheries through stock assessments, setting quotas, and implementing fishery management plans 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 state, regional, or federal agencies may affect commercial fisheries and for-hire recreational fishing by modifying the nature, distribution, and intensity of fishing-related impacts.

Commercial and for-hire recreational fisheries would also be affected by 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.

The following ongoing offshore wind activities within the geographic analysis area contribute to impacts on commercial and recreational fishing.

- Continued O&M of the Block Island Project (five WTGs) installed in state waters.
- Continued O&M of the CVOW-Pilot Project (two WTGs) installed in OCS-A 0497.
- 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 Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect commercial and recreational fishing through the primary IPFs of noise, presence of structures, and cable emplacement and maintenance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.9.3.2, *Cumulative Impacts of the No Action Alternative*, for planned offshore wind activities but the impacts would be of lower intensity.

The No Action Alternative would forgo any current or planned fisheries monitoring that Dominion Energy has committed to voluntarily perform, the results of which could provide an understanding of the effects of offshore wind development in and around the Project area, benefit future management of commercial and for-hire fisheries, and inform planning of other offshore developments. However, other ongoing and future surveys could still provide similar data to support similar goals.

3.9.3.2 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).

Offshore wind development along the U.S. Atlantic coast is expected to result in over 3,287 turbine structures (WTG, OSS, and met towers) over the next 30 years Appendix F, Table F-3). BOEM expects offshore wind activities to affect commercial fisheries and for-hire recreational fishing through the following primary IPFs.

Anchoring: Anchoring could pose a localized (within a few hundred feet of anchored vessels), temporary (hours to days) navigational hazard to fishing vessels. There would be an increase in vessel anchoring during survey activities and during the construction and installation of offshore components as a result of offshore wind activities over the next 10 years. However, the location and level of these impacts would depend on specific locations and duration of activity, and the use of dynamic positioning vessels would lessen this impact. As specified in Appendix F, Table F2-2, BOEM assumes that up to 1,955 acres (7.9 square kilometers) of seafloor could be disturbed within the geographic analysis area as a result of anchoring during construction activities over the next 10 years. In addition, there could be increased anchoring associated with the installation of met towers or buoys. Anchoring impacts on finfish, invertebrates, and essential fish habitat are discussed in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, and impacts on navigation and vessel traffic are discussed in Section 3.16, *Navigation and Vessel Traffic*.

New cable emplacement and maintenance: This IPF could cause localized, short-term impacts including disrupting fishing activities during active installation and maintenance or periods during which the cable is exposed on the seabed prior to burial (if simultaneous lay and burial techniques are not used). As specified in Appendix F, Table F2-2, BOEM assumes over 130,145[1] acres (526.7 square kilometers) of seafloor could be disturbed within the geographic analysis area as a result of inter-array and export cable emplacement. Although the offshore wind projects listed in Appendix F are currently at various stages in the process, BOEM does anticipate some simultaneous emplacement activities. This will result in an actual disturbed footprint that will vary in scale and location over the course of the 10-year period. Fishing vessels may not have access to affected areas, in whole or in part, over various durations during the installation and operation period, which could lead to reduced revenue, displacement, or increased conflict over other fishing grounds. Cable preparatory work, including boulder relocation or boulder plow work, could result in changes to existing obstacles or creation of new obstacles that could cause fishing

[1] The Kitty Hawk Offshore Wind South Project has three export cables 57 miles (92 kilometers) to Virginia, 200 miles (322 kilometers) to North Carolina, and an additional 96 miles (154 kilometers) of inshore export cable to North Caroline) for a total of 352.9 miles (568 kilometers), and corridor widths between 1,520-mile (2,446-kilometer)-wide corridor to Virginia and 1,000-mile (1,609-kilometer)-wide corridors to North Carolina to allow for optimal routing of the cables.

gear loss or damage. Because most construction activities would likely take place in more favorable conditions (i.e., late spring through early fall), fisheries and fishery resources most active during that time period would likely be affected more than those in the winter (e.g., the longfin squid fishery). The localized commercial and for-hire recreational fishing industries proximal to the offshore export cable corridor (OECC) landing sites would also be disproportionately affected by emplacement activities.

Noise: Noise from construction, site assessment and monitoring geological and geophysical (G&G) survey activities, operations and maintenance, pile driving, trenching, and vessels could cause localized, temporary impacts on commercial fisheries and for-hire recreational fishing through direct effects on species (Popper and Hastings 2009). The most impactful noise on commercial fisheries and for-hire recreational fishing is expected to result from pile driving, which can cause behavioral changes, injury, and mortality (Popper et al. 2014). As discussed further in Section 3.13, modeling of a 36-foot (11-meter) diameter monopile, assuming 2,202 impact hammer strikes using a 4,000 kJ hammer with 10 dB of attenuation in approximately 91-foot (28-meter) water depth estimated that 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 (Appendix R-2; Ocean Wind 2022). Behavioral responses have been observed over larger ranges. 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, and that both species responded at a similar received level peak-to-peak sound pressure levels of 163 dB re 1 μPa, which could be expected tens of kilometers from the source. Work focusing on commercially important fish species like European seabass indicate they may change their dive depth, swim speed, and group cohesion when exposed to pile-driving noise (Neo et al. 2014, 2018; Herbert-Read et al. 2017). Overall, the available research suggests fishes are likely to exhibit short-term startle or physiological responses, but would recover quickly once pile-driving is complete. Noise impacts are also anticipated from operational WTGs. Elliot et al. (2019) compared field measurements during OSW operations from the Block Island Wind Farm to the published audiograms of a few fish species. They found that, even at 164 feet (50 meters) distance 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. There is no available information to suggest that such noise would negatively affect fishery resources on a broad scale (English et al. 2017); therefore, fishery-level impacts are unlikely in this context.

Port utilization: Ports are largely privately owned or managed businesses that are expected to compete against each other for offshore wind business. Major fishing ports in the geographic analysis area that have been identified as possible ports to support offshore wind energy construction and operations include New Bedford, Massachusetts; Hampton Roads, Virginia; Atlantic City and Ocean City, New Jersey; and Montauk, New York. Of those ports, only New Bedford and Hampton Roads have been identified as possible construction staging area ports. Other non-major fishing ports could also be used for operation and maintenance support. Port expansion and modification could have local, temporary impacts on commercial and for-hire fishing vessels in ports used for both fishing and offshore wind and other projects, and some displacement of available dockage may occur. Displacement and competition for port services could cause long-term adverse impacts for fishing vessels at ports that are affected by offshore wind construction or maintenance activities.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through fish aggregation, habitat conversion, allisions, displacement of certain vessels/gear types, entanglement or gear loss/damage, navigation hazards (including transmission cable infrastructure), alterations on fisheries management mechanisms, space use conflicts, and safety-related issues (e.g., hindering search and rescue). These impacts may arise from buoys, met towers, WTG foundations, OSSs, scour/cable protection, and transmission cable infrastructure. Using the assumptions in Appendix F, Tables F2-1 and F2-2, the expanded planned activities scenario would include over 3,135 WTGs, 4,592 acres (18.6 square kilometers) of WTG scour protection, and 2,684 acres (10.9 square kilometers) of new hard protection atop export and inter-array cables. Projects may also install additional buoys and met towers. BOEM anticipates that structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until conceptual decommissioning of each facility is complete.

Structures may alter the availability of targeted fish species in the immediate vicinity of the structures for commercial and for-hire recreational fishers. Structure-oriented fish such as black sea bass, striped bass, lobster, and cod may increase in areas where there was no previous structure (natural or artificial) (Claisse et al. 2014; Linley et al. 2007; Smith et al. 2016; Stevens et al. 2019). Highly migratory species may also be attracted to the wind turbine foundations (Fayram et al. 2007). Flatfish, clams, and squid species are likely to remain in open soft-bottom sandy areas, although offshore wind structures may act as substrate for larval settlement. Furthermore, altered community composition could change natural mortality of certain species due to predation (decrease) or refuge (increase), and increase competition between species, which could have beneficial and adverse effects, depending on the species (Langhammer 2012). These effects are not anticipated to result in stock-level impacts that would affect fisheries.

The presence of structures (including transmission cable infrastructure) would have long-term impacts on commercial fisheries and for-hire fishing by increasing the risk of allisions, entanglement or gear loss/damage, and navigational hazards. Although portions of cable infrastructure achieving target burial depths (4.9 to 9.8 feet [1.5 to 2 meters] below stable seabed elevation) would not likely pose a risk to vessels using mobile bottom-tending gear (Eigaard et al. 2015), the conversion of soft sediment to hard bottom via protective cover could negatively affect vessels fishing with bottom-tending mobile gear (e.g., dredges and trawls) by increasing the risk of snagging structure and the resultant vessel instability. The need to change vessel transit routes may also affect commercial and for-hire recreational fisheries by affecting travel time, fuel consumption, and overall trip costs. Certain sectors of the commercial fishing industry will likely be at higher risk operating within a WEA (e.g., mobile gear such as trawls and dredges) due to maneuverability and entanglement hazards, and the use of some gear types, such as longlining, may not be possible in wind energy lease areas where turbines are installed. Similar considerations also apply to fisheries-dependent and fisheries-independent surveys. Several long-standing fisheries surveys utilize mobile gear and have stations that will fall within offshore wind lease areas. These stations may need to be repositioned or non-standardized gear used, which will induce inconsistency in the data compared to the historical time series.

Space use conflicts could cause a temporary or permanent reduction in fishing activities and fishing revenue, as some displaced fishing vessels may not opt to, or may not be able to, fish in alternative fishing grounds. Potential increases in populations of structure-affiliated species (e.g., black sea bass) may result in an increase in for-hire recreational vessel trips in and around turbine structures. This may result in increased gear or space use conflicts as commercial fisheries and for-hire recreational fishing compete for space between turbines. Commercial fishing vessels, particularly those using mobile gear, which typically fish in areas designated as a Wind Farm Area may be displaced, and this relocation of fishing activity outside of offshore wind lease areas could increase conflict among commercial fishing interests as other areas are encroached. The competition is expected to be higher for less-mobile species such as lobster, crab, surfclam/ocean quahog, and sea scallop.

Table 3.9-13 shows the annual commercial fishing revenue exposed[2] to offshore wind energy development in the Mid-Atlantic and New England regions by FMP fishery from 2021 through 2030. However, it is only a lower-bound estimate of the maximum exposed revenue, as it is calculated using average historical revenue overlapping the WEAs and is based on vessel trip reporting data, which do not fully capture all fishery operations in the WEAs.

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 operational phases of the offshore wind energy projects. The largest impacts in terms of exposed revenue are expected to be in the sea scallop, other FMP, non-disclosed species, and non-FMP fisheries, and surfclam/ocean quahog FMP fisheries. The maximum exposed revenue is projected to occur in 2030, but exposure will continue to increase in years thereafter until facilities are decommissioned.

Of all the sub-IPFs identified herein, the presence of structures is likely to be the main mechanism of impacts on commercial and for-hire recreational fisheries. The presence of structures associated with offshore wind is anticipated to yield a variety of both positive and negative impacts on commercial and for-hire recreational fisheries, the extent of which are dependent on numerous factors. Additional details on the anticipated impacts on commercial and for-hire recreational fisheries in the geographic analysis area can be found in BOEM 2021a and 2021b.

Vessel traffic: Increased vessel traffic associated with offshore wind development could increase congestion, delays at ports, and the risk for collisions with fishing vessels. As stated in Section 3.16, *Navigation and Vessel Traffic*, offshore wind projects would result in a small incremental increase in vessel traffic, with a peak during surveys and construction over a 6- to 10-year period, particularly when offshore wind project construction activities overlap (Appendix F, Table F-4). The presence of construction vessels could restrict harvesting or other fishing activities in offshore wind lease areas and along cable routes during installation and maintenance activities.

Climate change: Climate change is affecting commercial fisheries and for-hire recreational fishing and is predicted to continue to do so over the course of this analysis. The primary driver of climate change-induced impacts on fisheries resources stems from an increase in sea surface and bottom temperature resulting in shifts in distribution, habitat utilization, and movement (Fabrizio et al. 2014; Hopkins and Cech 2003; Secor et al. 2018; Sims et al. 2001). Fish and invertebrate distribution in the Northeast and Mid-Atlantic have shifted markedly northward and into deeper waters over the past 35 years (NOAA 2022). These shifts in species distribution have changed, and will continue to change, the distribution of commercial fishing effort, impacting commercial and for-hire recreational fishermen and coastal communities (Hare et al. 2016; Rogers et al. 2019). Some species may benefit from warmer waters caused by climate change, which could result in benefits to commercial fisheries and for-hire recreational fishing. Ocean acidification, resulting from enriched levels of CO_2 in the marine environment, may impact growth and survival of many important crustacean and bivalve species including lobster, oyster, and scallops (Talmage and Gobler 2010; Keppel et al. 2012).

[2] Revenue exposure is the amount of revenue that could be potentially affected by WEA development.

Table 3.9-13 Annual Commercial Fishing Revenue Exposed to Offshore Wind Energy Development in the New England and Mid-Atlantic Regions Under the No Action Alternative by Fishery Management Plan

FMP Group	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030[1]
Mackerel, Squid, and Butterfish	$0.11	$0.11	$388.43	$625.18	$821.63	$1,187.76	$1,341.04	$1,474.91	$1,608.77	$1,608.77
Summer Flounder, Scup, Black Sea Bass	$0.15	$0.15	$306.08	$458.93	$641.68	$913.00	$1,098.87	$1,263.83	$1,428.79	$1,428.79
Northeast Multispecies (small-mesh)	$0.00	$0.00	$143.55	$185.44	$275.53	$366.48	$394.86	$411.72	$428.57	$428.57
Skates	–	–	$260.53	$299.64	$360.34	$455.44	$506.68	$538.91	$571.14	$571.14
American Lobster	$0.00	$0.00	$331.97	$377.13	$449.60	$606.01	$705.63	$760.30	$814.98	$814.98
Monkfish	$0.00	$0.00	$439.94	$513.04	$620.05	$784.47	$888.22	$970.77	$1,053.31	$1,053.31
Sea Scallop	$0.00	$0.00	$465.66	$2,709.55	$2,983.86	$7,927.08	$12,794.32	$17,634.56	$22,474.79	$22,474.79
Jonah Crab	$0.00	$0.00	$56.46	$93.99	$239.69	$326.31	$350.67	$371.17	$391.68	$391.68
Other FMPs, non-disclosed species and non-FMP fisheries	$0.42	$0.42	$783.50	$936.47	$1,123.64	$1,723.86	$2,137.48	$2,519.32	$2,901.16	$2,901.16
Golden and Blueline Tilefish	–	–	$4.14	$9.60	$55.69	$76.27	$81.37	$86.35	$91.33	$91.33
Northeast Multispecies (large-mesh)	–	–	$182.64	$197.21	$214.93	$264.12	$286.49	$300.78	$315.07	$315.07
Bluefish	$0.00	$0.00	$5.92	$8.51	$12.56	$16.08	$18.06	$19.60	$21.13	$21.13
Spiny Dogfish	–	–	$21.46	$28.71	$33.55	$39.48	$43.59	$45.70	$47.80	$47.80
Surfclam, Ocean Quahog	–	–	$132.53	$169.30	$792.71	$1,191.92	$1,591.13	$1,990.34	$2,389.56	$2,389.56
Atlantic Herring	–	–	$65.78	$97.88	$117.20	$169.57	$211.01	$243.39	$275.78	$275.78

FMP Group	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030[1]
Highly Migratory Species	$0.00	$0.00	$0.15	$0.21	$0.63	$0.86	$1.09	$1.31	$1.52	$1.52
All FMP and non-FMP Fisheries	$0.69	$0.69	$3,588.73	$6,710.80	$8,743.28	$16,048.69	$22,450.51	$28,632.95	$34,815.38	$34,815.38

Source: NMFS 2021d; excludes the Proposed Action.
Note: Dollar amounts are in $1,000s.
[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.
Revenue is in nominal dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing provided by the U.S. Bureau of Labor Statistics. The data represent the revenue-intensity raster developed using fishery-dependent landings' data. To produce the data set, 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. Resolution of the data does not allow estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridors. Therefore, estimates only pertain to individual offshore wind lease areas. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned. Slight differences in totals are due to rounding.
"–" indicates the value is zero; "$0" indicates the value is positive but less than $100.

Additional impacts on commercial fisheries and for-hire recreational fishing can result from climate change events such as an increase in the magnitude and frequency of storms and shoreline changes due to sea level rise. Increased freshwater input into nearshore estuarine habitats from stronger and more frequent precipitation events can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016). These effects may directly or indirectly impact commercially and recreationally important species and result 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). Thus, the viability of businesses engaged in or supporting commercial fisheries and for-hire recreational fishing could be affected. The economies of communities reliant on commercial and/or for-hire recreational fisheries may also be vulnerable to climate change-induced effects, as fishing-related infrastructure near the shore could be adversely affected by sea level rise (Colburn et al. 2016; Rogers et al. 2019).

Regulated fishing effort: Regulated fishing effort refers to fishery management measures necessary to maintain maximum sustainable yield under the Magnuson-Stevens Fishery Conservation and Management Act. This includes quota and effort allocation management measures. Regulated fishing effort changes as a result of offshore wind development could influence commercial fisheries and for-hire recreational fishing through two primary pathways: by changing fishing behavior to such an extent that overall harvest levels are not as predicted, and by affecting fisheries scientific surveys on which management measures are based. If scientific survey methodologies are not adapted to sample within wind energy facilities, then there could be increased uncertainty in scientific survey results, which would increase uncertainty in stock assessments and quota setting processes. Uncertainty in scientific assessments caused by limited access due to WTG spacing could result in more conservative (i.e., reduced) quotas that would negatively impact commercial fisheries. Future spatial management measures may change in response to changes in fishing behavior due to the presence of structures. Impacts on management processes would in turn have short-term or long-term impacts on commercial and for-hire recreational fisheries operations. Regulated fishing effort may also result in long-term benefits to commercial fisheries by achieving long-term sustainability of fishery resources.

3.9.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on commercial and recreational fishing. These effects are primarily driven by offshore construction impacts, the presence of structures.

Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to follow current regional trends and respond to current and future environmental trends and societal activities.

BOEM expects planned and ongoing offshore wind activities and future non-offshore wind activities to have continuing temporary to long-term impacts (displacement, space use conflicts, navigational and fishing hazards, changes in target species abundance and distribution) on commercial fisheries and for-hire recreational fishing, primarily through new cable emplacement, noise, port expansion, presence of structures, vessel traffic, ongoing climate change, and regulated fishing effort. The extent of impacts on commercial fisheries and for-hire recreational fishing would vary by fishery due to different target species, gear type, and location of activity.

BOEM anticipates **negligible** adverse to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fisheries as a result of ongoing activities other than offshore wind. This is largely driven by the effects of climate change and the ability for fisheries management agencies to readily adapt to changing distributions, and other climate-related effects. Regulated fishery effort will also have a substantial influence on commercial fisheries and for-hire recreational fishing in the geographic analysis area.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and commercial and recreational fishing would continue to be affected by natural and human caused IPFs. In addition to ongoing activities, reasonably foreseeable (i.e., planned) activities other than offshore wind may also contribute to impacts on commercial fisheries and for-hire fishing, particularly from increased vessel traffic and climate change. BOEM anticipates **negligible** adverse to **major** adverse impacts on commercial fisheries from planned actions other than offshore wind (dependent largely on the ability for management to adapt to climate change). For-hire recreational fisheries would experience **moderate** adverse impacts due to the potential need to shift fishing grounds as well as ongoing effects of climate change. In the context of reasonably foreseeable trends (e.g., environmental, infrastructure) BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in **negligible** adverse to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fisheries.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with offshore wind activities in the geographic analysis area would result in **negligible** to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing due primarily to the presence of structures (e.g., through gear loss, navigational hazards, space use conflicts, and potential impacts on fisheries surveys), new cable emplacement and to pile-driving noise. The presence of structures may also induce a **minor beneficial** impact, particularly on the for-hire recreational fishing.

The No Action Alternative would forgo any current or planned fisheries monitoring that Dominion Energy has committed to voluntarily perform, the results of which could provide an understanding of the effects of offshore wind development in and around the Project area, benefit future management of commercial and for-hire fisheries and inform planning of other offshore developments. However, other ongoing and future surveys could still provide similar data to support similar goals.

3.9.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on commercial fisheries and for-hire recreational fishing.

- Number, type, size, and location of WTGs and OSSs.
- The export cable landfall’s potential to interfere with nearshore fishing grounds during construction.
- The route of the inter-array cables and the offshore export cable, including the ability to reach target burial depth.
- The type of cable protection measures when burial depth is insufficient. Cables that may not achieve the proper burial depth and would require cable protection in the form of rock placement, concrete mattresses, or half-shells. Such covers can change the fish habitat (soft-bottom habitat to hard-bottom habitat) and can also damage fishing gear and equipment, which in turn could cause a potential safety hazard should gear snag or hook on to seabed structures. Cable protection measures could also result in a fish-aggregating effect for structure-oriented species. With an increase in structure-oriented species, predation in the vicinity of cable protection structures has the potential to increase.

Alternatively, new hard surfaces could provide new habitat for hard-bottom species, resulting in increases in biomass for commercially or recreationally fished benthic fish and invertebrates. New hard-bottom habitat could also be colonized by invasive species (e.g., certain tunicate species), but in the event this occurs, it is not expected to substantially affect commercial or for-hire recreational fisheries.

- The time of the year during which construction occurs. For-hire recreational fisheries are generally most active when the weather is more favorable, while commercial fishing is active year-round with many species harvested throughout the year. However, certain fisheries have peak times. Construction activities can affect access to fishing areas and availability of fish in the area, thereby reducing catch and fishing revenue.

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

- WTG and OSS number, size, and location: the level of impacts related to presence and location of structures. The number and size of WTGs and OSSs will influence the magnitude of impacts stemming from navigation, accessibility/displacement, and habitat conversion effects. Because known fishing grounds exist within the Project area (e.g., Triangle Reef), presence or lack of structures on or in the vicinity of these grounds will greatly influence the magnitude of impact.
- Season of construction: although commercial and for-hire recreational fishing occurs year-round, the majority of for-hire recreational fishing occurs April through October. Construction outside of this window would have a lesser effect on commercial fisheries and for-hire recreational fishing than construction during the active season.

3.9.5 Impacts of the Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing

Anchoring: Vessel stabilization during construction and possibly during conceptual decommissioning are assumed to be primarily done using either spud barges, jack-up vessels, or dynamic positioning vessels; therefore, only minimal anchoring would occur. Vessel anchoring would cause temporary impacts on fishing vessels and fishing activities. Anchoring vessels used in the course of the Proposed Action would pose a navigational hazard to fishing vessels and disturb seafloor habitats. All impacts would be localized, and potential navigation hazards would be temporary (hours to days). The anticipated impacts from anchoring on commercial fisheries and for-hire recreational fishing in the geographic analysis area under the Proposed Action alone would be minor. Anchoring impacts on finfish, invertebrates, and essential fish habitat are discussed in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*.

New cable emplacement and maintenance activities: The Proposed Action would potentially result in up to 6,347.3 acres (2,568.64 hectares) of seafloor being temporarily disturbed by cable installation, 8.92 acres (3.61 hectares) of seafloor being temporarily disturbed by cable protection, and 1.19 acres (0.48 hectare) of permanent impact from cable protection (COP, Table 4.2-17; Dominion Energy 2023). Construction and installation of the Proposed Action 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), which may result in the loss of revenue if alternative fishing locations are not available. Activities from cable emplacement would require communications with fixed-gear fisheries to ensure no gear is deployed in the installation path. According to information provided in the COP (Sections 4.4.6.1 and 4.4.6.2; Dominion Energy 2023a), fixed commercial gears are much more prevalent than mobile gear. The Proposed Action would result in localized and temporary minor adverse impacts.

Though many of the impacts from cable installation are temporary, it is expected that 1.19 acres (0.48 hectare) of the offshore export cable would require cable protection and would therefore be permanently affected (COP, Table 4.2-17; Dominion Energy 2023). Although cable routes and lengths for most other offshore wind projects are not known at this time, using assumptions in Appendix F, Table F2-2, the total seafloor disturbance from new cable emplacement within the geographic analysis area is estimated to be over 132,813[3] acres (537.5 square kilometers). Cable preparatory work, including boulder relocation or boulder plow work could result in changes to existing obstacles or creation of new obstacles that could cause fishing gear loss or damage. Overall, cable-laying activities would not restrict large areas, and navigational impacts would be on the scale of hours to days.

Noise: Noise from G&G surveys, construction, trenching, pile driving, operations, and maintenance may occur during construction of the Proposed Action. Noise can temporarily disturb fish and invertebrates in the immediate vicinity of the source, causing a temporary behavior change, including leaving the area affected by the sound source. Impacts on commercial fisheries and for-hire recreational fishing would depend on the duration of the noise-producing activity and corresponding impacts on fish species, coinciding with fishing, and are anticipated to be moderate adverse from the Proposed Action alone.

Acoustic modeling of construction noise indicates noise that exceeds behavioral thresholds for fish may extend to approximately 6 miles (10 kilometers) with 10 dB noise attenuation, so during impact pile driving fish may swim as far as 6 miles (10 kilometers) to avoid the greatest area of ensonification. However, this distance is based on the Project using the highest hammer energy, which will not occur for the full duration of construction, and impact pile-driving activities are only expected to occur for 4–6 hours per day, so this avoidance would be temporary. Additionally, the Project would only conduct impact pile-driving activities between May and October, and they would only occur during 109 days in 2024, 114 days in 2025, and 15 days in 2026 per the schedule in Table 8 of the Letter of Authorization application, so any avoidance of the ensonified area would be temporary and would not be expected to result in any biologically significant effects.

Noise impacts on fish and invertebrates are discussed in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*.

The moderate adverse impacts of noise under the Proposed Action alone would not considerably increase the impacts of noise beyond the impacts under the No Action Alternative.

Port utilization: During construction and operations, vessels would use existing ports, particularly Portsmouth, Virginia (COP, Table 3.4-5; Dominion Energy 2023a). This may result in a slight decrease in available dockage or other shore-based services such as fuel. Therefore, the Proposed Action would generate minor adverse impacts on commercial fisheries and for-hire recreational fishing associated with port utilization.

The minor impacts of port utilization under the Proposed Action alone would not considerably increase the level of impact under the No Action Alternative.

Presence of structures: The various types of impacts on commercial fisheries and for-hire recreational fishing that could result from the presence of structures are described in detail in Section 3.9.3.1, *Impacts of the No Action Alternative*. The Proposed Action may result in 202 foundations and 3 OSSs. The total disturbance from the foundation footprints and the scour protection for the Proposed Action would be 203.3 acres (88.27 hectares; COP, Table 4.2-17; Dominion Energy 2023).

[3] The Kitty Hawk Offshore Wind South Project has three export cables 57 miles (92 kilometers) to Virginia, 200 miles (322 kilometers) to North Carolina, and an additional 96 miles (154 kilometers) of inshore export cable to North Caroline) for a total of 352.9 miles (568 kilometers), and corridor widths between 1,520-mile (2,446-kilometer)-wide corridor to Virginia and 1,000-mile (1,609-kilometer)-wide corridors to North Carolina to allow for optimal routing of the cables.

The impacts from the presence of structures associated with the Proposed Action alone on commercial fisheries and for-hire recreational fishing are anticipated to range from negligible to major adverse impacts and would not considerably increase the impacts across entire fisheries beyond those of the No Action Alternative. However, impacts on local commercial fisheries and for-hire recreational fishing would be greater than under the No Action Alternative. Magnitude of impact will also vary depending on distance from the Project area, vessel size, and type of gear used (e.g., large mobile-gear vessels would be affected more than smaller fixed-gear vessels). There would also be a minor beneficial impact on local for-hire recreational fishing (e.g., from fish aggregation effects).

The installation of components, as well as the presence of construction vessels and permanent structures, could restrict harvesting and fishing activities in the Project area. The mechanisms of impacts from structures associated with the Proposed Action on commercial fisheries and for-hire recreational fishing are similar to those presented for other projects and are described in detail in the COP (Section 4.4.6.3; Dominion Energy 2023a; BOEM 2021a).

The location of the proposed infrastructure within the Project area could affect transit corridors and access to preferred or traditional fishing locations. The presence of structures in the Fish Haven area would create space use conflicts between recreational and commercial fishers and may increase risk of gear entanglement or loss. Transiting through the Project area could also create challenges associated with using navigational radar when there are many radar targets that may obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions like heavy fog. Larger vessels may find it necessary to travel around the Project area to avoid maneuvering among the WTGs. Vessels transiting to/from Virginia Beach may be most affected navigationally by the presence of structures.

Using the assumptions in Appendix F, there could be over 3,207 foundations, 4,790 acres (19.4 square kilometers) of foundation scour protection, and 2,843 acres (11.5 square kilometers) of new hard protection atop cables from planned actions (inclusive of the Proposed Action). Of this, up to 202 WTG foundations, three substations, and 430 acres (1.7 square kilometer) of permanent seafloor disturbance would result from the Proposed Action (Table F2-2; Dominion Energy 2023a).

Vessel traffic: The Proposed Action would generate an increase in vessel traffic compared to the No Action Alternative, with a peak during the proposed Project construction. Offshore construction and installation of the Proposed Action would temporarily restrict access to the Project area (OECC route and Wind Farm Area) during construction. Construction support vessels, including vessels carrying assembled WTGs or WTG components, would be present in the waterways between the Wind Farm Area and the ports used during the Proposed Action construction and installation.

The Proposed Action would result in the use of up to 73 vessels operating at some phase during construction and installation, with most transiting to and from the Project area from Portsmouth, Virginia (COP, Table 3.4-5; Dominion Energy 2023a). Based on information provided in the COP, construction activities (including offshore installation of WTGs, OSSs, array cables, interconnection cable, and export cable) would require up to 56 construction vessels transiting between the various ports and the Project area on a variety of schedules depending on the phase of construction. Vessel transits under the Proposed Action would average 46 trips per day through the duration of construction activities; daily estimated vessel trips would be dependent on the construction period and activity and range from a minimum of 3 trips per day to a maximum of 95 trips per day. While not directly comparable based on the limitations of AIS data, the average of 46 Project vessel trips per day would represent an approximately 79 percent increase over the current number of unique vessels operating in the Project area, though actual baseline vessel transits are likely considerably underrepresented in the data.

Fishing vessels transiting in proximity to the Project area or ports being utilized by construction and installation vessels would be required to avoid Project vessels and restricted safety zones though routine adjustments to navigation. Fishing vessels may experience increased transit times in some situations, or, if vessels choose to relocate, they could experience increased operating costs such as increased fuel expenses, more equipment wear and tear, increased labor expenses, or other costs. If the alternative fishing grounds proved to be productive, fishermen could experience lower revenues. Although these situations are expected to be spatially and temporally limited, BOEM expects vessel traffic from Project activities to have moderate adverse impacts on fishing vessels during the construction and installation phase.

The operations and maintenance of the Proposed Action would require a much more limited number of vessels than construction activities, with most vessels used for routine operations and maintenance. Estimated vessel trips during the operations and maintenance phase is 26 annual round trips for service operation vessels and 120 annual round trips for crew transfer vessels (COP, Section 3.5.1; Dominion Energy 2023a). Given this relatively low number of Project vessel trips during the operations and maintenance phase, it is expected the Proposed Action would have a negligible impact on commercial and for-hire recreational fisheries during this phase. For more discussion, see Section 3.16, *Navigation and Vessel Traffic*.

Climate change: This IPF would contribute to shifting distributions of commercial and for-hire recreational fisheries. Because this IPF is a global phenomenon, the impacts in context of reasonably foreseeable environmental trends and planned actions through this IPF would be similar to those under the No Action Alternative. Implementation of offshore wind projects would likely result in a net decrease in greenhouse gases, and more details on this IPF can be found in Sections 3.9.3.1 and 3.9.3.2.

Regulated fishing effort: This IPF would contribute to short-term and long-term moderate adverse impacts on commercial fisheries and for-hire recreational fisheries operations, as described in more detail in Sections 3.9.3.1 and 3.9.3.2. However, because the Project area is considered lightly fished compared to other offshore wind lease areas, the effects of the Proposed Action alone with respect to fisheries regulations would only marginally increase impacts on commercial and for-hire recreational fisheries beyond those of the No Action Alternative and would be minor.

The impacts on commercial fishing and for-hire recreational fishing would vary depending on the fishery and the changes in fishing behavior due to offshore wind development in the geographic analysis area. Offshore wind development may change the distribution of fishing effort in ways not contemplated in current fishery management plans. Additionally, impacts on fisheries scientific surveys may result in more conservative quota and effort management measures. However, regulated fishing efforts could also result in positive impacts by leading to long-term fisheries sustainability.

3.9.5.1 Cumulative Impacts of the Proposed Action

This section outlines the cumulative impacts of the Proposed Action considered in combination with other ongoing and planned wind activities.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the combined anchoring impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities, including offshore wind. Anchoring activities would result in minor increased vessel anchoring during survey activities and during the construction, installation, maintenance, and conceptual decommissioning of offshore components. In addition, there could be increased anchoring/mooring of met/ocean buoys. In context of reasonably foreseeable environmental trends and planned actions, anchoring could affect up to approximately 42 acres (0.17 square kilometer), including the Proposed Action (Appendix F, Table F2-2). Overall, impacts would be localized and temporary (hours to days) leading to minor adverse impacts.

The combined impacts from new cable emplacement and maintenance activities on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action would likely be localized, temporary minor adverse.

Combined noise impacts from ongoing and planned actions, including the Proposed Action would be similar to the impacts under the No Action Alternative, and would be moderate adverse.

Combined impacts due to port utilization from ongoing and planned actions, including the Proposed Action would be minor adverse.

In context of reasonably foreseeable environmental trends, the combined impacts from the presence of structures on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action would likely range from negligible to major adverse. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater. Remedial action during conceptual decommissioning may reduce long-term impacts.

Ongoing activities, future activities, and other offshore wind development could incrementally affect commercial fishing vessels as more projects are developed. In context of reasonably foreseeable environmental trends, the combined impacts from increased vessel traffic on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action would range from minor to moderate adverse.

The intensity and type of impacts in context of reasonably foreseeable environmental trends and planned actions, including the Proposed Action resulting from climate change are uncertain, but are likely to be moderate adverse.

In context of reasonably foreseeable environmental trends, the combined impacts of regulated fishing effort on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action would be moderate adverse.

3.9.5.2 Conclusions

Impacts of the Proposed Action. Impacts from the Proposed Action alone would include the temporary or permanent reduction in catch or loss of access to fishing areas due to the presence of construction activities or changes in fish and shellfish populations that are the basis of fishing activities. Other impacts also include a temporary or permanent reduction in fishing activities and fishing revenue due to characteristics of the Proposed Action. This could include abandonment of fishing locations due to difficulty in maneuvering fishing vessels, fear of allisions with the Proposed Action components (e.g., WTGs), increased risk of collisions with construction or lay vessels, and fear of damage or loss of deployed gear. Other impacts associated with the Proposed Action include alterations in the management of fisheries resources due to changes in fishing effort (duration, location, methodology), which may impact quota allocation in certain sectors.

In summary, activities associated with the construction and installation, operations and maintenance, and conceptual decommissioning in the Project area as part of the Proposed Action would affect commercial fisheries and for-hire recreational fishing to varying degrees. The main impact would be from the presence of structures, which, when combined with other IPFs could lead to **negligible** to **major** adverse impacts on commercial fisheries and for-hire recreational fishing and **minor beneficial** impacts on for-hire recreational fishing. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater.

Cumulative impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends, combined impacts resulting from individual IPFs from planned actions, including the Proposed Action would range from **negligible** to **major** adverse. Presence of structures is also expected to yield a **minor beneficial** impact, particularly on for-hire recreational fishing. Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action would result in **negligible** to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing in the analysis area, driven largely by the presence of structures.

3.9.6 Impacts of Alternatives B and C on Commercial Fisheries and For-Hire Recreational Fishing

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, described in this section.

Impacts of Alternatives B and C. The impacts resulting from individual IPFs associated with Alternatives B and C would be similar to those described under the Proposed Action, with the exception of the presence of structures. Alternatives B, and C would exclude the Fish Haven area along the northern boundary of the Lease Area (around the Triangle Reef) from development. The Fish Haven area (including the Triangle Wrecks artificial reef) is an important fishing ground for commercial and for-hire recreational fishing (COP, Section 4.4.6.2; Dominion Energy 2023a). Additionally, Alternative C would avoid and minimize impacts to sand ridge habitat and shipwrecks through a combination of micrositing of infrastructure (WTGs, inter-array cables, and OSSs), up to 500 feet, the removal of four WTGs from priority sand ridge habitat, and the relocation of one WTG to a spare position. Commercial fisheries and for-hire recreational fishing local to the Project area would still be affected to a greater degree than fisheries located outside of the Project area under Alternatives B and C. Displacement of the local fisheries effort from other areas within the Project area (both commercial and for-hire recreational) may affect fisheries located outside of the Project area through increased competition for fishing grounds. Alternatives B and C would decrease the number of WTGs (from up to 202 under the Proposed Action, up to 176 plus spare locations under Alternative B, and up to 172 under Alternative C). The length and locations of the OECC between Alternatives B and C and the Proposed Action may differ based on the different number and locations of WTGs. However, BOEM does not expect a change to impact from IPFs or sub-IPFs as compared to the Proposed Action with the exception of the presence of structures (particularly related to structures in the Fish Haven area and sand ridge habitat area; see Section 3.9.5, *Impacts of the Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing*). The presence of structures sub-IPF would range from negligible to major adverse for commercial fisheries and for-hire recreational fishing, which would remain the same as the Proposed Action even with the exclusion of development in the Fish Haven area under Alternatives B and C, and the exclusion of portions of the sand ridge habitat under Alternatives C since the Project area is lightly fished compared to other WEAs, fishing activity that does occur will likely be disrupted by the presence of the turbines.

Cumulative impacts of Alternatives B and C. In the context of other reasonably foreseeable environmental trends, combined impacts resulting from individual IPFs from planned actions, including Alternatives B and C would not be notably different from those described under the Proposed Action, and would range from negligible to major adverse.

3.9.6.1 Conclusions

Impacts of Alternatives B and C. Activities associated with the construction and installation, operations and maintenance, and conceptual decommissioning in the Project area under Alternatives B and C would impact commercial fisheries and for-hire recreational fishing similar to the Proposed Action with the exception of the presence of structures IPF. The main impacts would be from the presence of structures, which when considered with other IPFs could lead to **negligible** to **major** adverse impacts on commercial fisheries and for-hire recreational fishing and **minor beneficial** impacts on for-hire recreational fishing due to the increase in structures provided by WTGs, OSSs, and associated scour pads. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater. Mitigation measures may reduce impacts post-conceptual decommissioning.

Cumulative impacts of Alternatives B and C. In the context of other reasonably foreseeable environmental trends, combined impacts resulting from individual IPFs from planned actions, including Alternatives B and C would not be notably different from those described under the Proposed Action, and would range from **negligible** to **major** adverse. Considering all of the IPFs collectively, BOEM anticipates that the overall impact from ongoing and planned actions, including Alternatives B and C would result in the same level of impacts as the Proposed Action: **negligible** to **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing in the geographic analysis area.

3.9.7 Impacts of Alternative D on Commercial Fisheries and For-Hire Recreational Fishing

Impacts of Alternative D. Alternative D differs from the Proposed Action only with respect to onshore routing of the interconnection cable. Because the onshore portion of the Project area lies outside of the geographic analysis area for commercial fisheries and for-hire recreational fishing, impacts from Alternatives D-1 and D-2 would be the same as those under the Proposed Action and would range from negligible to major adverse in the geographic analysis area, depending on the IPF. The overall impacts would likely remain **negligible** to **major** adverse on commercial fisheries and for-hire recreational fishing and **minor beneficial** on for-hire recreational fishing.

Cumulative impacts of Alternative D. Considering all of the IPFs collectively, BOEM anticipates that the overall impact from ongoing and planned actions, including Alternative D, would result in the same level of impacts as under the Proposed Action: **negligible** to **major** adverse on commercial fisheries and moderate adverse on for-hire recreational fishing in the geographic analysis area.

3.9.7.1 Conclusions

Impacts of Alternative D. Although Alternatives D-1 and D-2 would minimize impacts on onshore habitats, BOEM does not anticipate a measurable benefit for commercial fisheries and for-hire recreational fishing in the geographic analysis area. Therefore, overall potential impacts would be the same as the Proposed Action and would range from **negligible** to **major** adverse. The presence of structures may also induce a **minor beneficial** impact, particularly on the for-hire recreational fishing.

Cumulative impacts of Alternative D. In the context of other reasonably foreseeable environmental trends, combined impacts resulting from individual IPFs from planned actions, including Alternative D, would not be different from those described under the Proposed Action, and would range from **negligible** to **major** adverse. Considering all of the IPFs collectively, BOEM anticipates that the overall impact from ongoing and planned actions, including Alternative D, would result in the same level of impacts as under the Proposed Action: **negligible** to **major** adverse on commercial fisheries and **moderate** adverse on for-hire recreational fishing in the geographic analysis area.

3.9.8 Agency-Required Mitigation Measures

The mitigation measures included in Table 3.9-14 are recommended for inclusion in the Preferred Alternative. BOEM has proposed guidance to lessees for mitigating impacts on commercial and recreational fisheries (see https://www.boem.gov/sites/default/files/documents/renewable-energy/DRAFT%20Fisheries%20Mitigation%20Guidance%2006232022_0.pdf). BOEM will consider requiring mitigation measures that may help mitigate impacts on commercial and for-hire recreational fishing. These measures include the following.

Table 3.9-14 Additional Agency-Required Measures: Commercial Fisheries and For-Hire Recreational Fishing[1]

Measure	Description	Effect
Fisheries Compensation	BOEM would require that Dominion Energy implement a compensation program for lost income for commercial and recreational fishermen and other eligible fishing interests for construction and operations consistent with BOEM's draft guidance for *Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585* or as modified in response to public comment.	This measure, if adopted, would reduce impacts from the impact-producing factor (IPF) presence of structures by compensating commercial and recreational fishing interests for lost income during construction and a minimum of 5 years post-construction. If adopted, this measure would reduce the negligible to major impact level from the presence of structures to negligible to moderate. This is because a compensation scheme will mitigate "indefinite" impacts to a level where the fishing community would have to adjust somewhat to account for disruptions due to impacts but income losses would be mitigated.

[1] Also Identified in Appendix H, Table H-3.

3.9.8.1 Effect of Measures Incorporated into the Preferred Alternative

BOEM has identified the additional measures in Table 3.9-2 and Appendix H, Table H-3 as incorporated in the Preferred Alternative. These measures, if adopted, would provide for compensation for fisheries, gear loss or damage, and lost income during the construction period. This compensation would provide for lost income from fishing interests during the construction period and losses or damage to gear from uncharted obstructions resulting from the Proposed Action and reduce the impacts from negligible to major to negligible to minor. In addition, the use of gear-friendly cable protection measures would reduce the potential for gear snags and damage and reduce the impacts of the Proposed Action.

3.10 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 3.10-1, is equivalent to the Project's area of potential effect (APE), as defined in the implementing regulations for NHPA Section 106 at 36 CFR Part 800 (Protection of Historic Properties). 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 affected by any bottom-disturbing activities, constituting the marine portion of the APE.
- The depth and breadth of terrestrial areas potentially affected by any ground-disturbing or other physical 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.
- 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. The resource can be historical (post-Contact) in character or date to the pre-Contact past (i.e., the time prior to the arrival of Europeans in North America). 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 3.10.1, *Description of the Affected Environment for Cultural Resources*.

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 [National Register; 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 tribes that meet National Register criteria.

3.10.1 Description of the Affected Environment for Cultural Resources

This section discusses baseline conditions in the geographic analysis area for cultural resources as described in COP, Section 4.3 (Dominion Energy 2023), supplemental COP cultural resources studies (COP, Appendices F, G, H-1, H-3, and H-4; Dominion Energy 2023), and Appendix O of this Final EIS (*Finding of Adverse Effect for the Coastal Virginia Offshore Wind Construction and Operations Plan*). Specifically, this includes marine and terrestrial areas potentially affected by the proposed Project's seabed- and ground-disturbing activities, areas where structures from the Proposed Action would be visible, and areas of intervisibility where structures from both the Proposed Action and other offshore wind projects would be visible simultaneously.

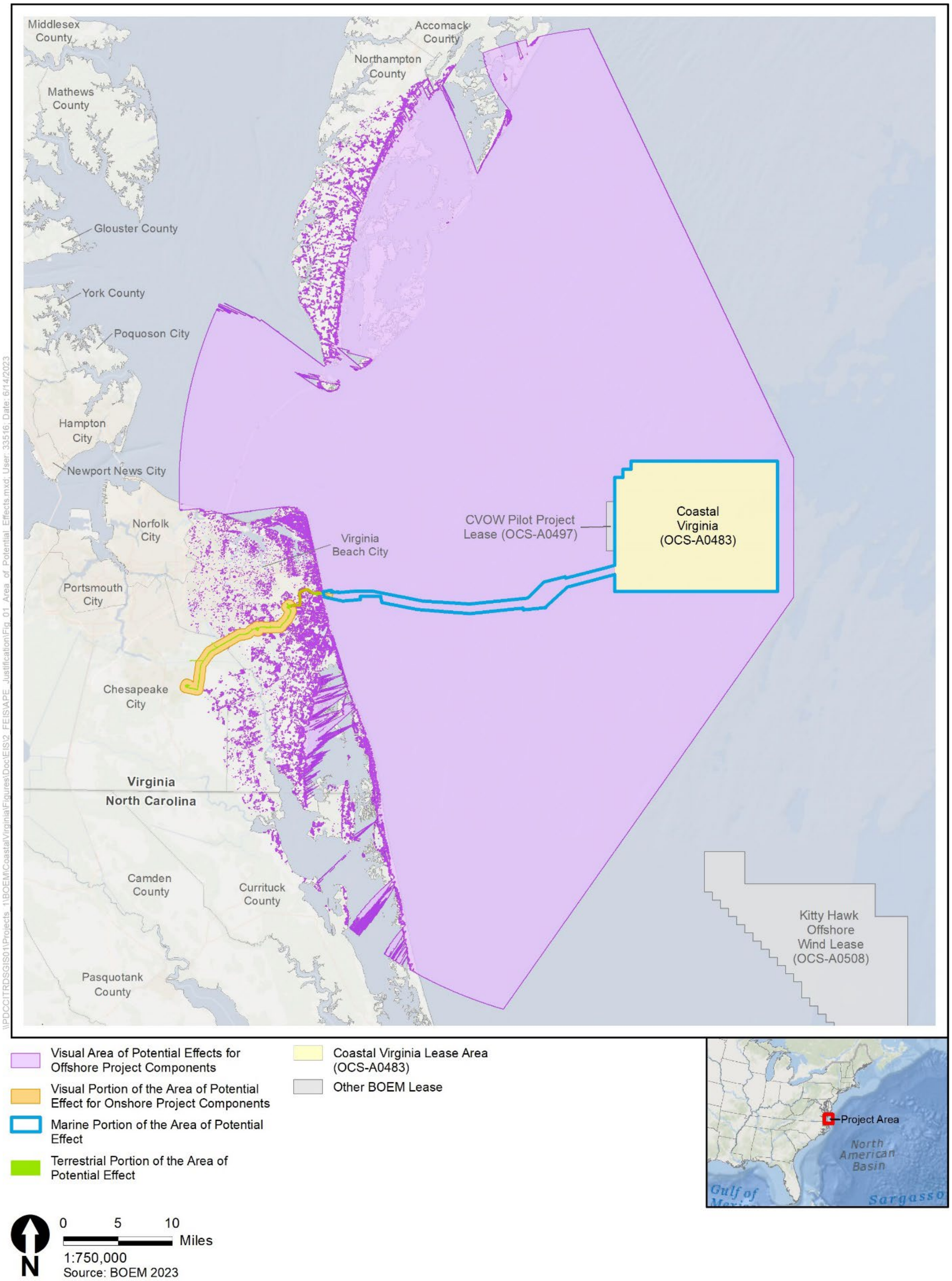


Figure 3.10-1 Cultural Resources Geographic Analysis Area

Dominion Energy 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 3.10-1 presents a summary of the pre-Contact and post-Contact cultural context of the Project area based on the Project's Terrestrial Archaeological Resources Assessment (TARA) (COP, Appendix G; Dominion Energy 2023).

Table 3.10-1 Summary of Cultural Context of Project Area

Period	Date	Description
Paleoindian	14950–9950 B.P.	The Paleoindian period in the Project area is characterized by small, likely kin-based, highly mobile bands engaged in generalized foraging. The fluted points that characterize the early Paleoindian period were manufactured from both high-quality lithic material derived far from their points of origin as well as more readily available, but coarser grained, materials such as quartz and quartzite.
Archaic	9950–3150 B.P.	The Archaic Period is subdivided into Early (9950–8450 B.P.), Middle (8450–4950 B.P.), and Late (4950–3150 B.P.) phases. During the Early Archaic Period, regional stylistic differences in the lithic assemblage become more pronounced with an increase in the amount of locally available material used for their manufacture. At the onset of the Middle Archaic, locally sourced lithic raw materials become more pronounced and biface technology markedly changed from notched to stemmed forms. The Late Archaic Period sees a profusion of sites throughout the region, which is likely indicative of a population increase and concurrent reduction in mobility.
Woodland	3150–350 B.P.	The Woodland Period, which is subdivided into Early (3150–2450 B.P), Middle (2450–1050 B.P), and Late (1050–350 B.P.) phases, is broadly characterized by a more sedentary population with a subsistence strategy increasingly reliant on plant cultivation and the widespread manufacture of ceramics. Late pre-Contact economy in the Virginia Coastal Plain shifted from a focus on hunting and foraging to maize-bean-squash horticulture situated on floodplains and was accompanied by a parallel shift toward semi-sedentism and increased population density.
Contact	1607–1750 A.D.	While the English presence at Jamestown, to the north, began in 1607, settlement in the Project area did not begin until the 1630s. Conflict between English settlers and Indians occurred often even as the two groups pursued mutually beneficial trade. The Euro-American economy during this period was based primarily on tobacco and products produced from surrounding pine forests including tar and turpentine. Agricultural output came from both plantations and small holdings. Initially, tenant farmers and indentured servants provided much of the labor with enslaved Africans making up only a small proportion of the workforce throughout the 17th and early 18th centuries. However, shifting economic patterns led to a decrease in the number of indentured servants during this period, and by the mid-18th century enslaved Africans became the bulk of agricultural laborers in the region.

Period	Date	Description
Early Post-Contact	1750–1789 A.D.	Over the course of the 18th century as the Euro-American and African population increased, inland settlements, particularly along waterways, continued to grow. Most of these settlements comprised small holders and the economy remained primarily agricultural.
	1789–1830 A.D.	Throughout the late 18th and early 19th centuries, the Project area remained largely rural in character with larger towns to the north and farms to the south. In the early 19th century, free people of African descent established a community in what is now the Beach District of Virginia Beach, named Seatack. Economic growth after the end of the War of 1812 spurred new interest in exploiting the resources of the Great Dismal Swamp.
Antebellum Period and Civil War	1830–1865 A.D.	Prior to the Civil War, the Project area continued to be largely rural with an economy predicated on agriculture and exploiting marine resources. The advent of war led to a U.S. Navy blockade of the southern coastline, including what is now Virginia Beach. The U.S. Government regained control of the area including Princess Anne County after the Confederates abandoned Hampton Roads in 1862. However, guerilla attacks against the U.S. military continued throughout the war. Like most of the South, Princess Anne County and environs were devastated both socially and economically by the end of the war.
Reconstruction	1870–1916 A.D.	After the Civil War, several communities were established in the area by people who had been formerly enslaved, including Beechwood, Burton Station, Doyletown, Gracetown, Great Neck, and Lake Smith. The economy continued to be primarily agriculture based and the Port of Norfolk provided ready access to regional markets. The expansion of railroads in the area during the 1880s created further opportunities for development, and in the late 19th and early 20th centuries both tourism and the military began to become important components of the regional economy.
World War I to World War II	1917–1945 A.D.	The entry of the United States into the First World War predicated the establishment of Naval Station Norfolk in 1917. The military presence in Norfolk and the surrounding area would become a major engine of economic growth over the course of the 20th century. World War II prompted further expansion of the military facilities in the area, including the establishment of what would become NAS Oceana, and saw an influx of both military and civilian workers to Norfolk, Virginia Beach, and environs. The tourist industry grew throughout the early 20th century spurred by improved transportation in the region.
---	20th Century A.D.	By the early 20th century, the Powhatan peoples of the Virginia Tidewater numbered around 2,000 individuals, largely composed of the Pamunkey, Mattaponi, Chickahominy, and Nansemond tribes. During the Jim Crow era (circa 1890–1965), the Powhatan strove to distinguish themselves from African American Virginians, seeking separate status for themselves that would protect them from the repressive laws of racial apartheid. The Pamunkey and Mattaponi had been accorded tribal status by Virginian authorities since the 17th century, while the Chickahominy and Nansemond had to wait for Commonwealth recognition until the 1980s. In 2015, the Pamunkey Indian Tribe gained federal recognition. In 2018, the federal government recognized the Chickahominy Indian Tribe, Chickahominy Indian Tribe-Eastern Division, Monacan Indian Nation, Nansemond Indian Nation, Rappahannock Tribe, Shinnecock Indian Nation, and Upper Mattaponi Tribe through federal legislation.

Source: COP, Appendix G; Dominion Energy 2023.
B.P. = before present; A.D. = Anno Domini.

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 sub-aerial or aboveground resources with cultural or religious significance to Native American tribes.

Archaeological resources, per 18 CFR § 1312.3, are defined as "…any material remains of human life or activities which are at least 100 years of age, and which are of archaeological interest." However, physical remnants of past human activity that occurred at least 50 years ago may be considered as archaeological resources eligible for listing in the NRHP and are, as such, considered in BOEM's assessment of archaeological resources. Archaeological resources 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, Appendix F; Dominion Energy 2023). Marine geophysical archaeological surveys performed for the Proposed Action identified 42 potential marine archaeological resources: 29 within or near the proposed offshore Lease Area and 13 within or near the Offshore Export Cable Route Corridor (ECRC) (COP, Appendix F; Dominion Energy 2023). These resources include both known and potential shipwrecks, downed aircraft, and related debris fields from the post-Contact and recent eras (i.e., less than 50 years ago). The ages of 31 marine archaeological resources cannot be confirmed through the marine cultural investigations; therefore, these resources are all assumed to be archaeological and consequently cultural resources potentially eligible for listing in the NRHP. Eleven other marine archaeological resources near the northern border of the Lease Area consist of large, scuttled World War II–era ships, tires, cable spools, and other materials intentionally deposited since the 1970s to facilitate development of the Triangle Reef Fish Haven (Fish Haven) and are therefore not considered eligible for listing in the NRHP (COP, Sections 2.1.1 and 4.2.4.2, Appendix F; Dominion Energy 2023); these include United States Naval Ships *Garrison* (Wreck Number [WN] 002a), *Webster* (WN 002b), *Haviland* (WN 003a), *Clark* (WN 003b), *John Morgan* (WN 007), *Lillian Luckenback* (WN 010), *Kurn* (WN 011), and *Tripca* (WN 013), as well as three other unidentified objects (i.e., WNs 009, 014, and 015).

Marine cultural resources also include ASLFs on the OCS (BOEM 2012). Marine geophysical remote archaeological surveys performed for the Proposed Action identified six ASLFs (COP, Appendix F; Dominion Energy 2023). Four of these landforms are located in the Lease Area portion of the marine APE. No ASLFs were identified in the Offshore ECRC. A fifth ASLF (Target P-01) is outside of the horizontal extent of the marine APE but is near the Lease Area. A sixth ASLF (P-05) is in the horizontal extent of the marine APE near the Lease Area but below the vertical extent of the marine APE, therefore, outside of the marine APE. Regardless, these two ASLFs (P-01 and P-05) have been considered for potential effects from the Proposed Action because of their proximity. The extent of marine cultural investigations performed for the Proposed Action does not enable conclusive determinations of eligibility for listing identified resources in the NRHP; as such, all identified marine archaeological resources and ASLFs are assumed eligible for listing in the NRHP and are therefore historic properties.

Cultural resource investigations performed for the Proposed Action (hereafter referred to as the *terrestrial APE*) identified 24 terrestrial archaeological resources (14 sites and 10 isolated finds [IFs]), 1 cemetery (i.e., 34-5027-0050), and 1 historic aboveground resource (i.e., Camp Pendleton/State Military Reservation Historic District) in the terrestrial APE (COP, Appendices G and H-3; Dominion Energy 2023). Sufficient data from Dominion Energy's investigations have enabled BOEM to determine that the 10 IFs are without sufficient integrity or significance for NRHP eligibility and are, therefore, not historic properties. Since the publication of the Draft EIS, and in consultation with the Virginia SHPO, BOEM has determined that of the 14 terrestrial archaeological sites, 3 (i.e., 44CS0250, 44VB0162, and 44VB0412) are potentially eligible for listing in the NRHP and are, therefore, historic properties. Dominion Energy's investigations identified one cemetery (i.e., 34-5027-0050), presently known to comprise one mid-20th century grave, outside of but near the terrestrial APE; this cemetery is considered for potential impacts from the Proposed Action due to its proximity to the proposed Harpers Switching Station. The historic aboveground resource in the terrestrial APE is the Camp Pendleton/State Military Reservation Historic District, which is presently listed in the NRHP. Two structures that are contributing elements to the historic district (i.e., Buildings 59 and 410) are in the terrestrial APE.

The visual portion of the APE (hereafter referred to as the *visual APE*) includes a visual APE for Offshore Project components and visual APE for Onshore Project components. Cultural resources review of the visual APE for Offshore Project components identified 712 historic aboveground resources, including 2 NHLs (i.e., First Cape Henry Lighthouse and Eyre Hall) (COP, Appendix H-1; Dominion Energy 2023). Cultural resources review of the visual APE for Onshore Project components identified 322 historic aboveground resources. Thirteen of these resources have been determined to be historic properties listed or eligible for listing in the NRHP (COP, Appendices H-3; Dominion Energy 2023).

3.10.2 Environmental Consequences

3.10.2.1 Impact Level Definitions for Cultural Resources

This Final 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 3.10-2.

Table 3.10-2 Adverse Impact Level Definitions for Cultural Resources

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.

Impact Level	Historic Properties Under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
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).
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.

3.10.3 Impacts of the No Action Alternative 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 activities 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 F, *Planned Activities Scenario*.

3.10.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for cultural resources described in Section 3.10.1, *Descriptions of the Affected Environment on Cultural Resources,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing and non-offshore wind and offshore wind activities. Ongoing activities in 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 affect cultural resources.

The following ongoing offshore wind activity in the geographic analysis area contributes to impacts on cultural resources.

- Continued O&M of the CVOW-Pilot Project (two WTGs) in Lease Area OCS-A 0497.

3.10.3.2 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). Other planned non-offshore wind activities that may have impacts on cultural resources include new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Appendix F, Section F.2 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 discussion assesses the potential impacts on these types of cultural resources from ongoing and planned wind facility developments during construction, O&M, and decommissioning and excludes the Proposed Action. BOEM assumes that the planned Kitty Hawk Offshore Wind Projects will be subject to NEPA and NHPA reviews and, as a result, will require the identification of cultural resources in their NEPA geographic analysis areas and NHPA APEs. The results of these project-specific studies to identify cultural resources are not yet available. Therefore, the No Action Alternative assumes that the same types of cultural resources identified in the geographic analysis area of the Proposed Action (i.e., marine cultural resources, terrestrial archaeological resources, and historic aboveground resources) are present in the geographic scopes of the planned Kitty Hawk Offshore Wind Projects and will be subject to the same IPFs as the Proposed Action. BOEM assumes that if project-specific cultural resource investigations identify historic properties in a project's APE and determines that the project would adversely affect said historic properties, BOEM will require the project to develop treatment plans to avoid, minimize, or mitigate effects to comply with the NHPA. Impacts are possible on marine cultural resources (i.e., marine archaeological resources and ASLFs), terrestrial archaeological resources, and historic aboveground resources.

Impacts on cultural resources are expected through the following primary IPFs.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, may pose 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 Virginia or North Carolina. The potential for accidental releases, volume of released material, and associated need for cleanup activities from future 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 future 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 buildings, structures, objects, and districts, which could include significant landscapes and TCPs; and damage to or removal of nearshore submerged 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 future offshore wind projects has the potential to cause permanent, adverse impacts on marine cultural resources. These activities would increase during the construction, O&M, and eventual decommissioning of future 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 cultural resources 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 from ongoing and planned activities, 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 previously undiscovered resources are discovered during construction.

Land disturbance: The construction of onshore components associated with future offshore wind projects, such as electrical export cables and onshore substations, could result in adverse physical impacts on known and undiscovered cultural resources. Such ground-disturbing construction activities could disturb or destroy undiscovered archaeological resources and TCPs, if present. The number of cultural resources subject to impacts and scale, extent, 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 treatment plans 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 future 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 offshore substations during operation. Up to 190 WTGs with a maximum blade tip height of approximately 1,042 feet (317.6 meters) AMSL would be added in the geographic analysis area for cultural resources (Kitty Hawk Offshore Wind North 2021; Kitty Hawk Offshore Wind South 2022).

Construction and decommissioning lighting would be most noticeable if construction activities occur at night. Up to three lease areas in the geographic analysis area could be constructed from 2024 through 2030 and beyond (with up to three projects simultaneously under construction between 2026 and 2028; see Appendix F, Table F-3). Some of the future offshore wind projects could require nighttime construction lighting, and all would require nighttime hazard lighting during operations. 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 WTGs or offshore substations and nearby vessels 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 future 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 cultural resources on the coasts of Virginia and North Carolina for which a dark nighttime sky is a contributing element to historical integrity. Such resources would include certain resource types that are assumed to have a dark nighttime sky as a character-defining feature, such as lighthouses or resources associated with historic events that may have occurred at night. 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 at least 27.9 statute miles (44.9 kilometers) from the shoreline in Corolla, North Carolina (Kitty Hawk Offshore Wind North 2021; Kitty Hawk Offshore Wind South 2022). 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 temporary, 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 offshore substations only when an aircraft is within a predefined distance of the structures (for a detailed explanation, see Section 3.20, *Scenic and Visual Resources*). For the Proposed Action, the reduced time of FAA hazard lighting resulting from an

ADLS, if implemented, would likely reduce the duration of the potential impacts of nighttime aviation lighting compared with the normal operating time that would occur without using ADLS. The use of ADLS or related systems on future offshore wind projects other than the Proposed Action would likely result in similar limits on the frequency of WTG and offshore substation 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 negligible to moderate.

Onshore structure lighting would be required for future 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, lighting associated with onshore components from future offshore wind activities could have long-term, continuous, negligible to moderate impacts on cultural resources.

Cable emplacement and maintenance: Construction of future offshore wind infrastructure would have permanent, geographically extensive, adverse impacts on cultural resources. Future offshore wind projects would result in seabed disturbance from foundation construction and installation of inter-array and offshore export cables and associated installation activities that may occur in cable corridors. Construction, O&M, and decommissioning of these cables may necessitate additional geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in adverse impacts. The only future offshore wind development projects (other than the Proposed Action) that are expected to lay cable in the geographic analysis area are Kitty Hawk Offshore Wind Projects (Lease Area OCS-A 0508) (Kitty Hawk Offshore Wind North 2021; Kitty Hawk Offshore Wind South 2022). The 2012 BOEM study and the Proposed Action studies (BOEM 2012; COP, Appendix F; Dominion Energy 2023) suggest that the offshore wind lease areas and export cable route corridors of the offshore wind projects would likely contain a number of marine archaeological resources and ASLFs subject to impacts from offshore construction activities.

As part of compliance with NHPA, BOEM and SHPOs will require offshore wind project lessees to conduct extensive geophysical surveys of offshore wind lease areas and offshore 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, due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided.

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 those ASLFs that are contributing elements to an NRHP-eligible TCP but cannot be avoided, mitigation would 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 the permanent, irreversible nature of the impacts.

Presence of structures: The development of future offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coasts of Virginia and North Carolina. In addition to the Proposed Action, up to 193 foundations (190 WTGs and a maximum of 3 suction caisson jacket foundations for electrical service platforms) would be added in the geographic analysis area for cultural resources, assuming WTGs with a maximum blade tip height of approximately 1,042 feet (317.6 meters) AMSL.

Impacts on cultural resources from the presence of structures would be limited to those cultural resources from which future offshore wind projects would be visible, which would typically be limited to historic buildings, structures, objects, and districts, and could include 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 cultural resources for which a maritime view, free of modern visual elements, is an integral part of their historic integrity and contributes to their eligibility for listing in the NRHP. Due to the distance between the reasonably foreseeable wind development projects and the nearest cultural resources, in most instances exceeding 27.9 miles (44.9 kilometers) (Kitty Hawk Offshore Wind North 2021; Kitty Hawk Offshore Wind South 2022), 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 3.20, *Scenic and Visual Resources*). While these factors would limit the intensity of impacts, the presence of visible WTGs from future offshore wind activities would have long-term, continuous, major impacts on cultural resources.

Additionally, the presence of onshore components associated with offshore wind projects, including substations, converter or switching stations, transmission lines, operations and maintenance 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 Virginia and North Carolina. The magnitude of impacts from the presence of structures would be greatest for aboveground cultural 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.

3.10.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, cultural resources would continue to be subject to impacts from existing environmental trends and ongoing activities. 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 effects are 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 are ground-disturbing activities and the introduction of intrusive visual elements, while the primary sources of offshore impacts are dredging, cable emplacement, and activities that disturb the seafloor. Given the extent of known cultural resources in the region and the 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** impacts on cultural resources.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and cultural resources would continue to be subject to impacts by 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 **moderate** due to the extent of known cultural resources in the region subject to impacts.

3.10.4 Relevant Design Parameters and Potential Variances in Impacts

This Final 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 E, *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 Dominion Energy would embed the WTGs and offshore substations into the seafloor in the Lease Area and the location of the cable in the Offshore ECRC;
- 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, such as historic buildings, structures, objects, and districts, which could include landscapes and TCPs), depending on the design, height, number, and distance of WTGs, offshore substations, and Onshore Project components (e.g., transmission lines, substations, and switching stations) visible from these resources.

Variability of the proposed Project design exists as outlined in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. The following summarizes the potential variances in impacts.

- WTG and offshore substation number, size, and location: If marine cultural resources cannot be avoided, impacts can be minimized with fewer WTGs and substation 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 and a setting free of modern visual elements is a contributing element to historical integrity.
- WTG and substation lighting: Arrangement and type of lighting systems, such as the implementation of an ADLS, 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 (inter-array, 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. Cable burial methods such as jetting tool, vertical injection, pre-trenching, scare plow, trenching (including leveling, mechanical cutting), plowing, and controlled-flow excavation could have varying degrees of potential to disturb or destroy marine cultural resources.
- Landfall for offshore export cable installation method: Selection of trenchless installation over open-cut installation could have decreased potential for disturbance of terrestrial archaeology.
- Onshore export cable width and burial depth: Reduced width and burial depth to reduce overall volume of excavation in the export cable construction corridor could decrease potential for unanticipated disturbance of terrestrial archaeology. 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.

Dominion Energy has committed to several measures to avoid, minimize, or mitigate impacts on cultural resources as described in Appendix H, *Mitigation and Monitoring,* Table H-1, and in the MOA (Attachment A of Appendix O).

3.10.5 Impacts of the Proposed Action on Cultural Resources

Under the Proposed Action, Dominion Energy would install up to 202 WTGs, 3 OSSs, and related 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 and terrestrial archaeological resources, historic aboveground resources, and potential but presently undocumented cultural landscapes or TCPs.

Specifically, the Proposed Action may have negligible to major impacts on 31 known marine archaeological resources (COP, Appendix F; Dominion Energy 2023); 6 ASLFs with archaeological or TCP potential (COP, Appendix F; Dominion Energy 2023); 24 known terrestrial archaeological resources (COP, Appendix G; Dominion Energy 2023); and 1 mid-20th century cemetery (i.e., 34-5027-0050) (COP, Appendix G; Dominion Energy 2023). The proposed Project would have moderate impacts on 25 historic aboveground resources that are historic properties located in the visual APE for Offshore Project components, including 1 NHL: the First Cape Henry Lighthouse (COP, Appendix H-1; Dominion Energy 2023). The proposed Project would have moderate to major impacts on 1 resource located in both the terrestrial and visual APE for Onshore Project components: the Camp Pendleton/State Military Reservation Historic District (COP, Appendix H-3; Dominion Energy 2023). This historic district would experience physical impacts due to the demolition of two contributing structures (i.e., Buildings 59 and 410) and removal of vegetation and visual impacts from visibility of Offshore Project components. See Appendix O for a complete list of historic properties in the marine, terrestrial, and visual APEs for the Project, and Attachment A in Appendix O for the MOA.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, could have impacts on cultural resources. The WTGs, offshore substations, and onshore substation for the Proposed Action would include storage for a variety of potential chemicals such as coolants, oils, lubricants, and diesel fuel (COP, Tables 3.3-2 and 3.3-6, and Section 3.3.2.5; Dominion Energy 2023). The Proposed Action would also require use of several types of machinery, vehicles, ocean-going vessels, and aircraft from which there may be unanticipated release or spills of substances onto land or into receiving waters. 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. Dominion Energy has produced an Oil Spill Response Plan to encompass activities for this Project (COP, Appendix Q; Dominion Energy 2023).

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 historic buildings, structures, objects, and districts, which could include 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 cultural resources. Dominion Energy's marine geophysical archaeological surveys identified 31 potential marine archaeological resources that are potential historic properties: 18 in or near the proposed offshore Lease Area and 13 in or near the Offshore ECRC (COP, Appendix F; Dominion Energy 2023). Additionally, 5 ASLFs were identified in the Lease Area. No ASLFs were identified in the Offshore ECRC. One additional landform was identified outside of but near the Lease Area and is considered for potential impacts from the Proposed Action because of its proximity.

The severity of effects of this IPF would depend on the horizontal and vertical extent of disturbance relative to the size of the marine archaeological resource or ASLF subject to impacts. Dominion Energy has committed to avoiding all 31 identified marine archaeological resources and 6 ASLFs. Based on this information, BOEM anticipates the impacts of the Proposed Action on marine cultural resources would be negligible. More substantial impacts could occur if previously undiscovered resources are discovered during construction.

Land disturbance: Land disturbance associated with the construction of Onshore Project components could have impacts on cultural resources. 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. Dominion Energy's investigations have identified 24 terrestrial archaeological resources, 1 cemetery, and 1 historic aboveground resource in or near the terrestrial APE or in areas that had been previously proposed for ground-disturbing activities (COP, Appendix G; Dominion Energy 2023). Of these resources, 3 (i.e., 44CS0250, 44VB0162, and 44VB0412) are potentially eligible for listing in the NRHP and are, therefore, historic properties. BOEM anticipates the Proposed Action would have minor impacts on these 3 historic properties as land disturbances would be limited to areas lacking scientific or cultural value (see Table 3.10-2 for a description of adverse impact level definitions for cultural resources). BOEM anticipates the Proposed Action would have negligible impacts on the other 20 terrestrial archaeological resources and cemetery.

Cultural resource investigations have also determined that the Proposed Action would have moderate impacts on one historic aboveground resource: the Camp Pendleton/State Military Reservation Historic District (134-0413). The demolition of two contributing structures, Buildings 59 and 410, for the installation of the underground transmission lines associated with the landing location to the Harpers Route would alter the setting and viewshed, resulting in a moderate impact on the resource (COP, Appendix H-3; Dominion Energy 2023). BOEM anticipates that Dominion Energy would implement plans to avoid, minimize, or mitigate impacts on aboveground historic properties as aligned with Virginia SHPO and NHPA requirements. Dominion Energy would determine treatment options through consultation with BOEM, the Virginia Department of Military Affairs-Virginia Army National Guard, the Virginia SCC, Virginia SHPO, and consulting parties. Dominion Energy notes that treatment options could include any of the following: detailed site documentation, historic research, and historic preservation studies; preparation of digital media or museum-type exhibits for public interpretation; installation of historic markers or signs; installation of vegetative screening; or contributions to historical preservation organizations or specific preservation projects. Additionally, the Young Men's Christian Association foundations that are part of the historic district will be protected during construction with the installation of temporary fencing.

Based on this information, the impacts of the Proposed Action on cultural resources are expected to be localized and permanent and range from negligible to major. BOEM will require Dominion Energy to implement plans to avoid, minimize, or mitigate impacts on cultural resources that are historic properties as aligned with Virginia SHPO and NHPA requirements. More substantial impacts could occur if previously undiscovered resources are discovered during construction (see Appendix O, Attachment A for the MOA, which includes Dominion Energy's post-review discovery plans [PRDPs] for archaeological resources).

Lighting: Development of the offshore wind industry 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 hazard/warning lighting on WTGs and offshore substations during operations. 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 could occur on cultural resources for which a dark nighttime sky or unobstructed ocean views are a contributing element to their historic integrity. Of the 712 historic aboveground resources reviewed in the offshore visual APE that could potentially be affected, up to 25 aboveground historic properties would be affected by operational lighting on offshore components.

Construction and decommissioning of the Proposed Action may require nighttime vessel and construction-area lighting. The lighting impacts would be short term, as they would be limited to the construction phase of either action alternative. The intensity of nighttime construction lighting would be limited to the active construction area at any given time. Impacts would be reduced by the distance between the nearest construction area (i.e., the closest line of WTGs) and the nearest cultural resources on the Virginia and North Carolina coasts. 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. Based on this information, the impact of vessel nighttime lighting from the Proposed Action on cultural resources is expected to be localized, short term, and negligible.

The Proposed Action would include nighttime and daytime use of operational phase aviation and vessel hazard avoidance lighting on WTGs and offshore substations (COP, Section 3.5.3; Dominion Energy 2023). Permanent aviation and vessel warning lighting would be required on all WTGs and offshore substations built by offshore wind projects. Operational lighting from the Proposed Action would have long-term, permanent, moderate impacts on up to 25 aboveground historic properties.

The operation and maintenance of onshore facilities could potentially impact cultural resources in the visual APE for Onshore Project components. To minimize and mitigate onshore impacts, Dominion Energy would evaluate vegetative buffers to help screen views of the onshore substation and switching station; design the lighting of the onshore substation and switching station to reduce light pollution where feasible, such as using downward lighting or motion-detecting sensors; consult with the U.S. Navy, City of Virginia Beach, and the City of Chesapeake to evaluate color treatment and other visual impact mitigations for the switching station and the onshore substation; implement an ADLS; develop a lighting, marking, and signal plan for review and concurrence by BOEM and the USCG based on consultations with the Fifth Coast Guard District; conform to applicable federal laws and regulations; and use NPS sustainable lighting best practices where practicable (COP, Section 4.3.4.4; Dominion Energy 2023). Therefore, onshore facility operational lighting from the Proposed Action would have negligible overall impacts on cultural resources.

Cable emplacement and maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., sand wave clearance, boulder removal) and cable installation via jet plow, mechanical plow, or mechanical trenching, which could have impacts on cultural resources. The specific cultural resources subject to potential impacts, avoidance commitments, 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, the impacts of the Proposed Action on marine cultural resources from this IPF are expected to be negligible based on Dominion Energy's commitments to avoidance of marine cultural resources. More substantial impacts could occur if previously undiscovered resources are discovered during construction.

Presence of structures: The presence of structures, including foundations and scour protection for WTGs and offshore substations, in the Lease Area could have impacts on cultural resources. Dominion Energy's historic aboveground resource investigations of the visual APE for Offshore Project components determined that the presence of offshore structures could result in adverse visual effects on 25 aboveground historic properties (COP, Appendix H-1; Dominion Energy 2023). The study determined that an uninterrupted sea view, free of modern visual elements, is a contributing element to the NRHP eligibility of these properties. As a result, the presence of visible WTGs from the Proposed Action would have long-term, continuous, widespread, moderate impacts on these resources. Although the operation life of the Project is 33 years, and the WTGs and offshore substations would be removed after that period, the presence of visible WTGs from the Proposed Action alone would have long-term, continuous, widespread, 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.

The presence of onshore structures, including substations, converter stations, transmission lines, and O&M facilities, could have impacts on cultural resources. Dominion Energy's Onshore Historic Resources Visual Effects Analysis (HRVEA) of the visual APE for Onshore Project components identified 322 historic aboveground resources (COP, Appendix H-3; Dominion Energy 2023). Thirteen of these resources have been determined to be historic properties listed or eligible for listing on the NRHP. BOEM has determined the undertaking would have an adverse effect on 1 of these 13 aboveground historic properties: the Camp Pendleton/State Military Reservation Historic District in Virginia Beach, Virginia, which is also located in the visual APE for Offshore Project components. With the elimination of certain Onshore Project components from Dominion Energy's PDE (i.e., Interconnection Cable Route Options 2, 3, 4, and 5), BOEM finds that the undertaking would have no effect on 5 of the 13 aboveground historic properties that would have otherwise been subject to visual adverse effects from the undertaking: the Albemarle & Chesapeake Canal Historic District in Chesapeake, Virginia; the Albemarle & Chesapeake Canal in Chesapeake, Virginia; a worker's house associated with Murray Farms in Chesapeake, Virginia; a residence at 2773 Salem Road in Virginia Beach, Virginia; and the Centreville-Fentress Historic District in Chesapeake, Virginia.

The NHPA Section 106 consultation process has culminated in an MOA detailing avoidance, minimization, mitigation, and monitoring measures to resolve adverse effects on historic properties, including cumulative adverse visual effects caused by the Project. These measures are listed in the MOA (Appendix O, Attachment A) and Appendix H of this Final EIS.

3.10.5.1 Cumulative Impacts of the Proposed Action

Construction and installation, O&M, and decommissioning of the Proposed Action and other offshore wind projects could potentially have impacts on cultural resources. The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind and offshore wind activities. In context of reasonably foreseeable trends, impacts from accidental releases from offshore wind projects would be similar to those of the Proposed Action and be negligible in most cases, except for rare cases of large-scale accidental release that represent major impacts. The overall impacts on marine cultural resources from accidental releases from the Proposed Action combined with those from ongoing and planned activities 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.

The Proposed Action, combined with impacts from ongoing and planned activities, could have impacts on marine cultural resources through anchoring and cable emplacement and maintenance. BOEM anticipates that lead federal agencies and relevant SHPOs would require the lessees for future 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. Additionally, the cumulative impacts from land disturbance would result in localized, permanent, negligible to major impacts on terrestrial cultural resources. BOEM would also continue to require developers to avoid, minimize, or mitigate impacts on any identified marine cultural resources during construction, operation, and decommissioning. BOEM has committed to working with applicants, consulting parties, Native American tribes, Virginia SHPO, and North Carolina SHPO to develop specific treatment plans to address effects on marine cultural resources that cannot be avoided by proposed offshore wind development projects. Development and implementation of Project-specific treatment plans, agreed to by all 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, in context of reasonably foreseeable trends, the impacts on cultural resources from anchoring, cable emplacement and maintenance, and land disturbance from the Proposed Action, combined with those 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 previously undiscovered resources are discovered during construction.

Lighting from the offshore wind developments could result in impacts on cultural resources. 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 the majority of the WTGs and OSSs in the geographic analysis area that could potentially have cumulative visual impacts on aboveground historic properties. Construction of other offshore wind projects in the geographic analysis area would contribute similar lighting impacts from nighttime vessel and construction area lighting as under the Proposed Action. 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 reduced in intensity. If offshore wind projects do not commit to using ADLS or a related system, operational lighting from the Proposed Action combined with ongoing and planned activities including offshore wind would have moderate impacts on cultural resources. Therefore, in context of reasonably foreseeable environmental trends, the Proposed Action, combined with ongoing and planned activities, would result in localized and negligible to moderate impacts on cultural resources.

BOEM conducted a Cumulative Historic Resources Visual Effects Assessment (CHRVEA) to evaluate visual impacts on the 25 adversely affected aboveground historic properties in the visual APE for Offshore Project components (BOEM 2022). The planned activities scenario effects assessment determined the number of WTGs from the Proposed Action and offshore wind projects that could be constructed in the geographic analysis area and from each historic property. The CHRVEA assessed these values using numbers and heights of WTGs from the Proposed Action and offshore wind projects in the geographic analysis area (Appendix F, Table F2-1) in order to determine the maximum number of WTGs that could be theoretically visible from the Proposed Action and other offshore wind projects. Other offshore wind projects included in the cumulative WTG count from historic properties included the CVOW-Pilot Project and Kitty Hawk Offshore Wind North Project; the exact WTG locations for the Kitty Hawk Offshore Wind South Project are not yet known, so that project was not included in the analysis.

The CHVREA demonstrated that portions of the WTGs could theoretically be visible from ground-level and high elevations. Substantially fewer WTGs would be visible from lower elevations or locations without clear east-facing seaward views. The 25 historic properties would be subject to the largest scale impacts, with portions of at least 207 WTGs of the up to 276 WTGs represented in the full build-out of offshore wind development activities theoretically visible from all but one of the properties. The Project WTG locations represent 72.7 to 99 percent of the total WTGs that are theoretically visible from the 25 historic properties in the planned activities scenario. Thus, the Project WTGs would constitute the majority of the WTGs potentially visible from the properties.

The intensity of cumulative visual impacts on these historic properties would be limited by distance and environmental and atmospheric factors. As discussed in the Visual Impacts Assessment (COP, Appendix I-1; Dominion Energy 2023), the visibility of WTGs would be further reduced by environmental and atmospheric factors such as meteorological conditions, such as cloud cover, fog, or haze. 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, and moderate impacts on the 25 historic properties.

3.10.5.2 Conclusions

Impacts of the Proposed Action. The Proposed Action 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 Dominion Energy and implementation of mitigation measures 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 preconstruction NHPA requirements to identify historic properties, assess potential effects, and develop treatment plans to resolve effects through avoidance, minimization, or mitigation. These NHPA-required, "good-faith" efforts to identify historic properties and address impacts resulted in or contributed to Dominion Energy identifying potential measures to reduce the magnitude of impacts on cultural resources (Appendix H).

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 future offshore wind projects as they complete the NHPA Section 106 review process. However, mitigation of adverse visual effects on historic properties would still be needed under the Proposed Action. Therefore, the overall impacts on historic properties from either action alternative would likely qualify as **moderate** to **major** because a notable and measurable impact requiring mitigation is anticipated.

Cumulative impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from the Proposed Action in combination with other ongoing and planned activities 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 **moderate** to **major** due to the long-term or permanent and irreversible impacts on archaeological (marine and terrestrial) resources, ASLFs, and historic aboveground resources if they cannot be avoided, and long-term impacts on other historic aboveground resources, including the First Cape Henry Lighthouse NHL.

3.10.6 Impacts of Alternative B on Cultural Resources

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative.

The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, described in this section.

Impacts of Alternative B. Alternative B involves the exclusion of Offshore Project components near the northern border of the Lease Area to avoid impacts on cultural resources and marine habitats in the Triangle Reef Fish Haven and in the northwest corner of the Lease Area to avoid conflicts with a proposed vessel traffic fairway. Proposed activities under Alternative B 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 this alternative would be the same as those under the Proposed Action. Additionally, given the size, location, and number of retained WTGs for this alternative, Alternative B would not substantially change the overall visual impact of Offshore Project components. As a result, impacts on historic aboveground resources in the visual APE for Offshore Project components under these alternatives would be the same or similar to those under the Proposed Action.

Due to Dominion Energy's commitments to avoidance made since publication of the Draft EIS, impacts under Alternative B on marine cultural resources that are historic properties are no longer anticipated to differ from impacts under the Proposed Action. While implementation of Alternative B would result in avoidance of impacts on 11 large, scuttled World War II-era ships, tires, cable spools, and other materials intentionally deposited since the 1970s to facilitate development of the Fish Haven area (COP, Sections 2.1.1 and 4.2.4.2; Dominion Energy 2023), these have been determined to be ineligible for listing in the NRHP. Additionally, while removal of Offshore Project components under this alternative would reduce impacts on presently undiscovered but potential marine archaeological resources, this alternative would not substantially change impacts on marine archaeological resources overall. As such, impacts on marine cultural resources under Alternative B would be the same or similar to those of the Proposed Action.

Cumulative impacts of Alternative B. In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B to the cumulative impacts on cultural resources would be appreciable—the same as under the Proposed Action.

3.10.6.1 Conclusions

Impacts of Alternative B. The impacts resulting from individual IPFs associated with Alternative B alone on cultural resources may be reduced compared to those under the Proposed Action. However, impacts on cultural resources that are historic properties eligible for listing in the NRHP would be the same as the Proposed Action. As a result, Alternative B would have similar **moderate** to **major** impacts on cultural resources as the Proposed Action that would be resolved through Dominion Energy's implementation of avoidance, minimization, mitigation, and monitoring measures developed through the NHPA Section 106 consultation process.

Cumulative impacts of Alternative B. In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B to the cumulative impacts on cultural resources would be appreciable—the same as for the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative B when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.10.7 Impacts of Alternative C on Cultural Resources

Impacts of Alternative C. Alternative C (Sand Ridge Impact Minimization Alternative) would include the range of Project design parameters as described under Alternative B. However, in addition to avoiding the Fish Haven and the proposed vessel traffic fairway, Alternative C would avoid and minimize impacts on sand ridge habitat and shipwrecks through a combination of micrositing of infrastructure, removing of four WTGs from priority ridge habitat, and relocating one WTG to a spare position.

Due to Dominion Energy's commitments to avoidance made since publication of the Draft EIS, impacts under Alternative C on marine cultural resources that are historic properties are no longer anticipated to differ from impacts under the Proposed Action. While implementation of Alternative C would result in avoidance of impacts on 11 large, scuttled World War II–era ships, tires, cable spools, and other materials intentionally deposited since the 1970s to facilitate development of the Fish Haven (COP, Sections 2.1.1 and 4.2.4.2; Dominion Energy 2023), these have been determined to be ineligible for listing in the NRHP. Additionally, while removal of Offshore Project components under Alternative C would reduce impacts on presently undiscovered but potential marine archaeological resources, this alternative would not substantially change impacts on marine archaeological resources overall. As such, impacts on marine cultural resources under Alternative C would be the same or similar to those of the Proposed Action.

Cumulative impacts of Alternative C. In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the cumulative impacts on cultural resources would be appreciable—the same as under the Proposed Action.

3.10.7.1 Conclusions

Impacts of Alternative C. The impacts resulting from individual IPFs associated with Alternative C alone on cultural resources may be reduced compared to those under the Proposed Action. However, impacts on a majority of cultural resources that are historic properties eligible for listing in the NRHP would be the same as the Proposed Action. As a result, Alternative C would have similar **moderate** to **major** impacts on cultural resources as the Proposed Action that would be resolved through Dominion Energy's implementation of avoidance, minimization, mitigation, and monitoring measures developed through the NHPA Section 106 consultation process.

Cumulative impacts of Alternative C. In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the cumulative impacts on cultural resources would be appreciable—the same 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**.

3.10.8 Impacts of Alternative D on Cultural Resources

Impacts of Alternative D. Alternative D includes two sub-alternatives (D-1 and D-2) with modifications to Project components to reduce potential impacts on sensitive onshore habitats, including wetlands. Proposed activities under this alternative would not involve any changes to Offshore Project components; therefore, impacts under Alternative D on historic aboveground resources in the visual APE for Offshore Project components and marine cultural resources would be the same as those under the Proposed Action. Impacts on terrestrial archaeological resources as well as historic aboveground resources located in the visual APE for Onshore Project components could differ under Alternative D as compared to those anticipated under the Proposed Action. These anticipated sub-alternative impact differences are described below.

Alternative D-1 would involve the use of Interconnection Cable Route Option 1. This interconnection cable route option would be approximately 14.3 miles (23 kilometers) long and installed entirely overhead. The proposed Harpers Switching Station would be built and used under this sub-alternative. Alternative D-2 would involve the use of Interconnection Cable Route Option 6 (Hybrid Route). This interconnection cable route option would be approximately 14.3 miles (23 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. The proposed Chicory Switching Station would be built and used under this sub-alternative.

Implementation of either Alternatives D-1 or D-2 would result in the same or similar impacts on historic aboveground resources.[1] While adoption of Alternative D-2 may reduce the potential visibility of Onshore Project components, impacts on other historic aboveground resources that BOEM has determined to be historic properties potentially eligible, eligible, or presently listed in the NRHP are not anticipated to differ between Alternative D-1 or D-2. As such, implementation of either Alternative D sub-alternative is anticipated to have the same impacts on historic aboveground resources as the Proposed Action.

Implementation of either Alternative D-1 or D-2 would result in similar impacts on known terrestrial archaeological resources due to ground-disturbing activities anticipated for the construction of either sub-alternative. Alternatives D-1 and D-2 would have minor impacts on the three terrestrial archaeological resources identified in Dominion Energy's cultural resource investigations as historic properties potentially eligible for listing in the NRHP. While BOEM anticipates that Dominion Energy's commitments to avoidance and monitoring measures for the identified cemetery near the proposed Harpers Switching Station would result in the Project having no impact on this resource, adoption of Alternative D-2 would eliminate the risk entirely. Adoption of Alternative D-2 would result in full avoidance of the cemetery.

In general, the adoption of Alternative D-1 (Route Option 1 installed entirely overhead) may result in fewer potential impacts on terrestrial archaeological resources as compared to Alternative D-2 (Route Option 6 installed as hybrid of underground and overhead), because the extent of ground disturbance from Project construction activities on presently undiscovered terrestrial archaeological resources that may be historic properties may be lesser for an entirely overhead route than a route with an underground segment. Overall, impacts on terrestrial archaeological resources may be similar or increased under Alternative D-2 compared to those of Alternative D-1 and, therefore, also similar or increased compared to those of the Proposed Action.

Cumulative impacts of Alternative D. In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the cumulative impacts on cultural resources would be appreciable—the same as under the Proposed Action.

3.10.8.1 Conclusions

Impacts of Alternative D. The impacts resulting from individual IPFs associated with Alternative D alone on cultural resources may be reduced, similar to, or increased compared to impacts under the Proposed Action. In general, implementation of Alternative D-2 may reduce the potential visibility of Onshore Project components, thereby reducing potential impacts on historic aboveground resources; however, Alternative D-2 would also increase the extent of ground disturbance in the installation of underground Onshore Project components, thereby increasing the potential for impacts on terrestrial archaeological resources. As a result, Alternative D would have similar **moderate** to **major** impacts on cultural resources as the Proposed Action that would be resolved through Dominion Energy's implementation of avoidance, minimization, mitigation, and monitoring measures developed through the NHPA Section 106 consultation process.

[1] Physical impacts on the Camp Pendleton/State Military Reservation Historic District, a historic aboveground resource that is a historic property presently listed in the NRHP, are not subject to change under Alternative D as the Onshore Project components that would have impacts on this resource (i.e., the cable landing location and onshore export cable route to the Harpers Road Switching Station) are not subject to modification under Alternative D.

Cumulative impacts of Alternative D. In the context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the cumulative impacts on cultural resources would be appreciable—the same as for the Proposed Action. BOEM anticipates that the cumulative impacts on cultural resources associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.10.9 Agency-Required Mitigation Measures

In the Draft EIS, BOEM analyzed several measures proposed to minimize impacts on cultural resources. After publication of the Draft EIS, BOEM continued Section 106 consultation with consulting parties to develop measures for resolving adverse effects on historic properties pursuant to 36 CFR 800.6 and will execute the Section 106 MOA prior to issuance of the ROD. A copy of the revised draft MOA is provided as Attachment A in Appendix O. These mitigation measures, as described in Table 3.10 3, are also identified in Appendix H, Table H-2. Dominion Energy will be required to comply with the executed Section 106 MOA.

Table 3.10-3 Measures Resulting from Consultations (Also Identified in Appendix H, Table H-2): Cultural Resources

Measure	Description	Effect
Compliance with Section 106 MOA	Dominion Energy will comply with stipulations of *The Memorandum Of Agreement Among the Bureau Of Ocean Energy Management, the State Historic Preservation Officers of Virginia and North Carolina, and the Advisory Council on Historic Preservation Regarding the Coastal Virginia Offshore Wind Commercial Project* (MOA**;** Attachment A) as developed by BOEM, federally recognized tribes, SHPOs, and consulting parties (as defined in the Section 106 regulations) through NHPA Section 106 consultations. Consulting parties include those who are property owners of or have demonstrated interest in the historic properties BOEM has determined would be adversely affected by the Project.	Compliance with stipulations in the MOA would result in the resolution of adverse effects on historic properties through avoidance, minimization, mitigation, and monitoring measures.
Avoidance of Adverse Effects on Historic Properties in Marine Area of Potential Effect	Per MOA Stipulation I.A.1 and the associated avoidance plan for marine cultural resources (MOA, Attachment 3), Dominion Energy will comply with horizontal protective buffers recommended by the Qualified Marine Archaeologist for all 31 identified marine archaeological resources (i.e., Targets 1–31) and 6 identified ancient submerged landform features (i.e., P-01, P-02, P-03, P-04-A, P-04-B, and P-05) to avoid adverse effects on these historic properties in the marine APE.	Implementation of and compliance with horizontal protective buffers to avoid historic properties in the marine APE would result in negligible impacts on these resources.
Marine Archaeology Post-Review Discovery Plan	Per MOA Stipulation XI, if historic properties are discovered that may be historically significant or unanticipated effects on historic properties are found, or in the event of a post-review discovery of a historic property or unanticipated effects on a historic property	Enforcement of this measure would be under the jurisdiction of Virginia SHPO if in state waters and BOEM/BSEE if in federal waters. Implementation of a

Measure	Description	Effect
	prior to or during construction, installation, O&M, or decommissioning of the Project, Dominion Energy will implement actions that are consistent with the PRDP for marine archaeology (MOA, Attachment 7).	PRDP would reduce potential impacts on any archaeological resources discovered during construction, installation, O&M, or decommissioning of the Project to a minor level by preventing further physical impacts on the resources. Greater moderate or major impacts could occur if further physical impacts on the resources are unavoidable or require mitigation.
Avoidance of Adverse Effects on Historic Properties in Terrestrial Area of Potential Effect	Per MOA Stipulation I.A.2 and the associated avoidance plan for cultural resources located in the terrestrial APE (MOA, Attachment 4), Dominion Energy will install temporary fencing for avoiding adverse effects on three terrestrial archaeological resources (i.e., 44CS0250, 44VB0162, and 44VB0412) and one grave/memorial on NAS Oceana (i.e., 34-5027-0050) in the terrestrial APE; and on one terrestrial archaeological resource outside of but adjacent to the terrestrial APE.	Implementation of and compliance with temporary fencing to avoid historic properties in the terrestrial APE would result in negligible impacts on these resources.
Archaeological Monitoring in the Terrestrial Area of Potential Effects	Per MOA Stipulation II.A.1, Stipulation X, and the associated minimization plan for cultural resources located in the terrestrial APE (MOA, Attachment 4), Dominion Energy will conduct archaeological monitoring of construction activities such that an archaeological monitor will be present at the locations of the following historic properties and cultural resources during construction activities that involve subsurface disturbance: 44CS0250, Camp Pendleton/State Military Reservation Historic District, and the grave/memorial on NAS Oceana (i.e., 34-5027-0050).	Implementation of and compliance with archaeological monitoring would result in negligible impacts by avoiding these resources or minor impacts by preventing further physical impacts on the resources. Greater moderate or major impacts could occur if further physical impacts on the resources are unavoidable or require mitigation.
Terrestrial Archaeology Post-Review Discovery Plan	Per MOA Stipulation XI, if historic properties are discovered that may be historically significant or unanticipated effects on historic properties are found, or in the event of a post-review discovery of a historic property or unanticipated effects on a historic property prior to or during construction, installation, O&M, or decommissioning of the Project, Dominion Energy will implement actions that are consistent with the PRDP for terrestrial archaeology (MOA, Attachment 8).	Enforcement of this measure would be under the jurisdiction of Virginia SHPO. Implementation of a PRDP would reduce potential impacts on any archaeological resources discovered during construction, installation, O&M, or decommissioning of the Project to a minor level by preventing further physical impacts on the resources. Greater moderate or major impacts could occur if further

Measure	Description	Effect
		physical impacts on the resources are unavoidable or require mitigation.
Avoidance of Adverse Effects on Historic Properties in Visual Area of Potential Effects	Per MOA Stipulation I.A.3, to maintain avoidance of adverse effects on historic properties in the visual APE where BOEM determined no adverse effects or where no effects would occur, BOEM will require Dominion Energy to ensure Project structures are within the design envelope, sizes, scale, locations, lighting prescriptions, and distances that were used by BOEM to inform the definition of the APE for the Project and for determining effects in the *Finding of Adverse Effect for the Coastal Virginia Offshore Wind Commercial Construction and Operations Plan* (Appendix O).	Implementation of these measures to avoid impacts would result in negligible impacts on historic properties in the visual APE.
Minimization of Adverse Effects on Historic Properties in the Visual Area of Potential Effects	Per MOA Stipulation II.A.2, a. Dominion Energy will use uniform WTG design, speed, height, and rotor diameter to reduce visual contrast and decrease visual clutter. b. Dominion Energy will reserve the option to reduce the number of constructed WTGs from a maximum proposed number of 202 positions. c. Dominion Energy will apply a paint color to the WTGs no lighter than RAL 9010 pure white and no darker than RAL 7035 light gray to help reduce potential visibility of the turbines against the horizon during daylight hours. d. Dominion Energy has committed to the use of an ADLS to automatically activate lights when aircraft approach and then return to darkness. The WTGs and OSSs will be lit and marked in accordance with FAA and USCG lighting standards and consistent with BOEM's *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (April 28, 2021) to reduce light intrusion.	Implementation of minimization measures would result in reduced impacts on historic properties in the visual APE from the Proposed Action but would not negate any adverse effects and would not change the impact level.
Historic Properties Treatment Plans	Per MOA Stipulation III.A.1 and the associated Historic Property Treatment Plans (HPTPs) (MOA, Attachments 5, 6, and 7), BOEM will ensure measures described in the HPTPs to resolve adverse effects on the 24 adversely affected historic properties are required as conditions of approval of the Project COP and are funded and implemented by Dominion Energy according to a timeline determined through consultation.	Development and implementation of HPTPs detailing and specifying processes, responsibilities, and schedule for completion associated with fulfilling compensatory mitigation actions appropriate to fully address the nature, scope, size, and magnitude of

Measure	Description	Effect
	These are the 24 adversely affected historic properties: • Atlantic Wildfowl Heritage Cottage/De Witt Cottage (Virginia Beach, Virginia) • Camp Pendleton/State Military Reservation Historic District (Virginia Beach, Virginia) • Cavalier Hotel and Beach Club (Virginia Beach, Virginia) • Cavalier Shores Historic District (Virginia Beach, Virginia) • Chesapeake Bay Bridge-Tunnel (Northampton County and Virginia Beach, Virginia) • Chesapeake Light Tower (Virginia Beach, Virginia) • Currituck Beach Lighthouse (Corolla, Currituck County, North Carolina) • Cutty Sark Motel Efficiencies (Virginia Beach, Virginia) • Econo Lodge/Empress Motel (Virginia Beach, Virginia) • First Cape Henry Lighthouse (National Historic Landmark; Fort Story, Virginia Beach, Virginia) • Fort Story Historic District (Fort Story, Virginia Beach, Virginia)[2] • Hilton Washington Inn/Quality Inn and Suites (Virginia Beach, Virginia) • House (100 54th Street, Virginia Beach, Virginia) • House (4910 Ocean Front Avenue, Virginia Beach, Virginia) • House (5302 Ocean Front Avenue, Virginia Beach, Virginia) • House (7900 Ocean Front Avenue, Virginia Beach, Virginia) • House (8304–8306 Ocean Front Avenue, Virginia Beach, Virginia) • House (8600 Ocean Front Avenue, Virginia Beach, Virginia) • Oceans II Condominiums/Aeolus Motel (Virginia Beach, Virginia) • Sandbridge Historic District (Virginia Beach, Virginia) • Seahawk Motel (Virginia Beach, Virginia) • Seatack Lifesaving Station/U.S. Coast Guard Station (Virginia Beach, Virginia)	impacts, including cumulative impacts, caused by the Project, on historic properties would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would guide fulfillment of compensatory mitigation actions.

[2] The Fort Story Historic District is part of the Joint Expeditionary Base Little Creek-Fort Story.

Measure	Description	Effect
	• Second Cape Henry Lighthouse (Fort Story, Virginia Beach, Virginia) • Virginia House (Virginia Beach, Virginia) The HPTPs have been developed in consultation with consulting parties, including those who are property owners of or have demonstrated interest in the historic properties BOEM has determined would be adversely affected by the Project.	

Table 3.10-4 Additional Agency-Required Measures[1]

Measure	Description	Effect
Lighting mitigation	Dominion Energy will comply with BOEM's detailed Lighting and Marking Guidelines and NPS sustainable lighting best practices.	Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Project. Additionally, Dominion Energy has committed to the use of an ADLS to reduce the duration of the potential impacts from nighttime aviation lighting as compared with the normal operating time that would occur without using ADLS.

Also Identified in Appendix H, Table H-3: Cultural Resources.

3.10.9.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.10 3 and Table H-2 in Appendix H are incorporated in the Preferred Alternative. Mitigation to resolve adverse visual effects on historic properties and to comply with the stipulations of the MOA would not reduce the impacts on the historic property. Rather, these measures would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Project. Implementation of a PRDP for marine archaeological resources (Attachment 7 of the MOA [Appendix O, Attachment A]) and PRDP for terrestrial archaeological resources (Attachment 8 of the MOA [Appendix O, Attachment A]) would reduce potential impacts on any archaeological resources discovered during construction, installation, O&M, or decommissioning of the Project to a minor level by preventing further physical impacts on the resources. Greater moderate or major impacts could occur if further physical impacts on the resources are unavoidable or require mitigation.

3.11. Demographics, Employment, and Economics

This section discusses potential impacts on demographics, employment, and economics from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.11-1, includes the cities where proposed onshore infrastructure and potential port cities are located, as well as the cities closest to the Wind Farm Area: Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach Cities, Virginia. All incorporated cities in Virginia are classified as independent cities and considered as county equivalents by the U.S. Census Bureau for the purposes of data collection.

3.11.1 Description of the Affected Environment for Demographics, Employment, and Economics

The cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach are notable for coastal activities such as swimming, fishing, surfing, and sailing along Virginia's ocean beaches from Grandview Beach in Hampton to False Cape State Park in Virginia Beach. Coastal communities provide hospitality, entertainment, and recreation for many visitors each year and benefit from high tourism employment. In 2019, travel to Virginia Beach yielded $1.6 billion in spending to employ 13,000 people (COP, Section 4.4.5; Table 4.4-17; Dominion Energy 2023a). The geographic analysis area is part of the Virginia Beach–Norfolk–Newport News VA-NC Metropolitan Statistical Area (MSA) (also known as the Hampton Roads MSA), which had a total estimated population of 1,768,901 in 2019. The Hampton Roads region is known for its maritime industry, large military installations, and tourism industry, which is dominated by cultural history and coastal recreation (COP, Section 4.4.1.1; Dominion Energy 2023a). Data on population and demographics for the state of Virginia and for the cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach are provided in Table 3.11-1 and Table 3.11-2. The population of Hampton, Newport News, and Portsmouth declined between 2010 and 2019, while the population of Virginia and Chesapeake, Norfolk, and Virginial Beach increased. The U.S. Census Bureau estimated the 2019 population of Norfolk at about 240,000 residents. Norfolk has the lowest percentage of residents over age 65 and the lowest median age. The population of Chesapeake City grew at the highest rate, 9.4 percent from 2010 to 2019, followed by Virginia Beach with 3.3 percent and Norfolk with 1 percent; while, the population of Newport News, Portsmouth, and Hampton declined by 1.2 percent, 1.7 percent, and 2.9 percent, respectively. The population of the six cities are all younger than or the same as, on average, Virginia, with a higher percentage of residents aged 65 or older and a higher median age.

Table 3.11-1 Demographic Trends (2010–2019)

Jurisdiction	2010 Population	2019 Population	2010–2019 Percent Population Change	2019 Percent Population 18–64	2019 Percent Population 65 or Older	2019 Median Age
Virginia	7,841,754	8,454,463	7.8	62.9	15	38.2
Chesapeake city	219,268	239,982	9.4	62.8	13	36.9
Hampton city	139,046	135,041	-2.9	63.9	15	36.2
Newport News city	181,822	179,673	-1.2	64.1	12.7	33.5
Norfolk city	242,143	244,601	1.0	69.4	10.9	30.7
Portsmouth city	96,785	95,097	-1.7	62.1	14.5	35.3
Virginia Beach city	435,996	450,201	3.3	64.0	13.7	36.2

Source: U.S. Census Bureau 2021a, 2021b.

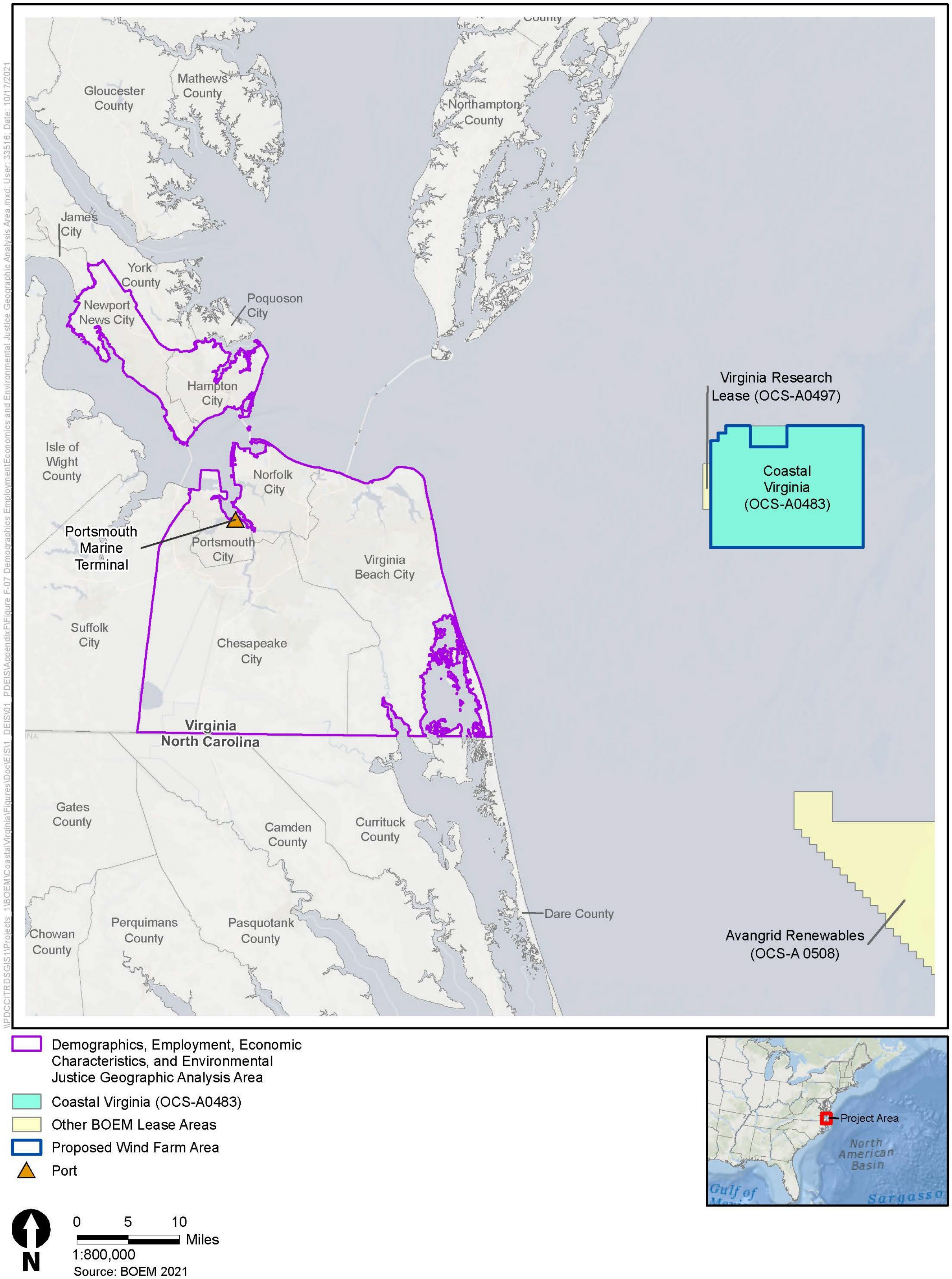


Figure 3.11-1 Demographics, Employment, Economic Characteristics, and Environmental Justice Geographic Analysis Area

Table 3.11-2 Demographic Data (2019)

Jurisdiction	Population	Population Density (persons per mi²)[1]	Per Capita Income (in USD)	Total Employment	Unemployment Rate (percent)
Virginia	8,454,463	214.1	39,278	4,156,018	4
Chesapeake city	239,982	703.8	35,536	111,227	5.2
Hampton city	135,041	990.8	30,135	61,782	5.6
Newport News city	179,673	1502.3	28,294	81,407	6.4
Norfolk city	244,601	2537.4	29,830	104,945	6
Portsmouth city	95,097	2037.2	26,312	41,396	5.1
Virginia Beach city	450,201	905.8	37,776	221,998	4.1

Source: U.S. Census Bureau 2021c; 2021d.
mi^2 = square mile; USD = U.S. dollars.

Chesapeake occupies about 341 square miles (883 square kilometers) of land. Hampton occupies about 136 square miles (352 square kilometers) of land in the coastal region of Virginia. Newport News occupies about 120 square miles (311 square kilometers) of land bordering the Chesapeake Bay and the James River. Norfolk occupies about 96 miles (155 kilometers) of land in the coastal region of Virginia. Portsmouth occupies about 47 miles (76 kilometers) of land, and the Portsmouth Marine Terminal (PMT) resides in Portsmouth County. Virginia Beach, occupies around 497 square miles (1,287 square kilometers) of land and is where the onshore cable route would be located. Virginia Beach is composed of 38 miles (61 kilometers) of shoreline and 3 miles (5 kilometers) of boardwalk, which are important to Virginia Beach's economy (Section 3.18, *Recreation and Tourism*).

The percentage of housing units for seasonal, recreational, or occasional use in Virginia Beach is highest at 1.7 percent compared to 0.1 percent in Chesapeake, 0.4 percent in Norfolk, 0.2 percent in Portsmouth, 0.4 percent in Hampton, and 0.2 percent in Newport News in comparison to 2.3 percent in Virginia as a whole (U.S. Census Bureau 2022b; COP, Section 4.4.1.1; Table 4.4-3; Dominion Energy 2023a). Virginia Beach relies on tourism and visitors to its economy and has the closest proportion of seasonal housing to Virginia as a whole. Table 3.11-3 includes housing data for the geographic analysis area. Throughout Virginia, 2.5 percent of housing units are seasonally occupied; (COP, Section 4.4.1.1; Table 4.4-3) 450,201 residents lived in Virginia Beach County in 2019. More than 19 million people visited Virginia Beach in 2017 (City of Virginia Beach 2017).

Table 3.11-3 Housing Data (2019)

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Total)	Vacancy Rate (percent)	Median Value (Owner-Occupied, USD)	Median Monthly Rent (Renter-Occupied, USD)
Virginia	3,537,788	82,998	353,667	10.0	282,800	1,257
Chesapeake city	91,707	52	5,183	5.7	286,000	1,300
Hampton city	60,145	234	5,298	8.8	188,600	1,115
Newport News city	77,851	133	7,475	9.6	194,700	1,075
Norfolk city	98,142	397	8,744	8.9	215,800	1,077
Portsmouth city	40,879	78	4,229	10.3	174,200	1,083
Virginia Beach city	185,735	3,156	13,283	7.2	287,400	1,380

Source: U.S. Census Bureau 2022a, 2022b.

Table 3.11-4 includes data on the industries where residents in these cities work. The industries that employ workers reflect recreation and tourism's importance to Hampton, Newport News, Norfolk, and Virginia Beach. A greater or equal proportion of residents in these cities work jobs in arts, entertainment, recreation, and accommodation and food services (9.3 percent in Hampton, 10.6 percent in Newport News, 12.8 in Norfolk, and 11.1 percent in Virginia Beach) than in Virginia as a whole (8.9 percent) (U.S. Census Bureau 2021c). Table 3.11-5 contains data on at-place employment by industry in the geographic areas of interest. A greater proportion of jobs in these cities is generally in health care and social assistance (18.8 percent in Hampton, 17 percent in Newport News, 19.4 percent in Norfolk, and 28.3 percent in Portsmouth); whereas, accommodation and food services comprise the largest employment by industry for Virginia Beach (16 percent), and retail services comprises the largest employment by industry for Chesapeake (16 percent) (Table 3.11 5). In 2019, unemployment was 5.2 percent in Chesapeake, 5.6 percent in Hampton, 6.4 percent in Newport News, 6 percent in Norfolk, 5.1 percent in Portsmouth, and 4.1 percent in Virginia Beach, compared to 4 percent overall in Virginia.

NOAA tracks economic activity dependent upon the ocean in its "Ocean Economy" data, which generally include, 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. In Newport News and Virginia Beach Counties, tourism and recreation account for 67.5 percent and 95.0 percent, respectively, of the overall Ocean Economy gross domestic product (GDP) (NOAA 2021). The "living resource" sector of the Ocean Economy is smaller but contributes to the identity of local communities and tourism. This includes commercial fishing, aquaculture, seafood processing, and seafood markets. Among Newport News and Portsmouth Counties, there are 17 living resources fisheries (NOAA 2021).

Table 3.11-4 Employment of Residents by Industry (2019)

Industry	Virginia	Chesapeake	Hampton	Newport News	Norfolk	Portsmouth	Virginia Beach
Agriculture, forestry, fishing and hunting, and mining	0.9%	0.20%	0.5%	0.3%	0.1%	0.4%	0.3%
Construction	6.6%	6.7%	6.3%	5.5%	7.0%	6.9%	6.5%
Manufacturing	7.1%	8.1%	12.6%	13.7%	7.1%	10.3%	5.5%
Wholesale trade	1.8%	1.5%	1.6%	2.1%	1.6%	2.3%	2.0%
Retail trade	10.4%	10.5%	10.4%	11.8%	11.2%	13.4%	11.5%
Transportation and warehousing, and utilities	4.4%	5.3%	4.4%	4.3%	4.9%	5.8%	4.2%
Information	1.9%	2.2%	1.1%	1.4%	1.7%	1.3%	1.7%
Finance and insurance, and real estate and rental and leasing	6.3%	7.0%	5.1%	3.5%	5.7%	4.3%	7.7%
Professional, scientific, and management, and administrative and waste management services	15.5%	11.8%	12.6%	10.7%	11.7%	9.4%	12.8%
Educational services, and health care and social assistance	22.2%	24.1%	22.0%	23.4%	23.1%	24.5%	22.9%
Arts, entertainment, and recreation, and accommodation and food services	8.9%	7.7%	9.3%	10.6%	12.8%	8.4%	11.1%
Other services, except public administration	5.3%	5.4%	4.5%	4.5%	4.4%	4.2%	4.6%
Public administration	8.8%	9.5%	9.6%	8.2%	8.7%	8.8%	9.2%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: U.S. Census Bureau 2021c.

Table 3.11-5 At-Place Employment by Industry (2019)

Industry	Virginia	Chesapeake	Hampton	Newport News	Norfolk	Portsmouth	Virginia Beach
Agriculture, forestry, fishing	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mining, quarrying, oil and gas	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Utilities	0.4%	0.1%	0.0%	0.1%	0.0%	0.1%	0.2%
Construction	5.6%	9.1%	4.4%	3.0%	3.6%	8.4%	6.7%
Manufacturing	7.0%	5.0%	4.9%	30.2%	6.4%	3.4%	3.8%
Wholesale trade	3.1%	4.2%	1.8%	2.3%	3.9%	2.3%	2.4%
Retail trade	12.5%	16.1%	15.4%	10.8%	10.7%	12.4%	15.3%
Transportation and warehousing	3.3%	4.8%	1.3%	1.6%	6.5%	7.0%	1.2%
Information	2.9%	2.5%	2.0%	1.9%	2.1%	0.5%	2.2%
Finance and insurance	4.8%	4.7%	2.1%	1.8%	4.1%	1.5%	7.4%
Real estate	1.6%	1.7%	1.8%	1.5%	3.3%	1.5%	3.4%
Professional services	14.3%	9.5%	12.2%	4.9%	10.4%	5.2%	9.7%
Management	2.4%	2.8%	0.3%	2.8%	2.4%	1.1%	1.6%
Administrative, business support, waste management	8.1%	9.1%	9.8%	6.7%	8.1%	8.7%	7.2%
Educational services	2.4%	1.7%	4.5%	1.2%	1.9%	0.8%	2.5%
Health care and social assistance	13.6%	10.6%	18.8%	17.0%	19.4%	28.3%	13.3%
Arts, entertainment, and recreation	1.9%	1.4%	1.3%	1.3%	1.4%	0.9%	2.3%
Accommodation and food services	10.8%	11.6%	14.7%	9.6%	11.1%	10.8%	16.0%
Other services (e.g., public administration)	5.0%	4.9%	4.4%	3.1%	4.3%	7.0%	4.8%
Industries not classified	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: U.S. Census Bureau 2021e.

3.11.1.1 Chesapeake and Virginia Beach

U.S. Census Bureau data indicate that over 70 percent of Virginia Beach's workforce resides in Virginia Beach and over 9 percent resides in both Chesapeake and Norfolk, suggesting significant economic linkages between the cities (COP, Section 4.4.1.1, Table 4.4-1; Dominion Energy 2023a). The population of Chesapeake grew over 9 percent from 2010 to 2019 while the population of Virginia Beach only grew about 3 percent. The share of Virginia's population in Chesapeake and Virginia Beach is roughly 8 percent. Median age in Chesapeake (36.9) and Virginia Beach (36.2) is slightly younger than Virginia as a whole (38.2 years) (Table 3.11-1).

Onshore recreational and tourism uses include beachgoing and other water borne activities, waterfront festivals, biking, freshwater fishing, and general use of open park spaces (COP, Section 4.4.5; Dominion Energy 2023a). Chesapeake is less dependent on tourism than Virginia Beach. The percentage of housing units for seasonal, recreational, or occasional use in Virginia Beach is 2.3 percent compared to less than 0.1 percent in Chesapeake (COP, Section 4.4.1.1; Table 4-4.3; Dominion Energy 2023a). Accommodation and food services comprises the largest employment by industry for Virginia Beach (16 percent) and retail services comprises the largest employment by industry for Chesapeake (16 percent) (Table 3.11-5).

3.11.1.2 Norfolk and Portsmouth

Norfolk and Portsmouth are key contributors to the Port of Virginia. From 2010 to 2019, Norfolk's population grew by 1.0 percent and Portsmouth's population decreased by 1.7 percent, while the population of Virginia grew by 7.8 percent (Table 3.11-1). Norfolk and Portsmouth's populations are much younger than Virginia's, 30.7 and 35.3, respectively. Compared to Virginia as a whole, Norfolk and Portsmouth have a higher portion of residents who work in health care and social assistance (19.4 percent and 28.3 percent) than Virginia (13.6 percent) (Table 3.11-5).

3.11.1.3 Hampton and Newport News

Across the inlet from Norfolk and Portsmouth are the cities of Hampton and Newport News. From 2010 to 2019, both Hampton and Newport News' population decreased by 2.9 and 1.2 percent, respectively, while Virginia grew by 7.8 percent (Table 3.11-1). Hampton and Newport News' populations are much younger than Virginia's median age of 38.2, 36.2, and 33.5, respectively. Compared to Virginia as a whole, Hampton and Newport News have a higher portion of residents who work in health care and social assistance (18.8 percent and 17 percent) than Virginia as a whole (13.6 percent) (Table 3.11-5).

3.11.2 Environmental Consequences

3.11.2.1 Impact Level Definitions for Demographics, Employment, and Economics

Definitions of impact levels are provided in Table 3.11-6.

Table 3.11-6 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.

Impact Level	Impact Type	Definition
Minor	Adverse	Impacts on the affected activity or geographic place 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 unavoidable disruptions to a degree beyond what is normally acceptable.
	Beneficial	Large local or notable regional benefit to the economy as a whole.

3.11.3 Impacts of the No Action Alternative 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 for demographics, employment, and economics. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with the other planned non-offshore wind and offshore wind activities as described in Appendix F.

Impacts of the No Action Alternative Under the No Action Alternative, the baseline conditions demographics, employment, and economics of the geographic analysis area described in Section 3.11.1, *Description of the Affected Environment for Demographics,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Tourism, recreation, and marine industries (e.g., fishing) would continue to be important components of the regional economy. Ongoing non-offshore wind activities in the geographic analysis area that would contribute to impacts on demographics, employment, and economics include continued commercial shipping and commercial 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. 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 (see Appendix F, Section F.2 for a description of ongoing and planned activities).

3.11.3.1 Cumulative Impacts of the No Action Alternative

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

Offshore wind could become a new industry for the Atlantic states and the nation. Although most offshore wind component manufacturing and installation capacity exists outside of the United States, some studies acknowledge that domestic capacity is poised to increase. This EIS uses available data, analysis, and projections to make informed conclusions on offshore wind’s potential economic and employment impacts in the geographic analysis area.

The BVG Associates Limited (2017) study estimated that the percentage of jobs sourced in the United States during the initial implementation of offshore wind projects along the Northeast coast would range from 35 percent to 55 percent of jobs. As the offshore wind energy industry grows in the United States, this proportion of jobs would increase because of growth of a supply chain in 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 United States is 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 compose the rest of the jobs outside the United States (BVG Associates Limited 2017).

The American Wind Energy Association (AWEA) 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 in the United States. 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 offshore wind direct impacts, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 gigawatts (GW) of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030. 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 would support $14.2 billion in economic output and $7 billion in value added by 2030 under the base scenario. Offshore wind energy development would support $25.4 billion in economic output and $12.5 billion in value added under the high scenario. It is unclear 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 $100.1 billion by 2030 (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 states with 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.

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 Responsible Offshore Development Alliance (RODA) in 2020 estimated that offshore wind projects would create 55,989 to 86,138 job 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 Virginia was 4.1 million (Table 3.11-2). While the extent to which there would 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 Virginia would likely be within commuting distance of ports in Hampton, Newport News, Norfolk, and Portsmouth for offshore wind staging, construction, and operations.

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.

Energy generation and security: Once built, offshore wind energy projects could produce energy at long-term fixed costs. These projects could provide reliable prices once built compared to the volatility of fossil fuel prices. Kitty Hawk Offshore Wind North would consist of up to 69 WTGs and Kitty Hawk Offshore Wind South would have up to 121 WTGs; a total nameplate capacity has not yet been determined for the projects (Appendix F, Table F2-1). The economic impacts of future offshore wind activities (including associated energy storage and capacity projects) on energy generation and energy security cannot be quantified, but could be long term and beneficial.

Light: Offshore WTGs require aviation warning lighting that could have economic impacts on certain locations. Aviation hazard lighting from up to 190 WTGs and three OSSs could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions (Appendix F, Table F2-1). 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. These lights would be incrementally added over the construction period and would be visible for the operating lives of future offshore wind activities. Distance from shore, topography, and atmospheric conditions would affect light visibility.

If implemented, an Aircraft Detection Lighting System 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. Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction. However, vessel traffic is common along the Atlantic coast, and frequent ship traffic is especially common in the geographic analysis area (COP, Appendix I-1, Section I-1.5.5.1; Dominion Energy 2023a).

New cable emplacement and maintenance: Cable installation could temporarily cause commercial fishing vessels, static gear fishing vessels, and recreational vessels based in the geographic analysis area to relocate away from work areas and disrupt fish stocks, thereby potentially reducing income of commercial fishing vessels. Fishing vessels are not likely to access affected areas during active construction, as about 130,145[1] acres (52,667.8 hectares) of seafloor disturbance would occur associated with offshore cable and inter-array cable installation as a result of the Kitty Hawk Offshore Wind Projects (Appendix F, Table F2-2). In the long term, concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers and dredgers. Assuming similar installation procedures as under the Proposed Action, the duration and range of impacts would be limited, and the disturbance to marine species important to recreational fishing and sightseeing would recover following the disturbance. Impacts from onshore cable installation would depend on the specific location but could temporarily

[1] Kitty Hawk South has 3 export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Carolina) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-mile-wide corridor to Virginia and 1,000-mile-wide corridors to North Carolina to allow for optimal routing of the cables.

disrupt beaches and other recreational coastal areas. Disruptions may result in conflict over other fishing grounds, increased operating costs for vessels, and lower revenue. Seafood processing and wholesaling businesses could also experience short-term reductions in productivity.

Noise: Noise from O&M, pile driving, cable laying and trenching, and vessel traffic could result in temporary impacts on demographics, employment, and economics due to impacts on commercial/for-hire fishing businesses, recreational businesses, and marine sightseeing activities based in the geographic analysis area.

Assuming other offshore wind facilities generate vessel traffic similar to the Proposed Action vessel trips, construction of each offshore wind project would generate about 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods (Section 3.16, *Navigation and Vessel Traffic*). 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 (COP, Section 4.2.5; Dominion Energy 2023a). This noise may also make these facilities less attractive to fishing operators and recreational boaters. Similarly, noise from pile driving from offshore wind activities would affect fish populations that are crucial to commercial fishing and marine recreational businesses (COP, Section 4.4.6.3; Dominion Energy 2023a). These impacts would be greater if multiple construction activities occur in close spatial and temporal proximity. An estimated 193 foundations (190 WTGs and three substations) would be installed in the North Carolina lease areas between 2024 and 2030 (Appendix F, Table F-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 and short-term 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. Future offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area, including the PMT. 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 2026 and 2028. 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, 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 2026 and 2028. If offshore wind construction results in competition for scarce berthing space and port service, port usage could have short- to medium-term adverse impacts on commercial shipping.

Presence of structures: The presence of up to 190 WTGs, hard cover for scour and cable protection, and up to 81 acres (32.7 hectares) of hard coverage (Appendix F, Table F2-2) would increase the risk of gear loss connected with cable mattresses and structures along the East Coast. These offshore facilities would also pose allision and height hazard risks, creating obstructions and navigational complexity for marine vessels, which would impose fuel costs, time, and risk and require adequate technological aids and trained personnel for safe navigation (Appendix F, Table F2-1 and Table F2-2). In the event of an allision, vessel damage and spills could result in both direct and indirect costs for commercial/for-hire recreational fishing.

WTGs could encourage fish aggregation and generate reef effects that attract recreational fishing vessels from the geographic analysis area (COP, Section 4.4.6.3; Dominion Energy 2023a). Fish aggregation could increase human fishing activities, but this attraction would likely be limited to recreational fishing vessels that already travel as far from the shore as the wind energy facilities. Fish aggregation could potentially result in increases to recreational fishing activities if these effects are widespread enough to encourage more participants to travel farther from shore.

The offshore wind structures could attract various wildlife and consequently increase the number of vessels conducting ecotourism trips from the geographic analysis area. As a result, the presence of the offshore wind structures could increase economic activity associated with ecotourism.

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. The fishing industry is expected to be able to adapt its fishing practices over time in response to these changes. These effects could simultaneously provide new business opportunities, such as fishing and tourism. Overall, the presence of offshore wind structures would have continuous, long-term impacts on demographics, employment, and economics.

Vessel 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. Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate about 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods (Section 3.16, *Navigation and Vessel Traffic*). Construction of two future offshore wind projects could occur in the Virginia and North Carolina lease areas between 2024 and 2027, with a maximum of three projects under construction concurrently (Appendix F, Table F2-1; Dominion Energy 2023b). Increased vessel traffic would have continuous, beneficial impacts during all project phases, with stronger impacts during construction and decommissioning.

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. Collisions could lead to vessel damage and spills, which could have direct costs (i.e., vessel repairs and spill cleanup), as well as indirect costs from damage caused by spills.

Vessel traffic would occur among ports (outside the demographics, employment, and economic geographic analysis area) and offshore wind work areas. COP, Section 3.4.1.5, Table 3.4-5 (Dominion Energy 2023a) summarizes the anticipated Project-related vessel traffic during construction of the Proposed Action. Construction vessel trips will likely originate or terminate at Portsmouth, Virginia.

Land disturbance: Land disturbance could result in localized, temporary 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, temporary, and both beneficial (jobs and revenues to local businesses that participate in onshore construction) and adverse (lost revenue due to construction disturbances).

Climate change: Climate change could affect demographics, employment, and economics in the geographic analysis area. Sea level rise and increased storm frequency and severity could result in property or infrastructure damage, increase insurance costs, and reduce the economic viability of coastal communities. Impacts on marine life due to ocean acidification, altered habitats and migration patterns, and disease frequency would affect industries that rely on these marine species. There would likely be a net reduction in GHG emissions, which contribute to climate change, and no collective adverse impact on climate change as a result of offshore wind projects.

3.11.3.2 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on demographics, employment, and economics. Future non-offshore wind activities, and future offshore wind activities would continue to sustain and support economic activity and growth in 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 in Newport News and Virginia Beach. 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 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) would have **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics. 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 there would be **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics from these planned activities. BOEM expects the combination of ongoing and planned non-offshore wind activities to result in **minor** adverse impacts and **minor beneficial** impacts on ocean-based employment and economics, driven primarily by the continued operation of existing marine industries, especially commercial 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 United States if supply chains develop as expected. While it is not possible to estimate the extent of job growth and economic output in the geographic analysis area specifically, there would be notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially job training, because of offshore wind development.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and demographics, employment, and economics would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on demographics, employment, and economics, due to increased onshore and offshore construction and operations. Many of the jobs generated by offshore wind projects are temporary construction jobs. The combination of these jobs over multiple activities and projects will create notable benefits during the construction phases of these projects. 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 (25 to 35 years); 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 would be overall **minor beneficial** impacts from future offshore wind activities in the geographic analysis area, combined with ongoing activities and planned activities other than offshore wind.

BOEM also anticipates **minor** adverse impacts associated with future offshore wind activities combined with ongoing activities, reasonably foreseeable environmental trends, and planned activities other than offshore wind. Future 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 entanglement and loss.

3.11.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on demographics, employment, or economics.

- The extent to which Dominion Energy 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.

The size of the proposed 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 in the geographic analysis area would depend on the proportion of workers, materials, vessels, equipment, and services that could be locally sourced and the specific ports used by the Project.

3.11.5 Impacts of the Proposed Action on Demographics, Employment, and Economics

Within the SMR, the Onshore Export Cable Route Corridor crosses under Lake Christine via HDD, which also serves as a fishing and boating area. In addition to the above-mentioned resources, there are two elementary schools near the General Booth Boulevard and South Birdneck Road intersection, which have athletic fields and passive open space on their properties. A public bikeway/trail also travels along the

Onshore Export Cable Route Corridor on Oceana Boulevard (COP, Section 4.4.5; Dominion Energy 2023a).

The Proposed Actions beneficial impacts on demographics, employment, and economics depend on what proportion of workers, materials, vessels, equipment, and services can be locally sourced. 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 $1.73 for Virginia's economy (E2 2018).

Dominion Energy's economic impact study estimates that the Proposed Action, through $8 billion of direct investment from Dominion Energy and up to a $40 million contribution from the State of Virginia for site improvement and readiness at the PMT, would support about 900 direct, indirect, and induced Virginia jobs[2] annually (about 60 percent in Hampton Roads), from 2020 through the end of 2026. Beginning in 2027, once construction is completed, it is estimated that O&M of the PMT facility would support 200 direct FTE jobs and 910 indirect and induced jobs annually in Hampton Roads over the 33-year operational life for the Proposed Action (COP, Figure 4.4-4, Table 4.4-7, Appendix EE-1, and Section 3.6; Dominion Energy 2023a).

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, and financial analysts; administrative personnel; trade workers such as electricians, technicians, steel workers, welders, and ship workers; and other construction jobs during construction and installation. 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 increases in local employment and economic activity.

Assuming that market conditions would be similar to those of the Massachusetts Vineyard Wind 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. 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 salary estimates for jobs in the wind energy industry that concur with the Vineyard Wind Project's projections. The expected salary range for trade workers and technicians ranges from $43,000 to $96,000, $65,000 to $73,000 for ships' crew and officers, and $64,000 to $150,000 for managers and engineers (Gould and Cresswell 2017).

Hiring local workers would stimulate economic activity through increased demand on 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 (COP, Section 4.4.1.2; Dominion Energy 2023a).Tax revenues for state and local governments would increase as a result of the proposed 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.

[2] Direct employment refers to jobs created by the direct hiring of workers. Indirect employment refers to jobs created through increased demand for materials, equipment, and services. Induced employment refers to jobs created at businesses where offshore wind industry workers would spend their incomes.

Dominion Energy's economic impact study estimated total state and local taxes generated would be $41.7 million during construction and $10.6 million annually during operations (COP, Section 4.4.1.2; Dominion Energy 2023a). Once the proposed Project is operational, property taxes would be assessed on the value of the Dominion Wind facilities. The increased tax base during operations would be a long-term, beneficial impact on local governments in the Project area.

Additionally, Dominion Energy has stated that in September 2021, it signed a Memorandum of Understanding (MOU) with the North America's Building Trades Unions and its state affiliate to identify opportunities to use union labor. Since the Project would require skilled and qualified workers in Hampton Roads, the MOU also includes commitments to using local workers; the hiring, apprenticeship, and training of veterans; and using workers from historically economically disadvantaged communities. These commitments were included in the MOU because Dominion Energy is working to satisfy the provisions of the Virginia Clean Economy Act, which calls for the priority hiring of veterans, local workers, and individuals from economically disadvantaged communities. To meet these requirements, Dominion Energy has met with hundreds of businesses, chambers of commerce, minority serving institutions, workers, educational institutions and students. In addition, the company has hosted and will continue to host local events and open houses specific to potential business suppliers and workers to learn about working in the offshore wind industry. Through these efforts, Dominion Energy is in the process of establishing a Project Labor Agreement with North America's Building Trades Union in collaboration with DEME and Siemens Gamesa Renewable Energy. Dominion Energy does not currently have any Community Workforce Agreements in place (Dominion Energy 2023b).

The reasonably foreseeable environmental trends and impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are described by IPF below.

Energy generation and security: The Proposed Action would produce up to 3,000 MW of electricity, or 7.5 percent of the estimated 40,201 MW of reasonably foreseeable offshore wind generation potential for the East Coast (Appendix E, Table E-2) (Appendix F, Table F2-1); 5,496 MW of this capacity is estimated to occur in the Virginia and North Carolina offshore areas (Appendix F, Table F2-1). Offshore wind energy projects could produce energy at long-term fixed costs, which could provide stability against fossil fuel price volatility, once built. Therefore, the Proposed Action would provide long-term beneficial contributions to energy security and resilience through a stable supply of energy. Impacts related to energy generation and security would have long-term, regional, and minor beneficial impacts on demographics, employment, and economics.

Light: Both onshore and offshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Dominion Energy is committed to using ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity to the wind farm. 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.

Lighting from vessels would occur during nighttime Project construction or maintenance or during transit to/from the ports. This lighting would be visible from coastal businesses, but is not anticipated to discourage tourist-related activities and would not affect other businesses; therefore, the impact of vessel lighting would be short term and negligible.

Between 2025 and 2028, there may be three offshore wind projects in the Virginia and North Carolina lease areas, including as many as two projects under construction concurrently from 2025 through 2030 (CVOW-C and the Kitty Hawk Offshore Wind Projects) (Appendix F, Table F2-1; Dominion Energy

2023a). WTG lighting in future offshore wind activities would be visible from the same locations as the Proposed Action in addition to Virginia coastal locations.

New cable emplacement and maintenance: The Proposed Action cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism, with potential adverse effects on employment and income. Construction vessel trips would average 46 trips per day through the duration of construction activities (2023–2027). Daily estimated vessel trips would be dependent on the construction period and activity but are anticipated to range from a minimum of 3 trips per day to a maximum of 95 trips per day. Operation and maintenance activities are anticipated to consist of 26 annual round tips to port for service operation vessels and each crew transfer vessel (COP, Section 3.4.1.5 and Section 3.5.1; Dominion Energy 2023a).

The approximate 6,036.6 acres (2,443.7 hectares) of seafloor disturbance (COP, Section 3.4.1.4, Table 3.4-4; Dominion Energy 2023a) could hinder commercial trawlers/dredgers, potentially reducing income and increasing costs for affected businesses over the long term. Cable installation would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of new cables and other existing submarine cables would have intermittent, long-term, negligible impacts under the Proposed Action.

Noise: Vessel noise traffic would indirectly affect commercial fishing businesses and recreational businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP, Section 4.4.11.2; Dominion Energy 2023a). Noise from O&M activities would have localized, intermittent, long-term, 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. The number of vessels in the Offshore Project area is expected to temporarily increase during construction of the Project. Project-related vessels would use existing transit lanes and fairways, as required, while in transit (COP, Section 4.4.6.3; Dominion Energy 2023a). Noise from vessels would have short-term, intermittent, negligible impacts on demographics, employment, and economics.

The estimated 202 foundations (WTGs and substations) related to the Proposed Action would generate noise from pile driving, one of the most impactful noises on marine species, especially if multiple project construction activities occur in spatial and temporal proximity to the proposed Project (COP, Section 4.1.5.3, Dominion Energy 2023a). These disturbances would be temporary and localized and would extend only a short distance beyond the work area. Pile driving and associated noise would have localized, short-term, and minor impacts on demographics, employment, and economics. Infrequent trenching, cable-laying activities, and construction activities of onshore components would emit noise. This noise could temporarily disrupt commercial fishing, marine recreational businesses, and onshore recreational businesses and residences. Noise from trenching and trenchless technology would affect marine life populations, which would, in turn, affect commercial and recreational fishing businesses. Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

The Proposed Action is anticipated to overlap in time with construction of the Kitty Hawk Offshore Wind North Project (Appendix F, Table F2-1). While operational activity would overlap, indirect noise impacts during operations would be far less than during construction.

Port utilization: The Proposed Action would support port investment and employment and would also support jobs and businesses in supporting industries and commerce in the geographic analysis area. The Proposed Action would use facilities at the PMT as a construction management, O&M, and cable-staging base (COP, Sections 3.2 and 3.5; Dominion Energy 2023a). The port 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 would be greatest during construction when the most jobs and most economic activity at ports supporting the Proposed Action would occur. During operations, activities would be concentrated in the Hampton Roads, Virginia Region where the proposed Project's onshore O&M facility would be located; Dominion Energy's selected lease location for the O&M facility is Lambert's Point, now named Fairwinds Landing, in Norfolk, Virginia (COP, Section 3.5; Dominion Energy 2023a). Dominion Energy estimated that 200 permanent jobs would support operations in Virginia (COP, Section 4.4.1.2; Dominion Energy). The O&M facility would help diversify the local economy by providing a source of skilled, year-round jobs. Overall, operation of the Proposed Action would generate 3,756 job-years of skilled permanent labor (direct job-years) and 6,360 total job-years created (direct job-years plus indirect and induced job creation) (COP, Section 4.4.1.2; Dominion Energy 2023a). The Proposed Action would have a minor beneficial impact on demographics, employment, and economics due to greater economic activity and increased employment at ports used by the proposed Project.

Other offshore wind energy activities would provide business activities at the same ports as the proposed Project, as well as other ports in 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.

Presence of structures: The Proposed Action would add up to 202 offshore wind structures that could affect marine-based 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 hazard and risk of allisions, fish aggregation, habitat alteration, and conflicting use of space. These structures may cause vessel operators to reroute, which would affect fuel costs, operating time, and revenue. Due to the risk of gear entanglement, fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial and for-hire recreational fishing industries. This would have continuous, long-term, and minor impacts on demographics, employment, and economics.

Offshore wind structures could encourage fish aggregation and generate reef effects that attract recreational fishing vessels capable of reaching the offshore wind energy facilities. This would have long-term, negligible benefits on demographics, employment, and economics. The proposed Project structures 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 (COP, Section 4.4.2.2; Dominion Energy 2023a). 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. It is expected that the presence of WTGs in the Offshore Project area may change marine recreational usage; however, some of these impacts may be beneficial because WTGs have served as tourism and recreational fishing destinations in other regions, which can lead to opportunities for tours and chartered trips (COP, Section 4.4.5.2; Dominion Energy 2023a). Portions of the WTGs and substations are expected to have limited visibility from onshore viewpoints based on location of WTGs, curvature of the earth, topography, wave height, and atmospheric conditions (COP, Section 4.3.4.2 and 4.3.4.3; Dominion Energy 2023a). These structures would be visible to recreational boaters who could avoid waters where structures are visible. This would have continuous, long-term, negligible impacts on demographics, employment, and economics.

Across the Virginia and North Carolina lease areas, up to 403 offshore structures, including those of the Proposed Action, would affect employment and economics by affecting marine-based businesses (Appendix F, Table F2-2). The presence of these structures would have both beneficial impacts, such as providing sightseeing opportunities and fish aggregation that benefit recreational businesses, and adverse effects, such as causing fishing gear loss, navigational hazards, and viewshed impacts that could affect business operations and income.

Traffic: The Proposed Action would generate vessel traffic in the Project area and to and from the ports supporting Project construction, O&M, and decommissioning. Dominion Energy estimates that construction activity would generate 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods. During operations, the Proposed Action would generate approximately 52 annual round trip vessel trips to port (refer to Section 3.16, *Navigation and Vessel Traffic*, for additional information regarding anticipated vessel traffic). Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning. 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 and decommissioning, and negligible beneficial impacts during operations. 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, which would result in economic costs for vessel owners. There may also be roadway traffic impacts such as lane closures, shifted traffic patterns, or closed roadways with temporary detours. Traffic impacts would be limited to the immediate construction vicinity. After construction, roadways would be returned to pre-construction conditions. Dominion would also implement a Traffic Management Plan to offset any traffic-related impacts (COP, Section 4.4.4.2; Dominion Energy 2023a). As a result of potential delays from increased congestion and increased risk of damage from collisions, and the impacts from vehicle related traffic, the Proposed Action or would have continuous, short-term, and minor impacts during construction and negligible impacts during operations.

Land disturbance: Construction of the Proposed Action would require onshore cable installation and substation construction. The employment and economic impact of the Proposed Action caused by disturbance of businesses near the onshore cable route and substation construction site would result in localized, short-term, minor impacts. The extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for future offshore wind energy projects.

Climate change: Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and economic health of coastal communities due, in part, to the costs of resultant damage to property and infrastructure, fisheries, and other natural resources, among other factors. It is anticipated that there would be a net reduction in GHG emissions, which contribute to climate change, and no collective adverse impact on climate change as a result of offshore wind projects. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts associated with the effects of climate change. The Proposed Action would have long-term, negligible beneficial impacts on demographics, employment, and economics from this IPF due to the anticipated carbon dioxide reductions resulting from the displacement of electricity generated from fossil fuel-powered plants. Future offshore wind activities would have similar contributions as the Proposed Action but at a larger scale.

3.11.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to lighting impacts from ongoing and planned activities, but the impacts on demographics, employment, and economics are anticipated to be negligible.

In context of reasonably foreseeable trends, the new cable emplacement and cable maintenance when combined with ongoing and planned activities would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of new cables and other existing submarine cables would have intermittent, long-term, negligible impacts.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action would contribute a noticeable increment to the combined noise impacts on demographics, employment, and economics from ongoing and planned activities including offshore wind, which would be short term and negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action and other ongoing and planned activities would have combined long-term, minor beneficial impacts on demographics, employment, and economics resulting from port utilization and the associated trained and skilled offshore wind workforce that would contribute to localized increases in economic activity and the region as a whole.

In context of reasonably foreseeable environmental trends, the Proposed Action and other ongoing and planned activities would have a long-term, minor impact on demographics, employment, and economics, due to impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

In context of reasonably foreseeable environmental trends, increased vessel traffic from the Proposed Action and other ongoing and planned activities would produce demand for supporting marine services, with beneficial impacts on employment and economics during all Project phases, including minor beneficial impacts during construction and decommissioning and negligible beneficial impacts during operations. In context of reasonably foreseeable environmental trends, increased vessel traffic congestion and collision risk from the Proposed Action and other ongoing and planned activities would have long-term, continuous impacts on marine businesses during all Project phases, with minor impacts during construction and decommissioning and negligible impacts during operations.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined land disturbance impacts on demographics, employment, and economics from ongoing and planned activities would be short term and minor due to the short-term and localized disruption of onshore businesses.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts from ongoing and planned activities would have a long-term, minor benefit.

3.11.5.2 Conclusions

Impacts of the Proposed Action. BOEM anticipates that the Proposed Action would have **negligible** impacts on demographics in the geographic analysis area. While it is likely that some workers would relocate to the area due to the proposed Project, this volume of workers would not be substantial compared to the current population and housing supply.

The Proposed Action 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 during the construction period.

The beneficial impact of employment and expenditures during O&M would have a modest magnitude over the 37-year duration of the proposed Project (4 years of construction and commissioning, and a 33-year Project lifespan). Although tax revenues and grant funds would be modest in magnitude, they also would provide a beneficial impact on public expenditures and local workforce and supply chain development for offshore wind. The impacts on demographics, employment, and economics from decommissioning would be short term, **minor,** and **beneficial** due to the construction activity 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.

While the proposed Project investments in wind energy would largely benefit the local and regional economies through job creation, workforce development, and income and tax revenue, adverse impacts on individual businesses and communities 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** to **minor** 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. Overall, the impacts on commercial fishing and onshore seafood businesses would have **minor** impacts on demographics, employment, and economics for this component of the geographic analysis area's economy. Although commercial fishing is a small component of the regional economy, it is important to the identity of local communities in the region. The IPFs associated with the Proposed Action alone would also result in impacts on certain recreation and tourism businesses that range from **negligible** to **minor**, with an overall **minor** impact on employment and economic activity for this component of the geographic analysis area's economy.

Cumulative impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts. Overall, BOEM anticipates that the Proposed Action and ongoing and planned activities would result in **minor** adverse impacts and **moderate beneficial** impacts on demographics, employment, and economics in the geographic analysis area. The **moderate beneficial** impacts primarily would be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the **minor** adverse effects would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions during construction, and land disturbance. Impacts on commercial and for-hire recreational fishing are anticipated to be **minor**. Because they are not expected to disrupt normal demographic, employment, and economic trends, overall impacts in the geographic analysis area likely would be **minor**. In addition, in context of reasonably foreseeable environmental trends, the Proposed Action and ongoing and planned activities would have a notable and measurable benefit from construction and operations employment and would have **minor beneficial** impacts on demographics, employment, and economics.

3.11.6 Impacts of Alternative B on Demographics, Employment, and Economics

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, which is described in this section.

Impacts of Alternative B. Alternative B would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitudes would be the same. Alternative B would construct 29 fewer WTGs and fewer associated inter-array cables than the Proposed Action. Alternative B would also use only 14 MW turbines (up to 14.7 MW each using power boost capability), resulting in a total Project capacity of approximately 2,587 MW; a reduction of 413 MW in total power-generating output compared to the Proposed Action. As a result, Alternative B would slightly reduce the offshore construction impact footprint and installation period. Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which would reduce impacts on commercial and for-hire recreational fishing. Because Alternative B would produce less energy, it would also offset fewer GHG emissions from fossil-fueled power generation compared to the Proposed Action, further reducing beneficial impacts. A reduced number of WTGs would slightly reduce port utilization and reduce expenditures, generating less economic activity at ports in general. However, the change in these impacts would not alter the overall impact rating compared to the Proposed Action.

This reduction in number and size of WTGs would also slightly reduce visual and light impacts from shore when compared to the Proposed Action, thereby reducing potential impacts on the tourism, recreation, and real estate businesses that are sensitive to viewshed impacts from WTGs. However, because most of the WTGs would still be visible, localized, long-term, minor impacts are still anticipated. Fewer WTGs and the avoidance of the Fish Haven area in the northern portion of the lease area could reduce reef effects and fish aggregation compared to the Proposed Action but are anticipated to reduce potential displacement of mobile target species from construction noise and the presence of structures. The reduction in WTGs would also reduce the impact of new cable emplacement and maintenance by requiring fewer worksites, slightly reducing the short-term disturbance to species important to recreation and tourism. However, because most of the WTGs would still be built, intermittent, long-term, negligible impacts are still anticipated. Fewer WTGs would reduce the risk of allisions and the need for vessels to reroute, which would reduce travel time, fuel costs, and other associated costs.

Cumulative impacts of Alternative B. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.6.1 Conclusions

Impacts of Alternative B. Alternative B would reduce the overall offshore footprint of the Project. The impacts resulting from individual IPFs associated with Alternative B would result in slightly lower adverse impacts and slightly lower beneficial impacts compared to the Proposed Action, but would not change the overall impact magnitudes, which are anticipated to range from **negligible** to **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics.

Cumulative impacts of Alternative B. In context of reasonably foreseeable environmental trends, the contribution of Alternative B to the impacts from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts.

3.11.7 Impacts of Alternative C on Demographics, Employment, and Economics

Impacts of Alternative C. Alternative C would install 33 fewer WTGs and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. Alternative C could potentially reduce localized impacts on marine species that local commercial/for-hire and recreational fishing use for seafood production compared to the Proposed Action, but the overall impact magnitudes would not change. Alternative C would reduce impacts in priority sand ridge habitats, resulting in fewer impacts on species dependent on those habitat types while also reducing the potential for commercial fishing and recreational vessel allisions in the southern portion of the lease area. In addition, reduced underwater noise from pile driving and vessels during construction activities, and reduced habitat alteration, vessel strikes, artificial lighting, and decommissioning activities, would lessen the potential for displacement of marine species and associated impacts on commercial and recreational vessels.

Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which could reduce impacts on commercial and for-hire recreational fishing. The reduced number of WTGs would also mean that the Project would generate less energy—with the removal of 33 WTGs, Alternative C would result in an expected total power output of 2,528 MW compared to 3,000 MW under the Proposed Action—and would therefore result in slightly lower beneficial impacts associated with delivering a reliable supply of energy and reduced GHG emissions from offsetting fossil-fueled power generation. A reduced number of WTGs would also generate less economic activity, which would reduce port utilization and result in lower expenditures in general. However, the change in these impacts would all be slight and would not alter the overall impact rating compared to the Proposed Action.

Cumulative impacts of Alternative C. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.7.1 Conclusions

Impacts of Alternative C. Alternative C would result in slightly reduced impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitude would not change. The removal of 33 WTGs under Alternative C would result in fewer impacts on marine species and, by extension, fewer impacts on commercial and for-hire recreational fisheries. Energy generation and associated beneficial impacts would be reduced under Alternative C because there would be fewer WTGs. Impacts under Alternative C are anticipated to be short term and range from **negligible** to **minor** adverse impacts and **minor beneficial** on demographics, employment, and economics.

Cumulative impacts of Alternative C. In context of reasonably foreseeable environmental trends, the impacts resulting from individual IPFs would be the same as those of the Proposed Action: **minor** adverse impacts and **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternative C when combined with the impacts from ongoing and planned activities including offshore wind would be **negligible** to **minor** adverse and **negligible** to **moderate beneficial**.

3.11.8 Impacts of Alternative D on Demographics, Employment, and Economics

Impacts of Alternative D. The impacts of Alternative D on demographics, employment, and economics would be similar to those of the Proposed Action. Alternative D would have the same offshore layout of Project components and number of WTGs; however, Alternative D would consider two onshore interconnection cable route options. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The overall length of Alternative D-1 or Alternative D-2 would be the same (14.3 miles [23.0 kilometers]). However, portions of Alternative D-2 would be installed via underground methods, while portions of Alternative D-1 would be installed entirely overhead. Overall, BOEM anticipates land disturbance and visual impacts on onshore businesses and residents from interconnection cable construction and operation under Alternative D to be the same as the Proposed Action.

The impacts on demographics, employment, and employment of Alternative D and the Proposed Action would be substantively the same, and the overall impact magnitude would not change. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the impacts from ongoing and planned activities including offshore wind would be the same as those described under the Proposed Action.

3.11.8.1 Conclusions

Impacts of Alternative D. Alternative D would result in the same impacts on demographics, employment, and economics as the Proposed Action. All offshore components under Alternative D and the associated beneficial impacts from energy generation would be the same as described for the Proposed Action. While Alternative D could reduce impacts on sensitive onshore habitats, including wetlands, when compared to the Proposed Action, the impacts resulting from individual IPFs associated with Alternative D are anticipated to be similar because the same interconnection cable route option could be selected under the Proposed Action. Impacts on demographics, employment, and economics under Alternative D are anticipated to be **negligible** to **minor** adverse and **negligible** to **moderate beneficial**.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action: short term and ranging from **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts. The overall impacts of Alternative D combined with ongoing and planned activities on demographics, employment, and economics would be the same as the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts.

3.11.9 Agency-Required Mitigation Measures

No additional measures to mitigate impacts on demographics, employment, and economics have been proposed for analysis.

3.12. 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 Figure 3.12-1, includes the boundaries of the incorporated cities where proposed onshore infrastructure and potential port cities are located, as well as the incorporated cities closest to the Offshore Project area. The incorporated cities in the geographic analysis area include the City of Virginia Beach, City of Norfolk, City of Portsmouth, City of Chesapeake, City of Hampton, and City of Newport News.

Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major using the four-level classification scheme outlined in Section 3.12.2.2, *Impact Level Definitions for Environmental Justice*. A determination of whether impacts are “disproportionately high and adverse” in accordance with Executive Order (EO) 12898 is provided in the conclusion sections for the Proposed Action and action alternatives.[1]

3.12.1 Description of the Affected Environment for Environmental Justice

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 disproportionately high and adverse, 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 Indian 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). While beneficial impacts are not typically considered environmental justice impacts, this section identifies beneficial effects on environmental justice communities, where appropriate, for completeness.

EO 12898 directs federal agencies to consider the following 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 on minority or low-income individuals.
- Public participation strategies, including community or tribal participation in the NEPA process.

According to USEPA guidance, environmental justice analyses must address disproportionately high and adverse impacts on minority populations (i.e., residents who are non-white, or who are white but have Hispanic ethnicity) when minority populations comprise over 50 percent of an affected area. 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”—the population of a larger area, often a county, region, or an entire state. Low-income populations are those that fall within 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).

[1] EO 14096 was released and implemented on April 25, 2023, but has not been incorporated into this Final EIS.

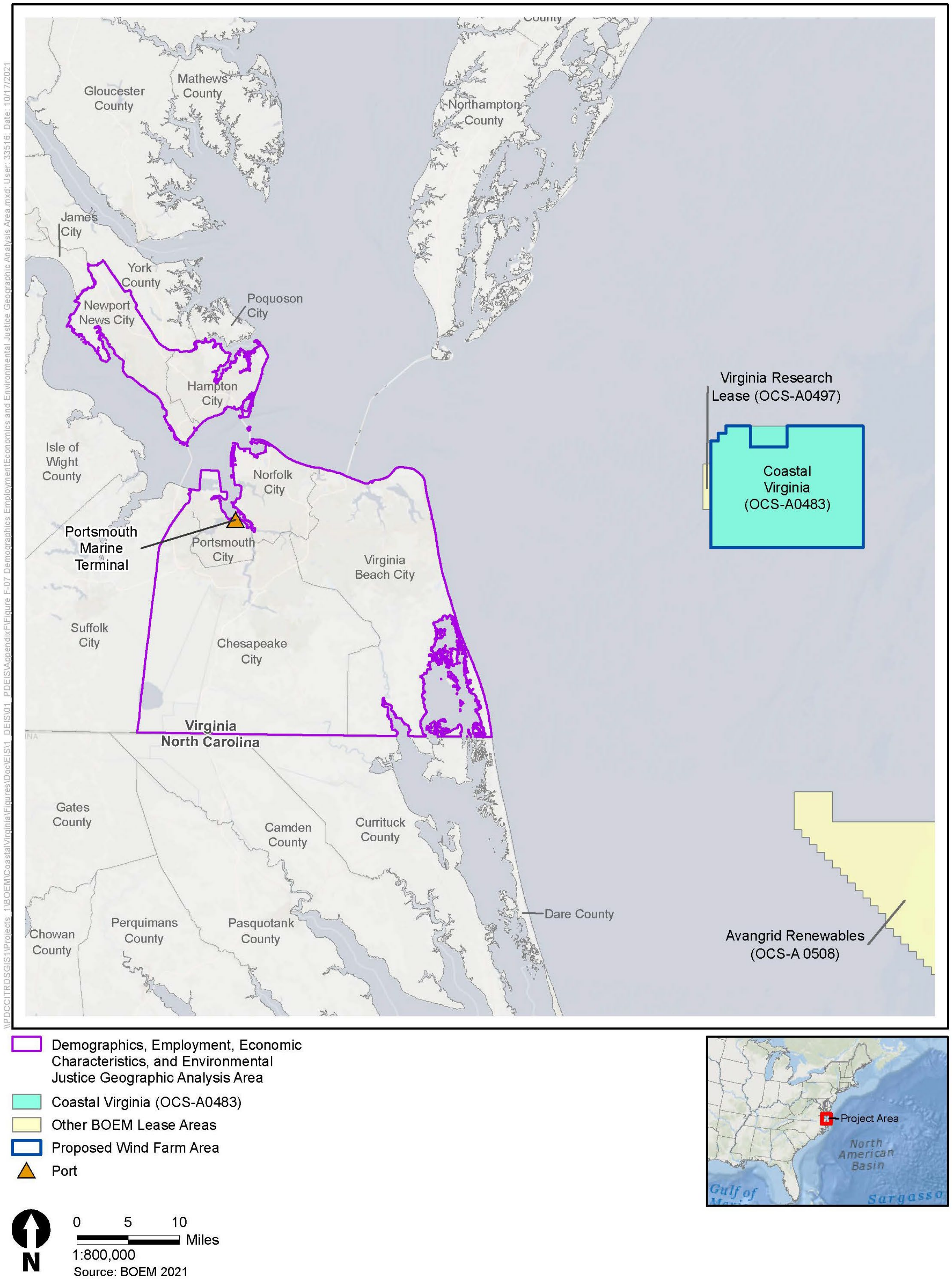


Figure 3.12-1 Demographics, Employment, Economic Characteristics, and Environmental Justice Geographic Analysis Area

Additionally, USEPA identifies an overburdened community as minority, low-income, tribal, or indigenous populations or geographic locations in the United States that potentially experience disproportionate environmental harms and risks. This disproportionality can be as a result of greater vulnerability to environmental hazards, lack of opportunity for public participation, or other factors (USEPA 2022).

3.12.1.1 State of Virginia Criteria

The Commonwealth of Virginia's, Virginia Environmental Justice Act of 2020 defines an environmental justice community as "any low-income community or community of color." The Commonwealth of Virginia defines a "community in which a majority of the population are people of color," or community of color, as a group of individuals belonging to one or more of the following racial and ethnic categories: "Black, African American, Asian, Pacific Islander, Native American, other, non-white race, mixed race, Hispanic, Latino, or linguistically isolated."

Additionally, these communities are defined as "any geographically distinct area where 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" and notes that "if a community of color is comprised primarily of one of the groups listed in the definition of 'population of color,' the percentage population of such a group in the Commonwealth shall be used instead of the percentage population of color in the Commonwealth" (VA Code § 2.2-234). The Virginia Environmental Justice Act defines low-income as "having an annual household income equal to or less than the greater of (i) an amount equal to 80 percent of the median income of the area in which the household is located, as reported by the [U.S.] Department of Housing and Urban Development, and (ii) 200 percent of the Federal Poverty Level" and a low-income community as "any census block group in which 30 percent or more of the population is composed of people with low income" (VA Code § 2.2-234). Figure 3.12-1 contains block group information from EPA's EJScreen tool.

3.12.1.2 Demographic Trends in the Geographic Analysis Area

As shown in Figure 3.12-2, using this definition, environmental justice communities in the geographic analysis area occur in the City of Chesapeake, City of Hampton, City of Newport News, City of Norfolk, the City of Portsmouth, and the City of Virginia Beach, which contain populations that meet the income and/or minority criteria. Table 3.12-1 summarizes the percentages of the non-white population in each incorporated city and the percentage of residents with household incomes below the federally defined poverty line in the counties studied in the geographic analysis area. All six incorporated cities have a higher percentage of non-white populations than that of the non-white population for the Commonwealth of Virginia, which was used as the reference population.

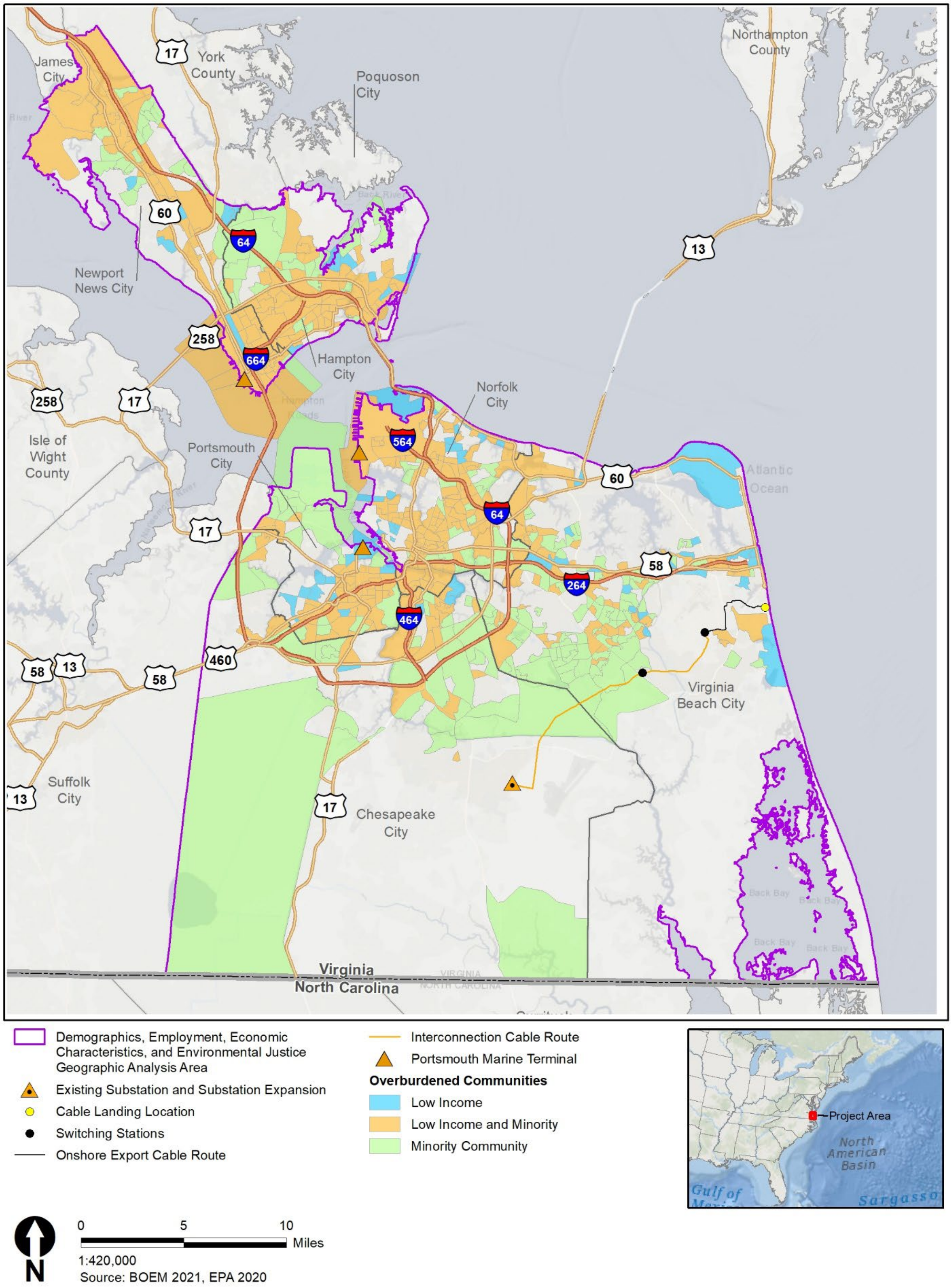


Figure 3.12-2 Environmental Justice Populations in Geographic Analysis Area

For the purposes of this analysis, this is considered meaningfully greater as the Commonwealth of Virginia does not provide a specific percentage or other quantitative measure to define "meaningfully greater." Additionally, all of the incorporated cities in the geographic analysis area, except for the City of Chesapeake and the City of Virginia Beach, have a higher percentage of the population below the federal poverty level than the Commonwealth of Virginia. Table 3.12-1 summarizes trends for non-white populations and the percentage of residents with household incomes below the federally defined poverty line in the counties studied in the geographic analysis area. The non-white population percentage generally increased throughout the geographic analysis area between 2000 and 2019. The percentage of population living under the poverty level declined slightly between 2000 and 2010, but increased between 2010 and 2019.

Table 3.12-1 State and City Minority and Low-Income Status

Jurisdiction	Percentage of Population below the Federal Poverty Level			Non-White Population Percentage		
	2000	2010	2019	2000	2010	2019
Virginia	20%	11.1%	25%	30%	35%	38%
Chesapeake	16%	7.0%	21%	34%	39%	43%
Hampton	19%	11.8%	30%	52%	58%	62%
Newport News	20%	14.6%	36%	48%	57%	57%
Norfolk	26%	16.4%	39%	53%	56%	57%
Portsmouth	23%	18.1%	37%	55%	59%	62%
Virginia Beach	13%	7.5%	20%	31%	35%	38%

Sources: USCB 2000a, 2000b, 2010, 2019.
[1] Non-White Population Percentage is considered the White alone, not Hispanic or Latino population. This percentage also includes the percentage of Native Americans.

Low-income and minority workers may be employed in commercial fishing and related industries that provide employment on commercial fishing vessels, at seafood processing and distribution facilities, and in other trades related to vessel and port maintenance, operations at marinas, boat yards, and marine equipment suppliers and retailers, and therefore may be vulnerable to employment disruptions in the commercial fishing industry (National Guestworker Alliance 2016). Virginia's total ocean economy, which includes marine construction, tourism and recreation, commercial fishing, aquaculture, and the seafood processing industry supports over 134,215 jobs (NOAA 2018).

NOAA has developed a social indicator mapping tool (NOAA 2022) that has been used to identify, in the geographic analysis area, environmental justice populations that also engage with, or rely on commercial or recreational fishing. The fishing engagement and reliance indices portray the importance or level of dependence of commercial or recreational fishing to the coast communities in the geographic analysis area.

- Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high level 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.

Figure 3.12-3 depicts the level of commercial and recreational fishing engagement and reliance in the geographic study area. As outlined in Figure 3.12-3 the coastal communities of Virginia have a variety of social indicator levels. Newport News and Hampton, Virginia, have a high level of commercial fishing engagement. Norfolk and Virginia Beach, Virginia, have a medium level of commercial fishing engagement, and Portsmouth and Chesapeake, Virginia, have a low level of commercial fishing engagement. All communities have a low level of commercial fishing reliance. Within these communities that have a high level of commercial fishing engagement, Newport News and Hampton, Virginia, are both determined to contain environmental justice populations (Figure 3.12-2). Newport News, Hampton, Norfolk and Virginia Beach, Virginia, all have a high level of recreational fishing engagement, Portsmouth and Chesapeake, Virginia, have a low level of recreational fishing engagement. All communities have a low level of recreational fishing reliance. Within these communities that have a high level of recreational fishing engagement, Newport News, Hampton, Norfolk, and Virginia Beach, Virginia, are all determined to contain environmental justice populations (Figure 3.12-2). The PMT is also located in an area of identified environmental justice populations.

In addition to NOAA’s commercial and recreational fishing engagement and reliance maps, NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2022). This map measures elements that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront. Gentrification indicators are related to housing disruption, retiree migration, and urban sprawl.

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including changes in mortgage values. 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, population 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.

Similar to the commercial and recreational fishing engagement and reliance indices, the gentrification indices have varied levels. Newport News, Virginia, has a low level of housing disruption, Hampton, Portsmouth, Chesapeake and Virginia Beach, Virginia, have a medium level of housing disruption, and Norfolk, Virginia, has a medium high level of housing disruption. All communities have a low level of retiree mitigation and urban sprawl.

Environmental justice analyses must also address impacts on Native American tribes and indigenous peoples. 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 significance to environmental justice populations include loss of significant cultural or historical resources and the impact’s relation to other cumulatively significant impacts (USEPA 2016).

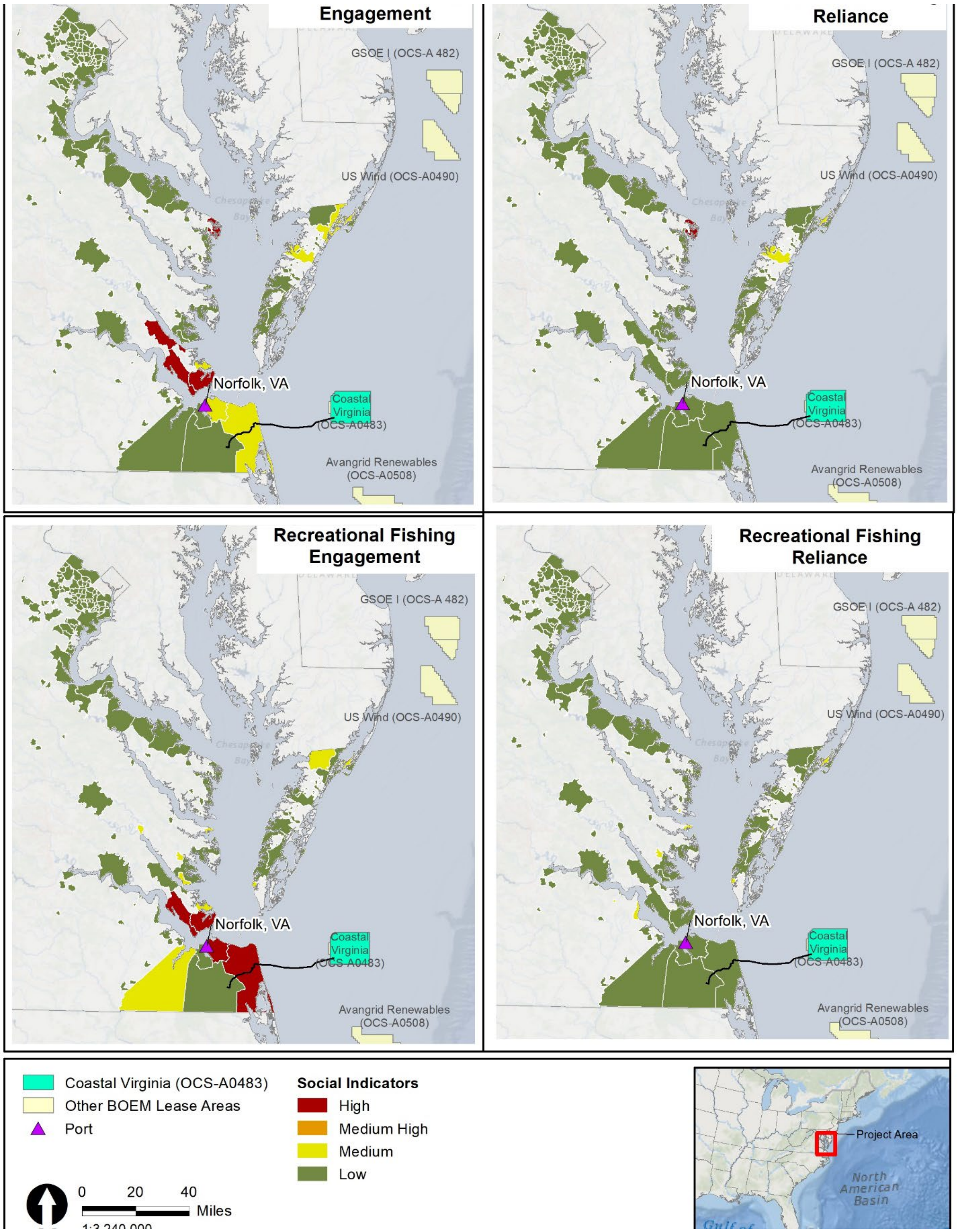


Figure 3.12-3 Commercial and Recreational Fishing Engagement or Reliance of Coastal Communities

While there are no tribal lands in the geographic analysis area, BOEM has invited federally recognized tribes with ancestral associations to lands in the Project area to participate in government-to-government consultation and to participate in the NHPA Section 106 consultation process to determine if ancestral lands or properties would be adversely affected by the Project. BOEM has invited the following federally recognized tribes to participate in government-to-government consultation on the proposed Project: Chickahominy Indian Tribe (early in the 21st century, approximately 975 people lived within a 5-mile [8-kilometer] radius of the Tribal center [Secretary of the Commonwealth n.d.]), Chickahominy Indian Tribe - Eastern Division (early in the twenty-first century, approximately 67 individuals lived in Virginia [Secretary of the Commonwealth n.d.]), Delaware Nation, Monacan Indian Nation (early in the twenty-first century about 1,600 individuals belonged to the Tribe still existing in its ancestral homeland [Secretary of the Commonwealth n.d.]), Nansemond Indian Nation (as of 2009, there were approximately 200 registered Nansemond Tribal members in Virginia [Secretary of the Commonwealth n.d.]), Pamunkey Indian Tribe, Rappahannock Tribe, and the Upper Mattaponi Indian Tribe, (Appendix K, *List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent*). Please see Table 3.12 under the “Non-White Population Percentage” heading, showing the percentage of minority populations in the geographic analysis area, which include Native Americans.

The Commonwealth of Virginia recognizes 11 tribes, 7 of which the United States federally recognizes. None of the tribes recognized by the Commonwealth of Virginia have headquarters or reservations in the geographic analysis area. Though no tribes are based in the area, the Nansemond Indian Nation serves the cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, Suffolk, Virginia Beach, and Isle of Wright County. Historically, the Nansemond Indian Nation lived in settlements along both sides of the Nansemond River, where they fished, harvested oysters, hunted, and farmed in fertile soil (Nansemond Indian Nation n.d.).

3.12.2 Environmental Consequences

3.12.2.1 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 Section 3.4 through Section 3.22 to assess whether the Proposed Action and action alternatives would result in impacts that would be considered “high and adverse” and whether impacts had the potential to affect environmental justice populations given the geographic extent of the impact relative to the locations of environmental justice populations. Adverse impacts that had the potential to affect environmental justice populations were further analyzed to determine if the impact would be disproportionately high and adverse. Although the environmental justice analysis considers impacts of other ongoing and planned activities, including other future offshore wind projects, determinations as to whether impacts on environmental justice populations would be disproportionately high and adverse are made for the Proposed Action and action alternatives alone.

As shown on Figure 3.12-2, onshore Project infrastructure including cable landfalls, onshore export cable routes, onshore substations, and points of interconnection are in areas where environmental justice populations have been identified and would therefore be potentially affected. Interconnection cables and the PMT are identified to be in areas of low-income and/or minority populations. The switching stations are identified as being on the cusp of minority populations. The Chicory Switching Station would only be constructed if Interconnection Cable Route Option 6 is selected (COP, Section 4.4.2.2; Dominion Energy 2023). Because onshore construction may affect environmental justice populations identified in the geographic analysis area, impacts associated with construction, O&M, and decommissioning of onshore Project components would be carried forward for further analysis of disproportionately high and adverse effects in the environmental justice analysis. Based on the geographic extent of onshore construction impacts relative to the location of environmental justice populations, BOEM concludes that environmental justice populations would not experience disproportionately high and adverse effects related to construction, O&M, and decommissioning of onshore infrastructure.

Dominion Energy and the Port of Virginia have executed a lease agreement for PMT to support the staging of components and construction vessels for the Project. As shown on Figure 3.12-1 through Figure 3.12-3, the PMT is located in and near environmental justice communities. Dominion Energy is considering locations in Newport News, Portsmouth and Norfolk, Virginia, with Lambert's Point, which is located on a brownfield site, as the preferred location, to serve as the O&M facilities for the Project. For both the PMT and the O&M facilities, in the event that upgrades or a new, build to suit, facility is needed for any purpose, construction would be undertaken by the lessor and would be separately authorized, as needed (COP, Section 3.2; Dominion Energy 2023).

Construction, O&M, and decommissioning of offshore structures (WTGs and OSSs) 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 and OSSs) 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, O&M, and decommissioning of Offshore Project components are carried forward for analysis of disproportionately high and adverse effects in this environmental justice analysis under the IPFs for presence of structures, cable emplacement and maintenance, and noise.

Section 3.10, *Cultural Resources*, discusses marine cultural resources, which include pre-contact period Native American landscapes on the OCS, referred to as ancient submerged landforms (ASLFs) (BOEM 2012), which have potential to contain Native American archaeological sites inundated and buried as the sea level rose at the end of the last ice age and may be places where the ancestors of modern tribes lived. Five ASLFs were identified in the Lease Area. A sixth landform was identified outside of, but near, the Lease Area. Construction of offshore wind structures and cables could result in major impacts on ASLFs if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction, which may result in a disproportionate impact on the Native American environmental justice population. BOEM has committed to working with lessees, consulting parties, including Native American tribes, and the Virginia Department of Historic Resources and the North Carolina State Historic Preservation Office (SHPO) to develop specific treatment plans to address impacts on ASLFs 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 ASLFs. 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 ASLFs identified in the Lease Area 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 fishing or hunting grounds, or other potentially affected tribal resources have been identified to date.

BOEM held scoping meetings regarding this Project on July 12, 2021, July 14, 2021, and July 20, 2021. All scoping meetings were virtual and accessible online or through calling in. Each meeting was also recorded for later reviewing if necessary.

Dominion Energy has engaged directly with historically underrepresented communities and minority-serving institutions. Dominion Energy hosted virtual and in-person events for potential business suppliers, workers, such as the Virginia Beach Minority Business Council, and those interested in working in the offshore wind industry. Dominion Energy enlisted a grassroots advisory group and coordinated with trusted individuals and organizations, such as faith-based organizations, neighborhood and homeowner associations, as well as other EJ-relevant organizations such as local NAACP chapters, Urban League of Hampton Roads, Norfolk State University Center for African American Public Policy, diverse chambers of commerce, community organizations and civic leagues, houses-of-faith, historical centers, societies, and preservation groups, educational leaders, and socio-economic equity advocacy groups to ensure appropriate understanding and engagement with the communities directly and indirectly affected by the CVOW Project.

Consistent with ACHP Early Coordination Handbook (2019), Dominion Energy has pursued early coordination with Native American Tribes known to have interest in the CVOW Project area. Dominion Energy began engaging with Tribes via direct meetings in 2020, prior to the start of Project surveys. Dominion Energy continued outreach and engagement through a series of individual and group meetings with Tribes to provide information and receive feedback. In total, more than 20 individual or group meetings were held with approximately 11 tribes including the Nansemond Indian Nation and Upper Mattaponi Indian Tribe. These efforts took place in advance of BOEM's agency-led government-to-government consultation and Section 106 review.

BOEM held a meeting with Upper Mattaponi Indian Tribe, Delaware Tribe of Indians, Chickahominy Indian Tribe - Eastern Division, Rappahannock Tribe, Wampanoag Tribe of Gayhead (Aquinnah), Shinnecock Indian Nation on April 10, 2023, to discuss fisheries and subsistence fishing concerns. Anadromous fishes (shad, alewife, and river herring), catadromous fish (American eel), mollusks, and sturgeon were discussed as some of these species have historically been an important food source for indigenous peoples. BOEM determined that American shad are present in the Project area and may experience negligible short-term and permanent impacts from noise and displacement; river herring are also present in the Project area and may experience negligible short-term benthic impacts; American eel are present in the Project area and may experience negligible short-term benthic impacts; mollusk species such as the blue mussel, eastern oyster, hard clam, and soft shell clams are included as part of the EFH-A and may experience minor short-term and permanent impacts; Atlantic sturgeon may be affected by Project activities, but are not likely to adversely effect. Species that tribes have indicated they fish for may be primarily temporarily affected by Project activities but the environmental justice populations are not anticipated to be disproportionately affected.

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; recreation and tourism; sea turtles; water quality; and wetlands. See Chapter 2, *Alternatives Including the Proposed Action*, Table 2-4 for a summary of impact levels determined for each of these resource topics.

3.12.2.2 Impact Level Definitions for Environmental Justice

This Final EIS uses a four-level classification scheme to characterize potential impacts of alternatives, including the Proposed Action, as negligible, minor, moderate, or major as defined in Table 3.12-2. 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 or minority populations. A determination of whether impacts are “disproportionately high and adverse” in accordance with Executive Order 12898 is provided in the conclusions sections for the Proposed Action and action alternatives.

Table 3.12-2 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 functions 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.
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 improvement.

3.12.3 Impacts of the No Action Alternative 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 activities 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 F, *Planned Activities Scenario*.

3.12.1.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for environmental justice described in Section 3.12.1, *Description of the Affected Environment for Environmental Justice*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities.

Ongoing non-offshore wind activities that affect environmental justice populations in the geographic analysis area include onshore development and land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; and commercial fishing operations (see Appendix F for a description of ongoing activities). These activities support beneficial employment and generate sources of air emissions, noise, lighting, and vehicle and vessel traffic that can adversely affect the quality of life in affected communities. Ongoing activities contribute to impacts on environmental justice populations through the primary IPFs of air emissions, lighting, cable emplacement and maintenance, noise, port utilization, presence of structures, and vessel traffic. There are no ongoing offshore wind activities in the geographic analysis area for environmental justice. Coastal development that leads to gentrification of coastal communities may create space-use conflicts and reduce access to coastal areas and working waterfronts that communities rely on for recreation, employment, and commercial or subsistence fishing. Gentrification can also lead to increased tourism and recreational boating and fishing that provide employment opportunities in recreation and tourism. As described in Section 3.12.1, mapping of gentrification indices show medium high to medium levels of housing disruption in coastal Virginia communities such as Hampton, Portsmouth, Chesapeake, Virginia Beach at a medium level, and Norfolk at a medium-high level. Housing disruption may be caused by rising home values and rents, that can displace affordable housing, and have disproportionate effects for low-income populations, which are identified in these medium to medium high level areas.

Areas in the vicinity of proposed locations for onshore infrastructure, such the switching stations, the onshore export cable, and the interconnection cable, in Virginia Beach and Chesapeake, Virginia, related to the EJScreen environmental justice indices, have lower levels of exposure with regard to all indices, ranging between the 4th and 41st percentile compared to the state, and the conditions around the PMT related to the EJScreen environmental justice indices regarding air emission (PM2.5, ozone, diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index) range between the 42nd and 79th percentile compared to the state (USEPA 2023).

Given the variability across the geographic analysis area, BOEM determined that the overall impact of ongoing activities on environmental justice communities is moderate and is driven primarily by the IPFs of air emissions, traffic, and noise. See Appendix F, Table F1-10 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for environmental justice.

There are no ongoing offshore wind activities in the geographic analysis area that contribute to impacts on environmental justice.

3.12.1.2 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). Other planned non-offshore wind activities that may affect environmental justice populations include port utilization and expansion, construction, and maintenance of coastal infrastructure (marinas, docks, and bulkheads), and onshore coastal development that can lead to gentrification of coastal communities and working waterfronts (see Appendix F, Section F.2, for a description of ongoing and planned activities).

Planned non-offshore wind activities would have impacts like those of ongoing non-offshore wind activities and would be minor and minor beneficial. BOEM expects that most impacts of ongoing and planned activities would be minor because, while they would be measurable, they would not disrupt the normal or routine functions of the affected population. Impacts of gentrification are expected to be moderate because low-income populations would have to adjust somewhat in response to housing disruptions caused by rising home values and rents. These changes would be long term, but the intensity would vary across the geographic analysis area, with higher intensity in coastal communities with waterfront access and lower intensity in more inland areas. BOEM expects that improvements related to employment for ongoing and planned activities would be measurable but small and minor beneficial.

See Appendix F, Table F2-10 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for environmental justice. Appendix F, Table F-3 identifies 29 future offshore wind projects, other than the Proposed Action, that could be constructed off the Atlantic Coast. Of these future offshore wind projects, only the proposed Kitty Hawk Offshore Wind Projects would be located in the geographic analysis area for environmental justice.

BOEM expects future offshore wind development to primarily affect environmental justice communities as shown in Table 3.12-1 through the following IPFs.

Air emissions: Increased port activity associated with offshore wind projects would generate short-term, variable increases in air emissions, with the largest emissions anticipated during construction from diesel-powered equipment and vehicle or vessel activity. Emissions at offshore locations would have regional effects with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts depending on project infrastructure location and proximity to the ports used, the ambient air quality, and the increase in emissions at any given port.

Emissions are expected to be highly variable and limited in spatial extent at any given period. Emissions from vessels, vehicles, and equipment operating in ports could affect environmental justice communities adjacent or close to those ports. Emissions attributable to future offshore wind activities excluding the Proposed Action affecting any neighborhood have not been quantified; however, it is assumed that emissions would contribute a small proportion of the total emissions from those facilities. Air emissions during construction would have a small, short-term, variable impact on environmental justice communities due to temporary increases in air emissions during construction. The air emissions impact would be greater if multiple offshore wind projects simultaneously use the same port for construction staging.

As stated in Section 3.4, *Air Quality,* during the construction phase, the total emissions of criteria pollutants and ozone precursors from the Kitty Hawk Offshore Wind Projects are estimated to be 4,263 tons of CO, 15,586 tons of NO_X, 538 tons of PM10, 521 tons of PM2.5, 264 tons of SO_2, 670 tons of VOCs, and 963,302 tons of CO_2e (Kitty Hawk Offshore Wind North 2021; Kitty Hawk Offshore Wind South 2022; Appendix F, Table F3-4; Appendix F, Table F3-4). The geographic analysis area for air quality is larger than that for environmental justice,[2] and most air quality impacts would remain offshore because the highest emissions would occur in the offshore region and the northerly and southwesterly prevailing winds would result in most emission plumes remaining offshore. However, ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land.

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, even for overlapping projects.

Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. Estimated operational emissions from the Kitty Hawk Offshore Wind Projects would be 343 tons per year of CO, 869 tons per year of NO_X, 39 tons per year of PM_{10}, 36 tons per year of $PM_{2.5}$, 12 tons per year of SO_2, 43 tons per year of VOCs, and 64,216 tons per year of CO_2e (Kitty Hawk Offshore Wind North 2021; Kitty Hawk Offshore Wind South 2022; Appendix F, Table F3-4). Operational emissions would overall be intermittent and dispersed throughout the Lease Area and the vessel routes from the onshore O&M facility, and would generally contribute to small and localized air quality impacts.

The power generation capacity of offshore wind development has the potential to lead to lower regional air emissions by displacing fossil fuel plants for power generation. See Section 3.4, *Air Quality*, for further analysis of reductions in regional GHG emissions. A 2019 study found that nationally, exposure to

[2] The air quality geographic analysis area, depicted on Figure 3.4-1, includes the airshed with 25 miles (40 kilometers) of the Wind Farm Area (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.

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. 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).

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 related to 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.

Lighting: The view of nighttime aviation warning lighting required for offshore wind structures could have impacts on economic activity in locations where lighting is visible by being a consideration when tourists select which Mid-Atlantic coastal locations to visit. Service industries that support tourism are a source of employment for low-income workers. Impacts on tourism are anticipated to be localized, not industry-wide (Section 3.11, *Demographics, Employment, and Economics*) so would have negligible impact on environmental justice communities.

The Kitty Hawk Offshore Wind Projects are anticipated to include up to 190 WTGs (Appendix F, Table F-2-1). Vegetation, topography, weather, and atmospheric conditions contribute to the visibility of aviation hazard lighting from WTGs. The long-term presence of WTGs associated with future offshore wind may also cause major adverse impacts on scenic and visual resources in coastal communities that are within the viewshed of future offshore wind projects. The level of impact on onshore viewers would depend on the distance to the WTGs offshore, the number and height of the WTGs associated with each future offshore wind project, and the design of the aviation warning lighting system, which could introduce continuous nighttime lighting. Lighting impacts would be reduced if the emerging technology of ADLS is used. ADLS lighting would be activated only when an aircraft approaches (Section 3.20, *Scenic and Visual Resources*). Depending on exact location and layout of offshore wind projects, ADLS would likely limit the frequency of WTG aviation warning lighting use. This technology, if used, would significantly reduce the impacts of lighting. Aviation hazard lighting is evaluated as part of Section 3.20, *S*and Section 3.18, *Recreation and Tourism*. The impacts on recreation and tourism-related economic activity, if any, would be continuous and long term, which in turn could have impacts on environmental justice populations, specifically low-income employees of tourism-related businesses.

New cable emplacement and maintenance: New operating transmission cables would be installed to connect the offshore WTGs and substations to shore facilities. A new offshore export cable installation of 453 miles (729 kilometers) for the Kitty Hawk Offshore Wind Projects lease area is provided in Appendix F, Table F2-1. Assuming future projects use installation methods similar to those proposed in the COP, cable emplacement could displace other marine activities for a period of one day to several months. During the displacement for cable emplacement and during maintenance activities, commercial fishing operations may temporarily be less productive, resulting in potentially reduced hours and income for workers. Such business impacts could affect environmental justice populations due to the potential loss of income or jobs in the affected industries. In addition, cable installation and maintenance could temporarily disrupt subsistence fishing, resulting in short-term, localized impacts on individuals who rely on subsistence fishing as a food source. Further discussion is found in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing.*

Noise: Construction noise associated with proposed offshore wind facilities, such as pile driving, could affect fish and marine mammal populations, which would create impacts on commercial fisheries and visitor-oriented services such as for-hire fishing and the marine sightseeing business. A reduction in catch volume by commercial fishing operations may result in reduced income for low-income or minority populations working in the industry and could also lead to short-term reductions in business volumes for seafood processing and wholesale businesses that depend on the commercial fishing industry. The impacts of offshore noise on marine businesses could be short term and localized on low-income and minority workers in communities with a high level of commercial or recreational fishing engagement or reliance as well as residents who practice subsistence fishing. Additional information can be found the Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*.

Onshore construction noise would temporarily inconvenience visitors, workers, and residents near sites where onshore cables or substations are installed to support offshore wind, resulting in a short-term reduction in economic activity for businesses in these areas. Impacts would depend on where the onshore construction is in relation to businesses and environmental justice communities and are likely to be short-term and intermittent, comparable to the impacts of other onshore utility construction activity.

Noise generated by offshore wind staging operations at ports could have impacts on environmental justice communities if the port is near such communities. In the geographic analysis area, the PMT is in a low-income environmental justice community and is surrounded by low-income/minority and minority populations. The noise impacts from 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 measures are used for motorized vehicles and equipment.

Port utilization: The PMT is in and near environmental justice communities with impacts on these communities resulting from increased air emission and noise generation by port utilization as described for the air emissions and noise IPFs. Port utilization and possible expansion resulting from offshore wind would have short-term, beneficial impacts for environmental justice populations during construction and decommissioning, resulting from new employment opportunities, the support for other local businesses by port-related activities and businesses, and employee expenditures. Beneficial impacts would continue during the port utilization during offshore wind operations, but those impacts would be of a lower magnitude.

Presence of structures: Construction, decommissioning, and, to a lesser extent, O&M of future offshore wind projects could affect employment and economic activity generated by commercial fishing and marine-based businesses. Commercial fishing vessels would need to adjust routes and fishing grounds to avoid offshore work areas during construction and to avoid WTGs and OSSs 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. Future offshore wind activities would generate increased vessel traffic, which would increase navigational complexity in offshore construction areas during construction and in each project's offshore wind lease area long term due to the presence of WTGs and OSSs. For-hire recreational fishing businesses would also need to avoid construction areas and offshore structures. A decrease in revenue, employment, and income in commercial fishing and marine industries could affect low-income and minority workers in communities with a high level of commercial fishing engagement or reliance. The impacts during construction would be short term and would increase in magnitude if multiple offshore construction areas are being used at the same time. Impacts during operations would be long term 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 commercial and for-hire recreational fishing activity and supporting businesses, WTGs are anticipated to provide new opportunities for recreational fishing through fish aggregation and reef effects, and to provide attraction for recreational sightseeing businesses, potentially benefitting for-hire recreational fishing and low-income employees of fishing-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 for low-income workers, impacts on tourism have the potential to result in impacts on environmental justice populations. However, as described in Section 3.11, *Demographics, Employment, and Economics*, a University of Delaware study found that WTGs visible more than 15 miles (24 kilometers) from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity. While WTGs could be visible from the shore, depending on vegetation, topography, weather and atmospheric conditions, all proposed WTG positions in the geographic analysis area would be more than 15 miles (24 kilometers) from coastal locations. The impact of 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.

Vessel traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operation, would generate increased vessel traffic, though projected vessel traffic for the proposed offshore wind project off the coast of Virginia is not known. More information on vessel traffic can be found in Section 3.16, *Navigation and Vessel Traffic*.

The volume of vessel traffic during construction would complicate marine navigation in areas of offshore construction and create the potential for vessel congestion and reduced capacity in and near the ports that support offshore construction, with additional potential competition for berths and docks. The temporary impacts on commercial fishing or recreational boating would affect some local boaters and would not have disproportionate impacts on residents or businesses in areas identified as environmental justice communities. Impacts may be on a greater magnitude, however, for individuals who fish for subsistence, or members of environmental justice communities who depend on jobs in commercial or for-hire fishing or marine industries for their livelihood. Vessel traffic generated by offshore wind project construction would have short-term, variable impacts on environmental justice communities due to the impacts on jobs, income, and subsistence fishing resulting from impacts on marine businesses, port congestion, and availability of berths. The magnitude of impact would depend on the navigation patterns and the extent of facility preparation and planning at the particular port. In addition to the temporary impacts related to navigation and port availability, the increased need for marine transportation to support offshore wind development could have beneficial impacts on environmental justice populations through the provision of jobs and support of businesses.

Land disturbance: Offshore wind development would require onshore cable installation, substation construction or expansion, and possible expansion of shore-based port facilities. The exact siting of the onshore facilities for the proposed offshore wind facility off the coast of Virginia has not been finalized. Depending on the siting, land disturbance could result in disturbances of neighborhoods and businesses comprising environmental justice communities near cable routes and construction sites due to expected 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. However, impacts of this IPF on environmental justice populations would not be high and adverse.

3.12.1.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, baseline conditions for environmental justice would continue to follow current regional trends and be modified by any IPFs introduced by other ongoing and planned activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts on environmental justice communities primarily though the following trends: ongoing coastal development and gentrification of coastal communities; ongoing commercial fishing, seafood processing, and tourism industries that provide job opportunities for low-income residents; and air emissions, noise, lighting, and traffic associated with onshore construction and land uses when these occur near environmental justice populations. BOEM anticipates that the impacts of these ongoing activities on environmental justice communities would be **minor** to **moderate** adverse and **minor beneficial** as BOEM also anticipates that the impacts associated with future offshore wind activities in the geographic analysis area would result in 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 projects displace energy generation using fossil fuels.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and activities would continue, and environmental justice populations may continue to be affected by natural and human-caused IPFs. BOEM anticipates that the overall impacts associated with the No Action Alternative combined with all planned activities (including other offshore wind activities) in the geographic analysis area would result in **minor** adverse impacts on environmental justice communities. This reflects impacts on environmental justice communities from cable emplacement, construction-phase noise, air emissions, and vessel traffic, and the long-term presence of offshore structures, which could affect commercial fishing and for-hire fishing businesses, resulting in job losses for low-income workers. However, **minor beneficial** impacts associated with future offshore wind activities in the geographic analysis area, such as increased economic activities and job opportunities in marine and offshore wind industries are also anticipated. Additional beneficial effects may result from reductions in air emissions if offshore wind displaces energy generation from fossil fuels.

3.12.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances to 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 E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on environmental justice communities.

- Overall size of the Project and number of WTGs.
- The Project layout including the number, type, height, and placement of the WTGs and offshore substations, and the design and visibility of lighting on the structures.
- The extent to which Dominion Energy hires local residents and obtains supplies and services from local vendors.
- The PDE parameters that could affect commercial fishing and recreation and tourism as these activities affect employment and economic activity.
- Arrangement of WTGs and accessibility of the Wind Farm Area to recreational boaters.
- The time of year during which onshore and nearshore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts on members of environmental justice communities 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 WTG 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.

3.12.5 Impacts of the Proposed Action on Environmental Justice

Effects on environmental justice communities would occur when the Proposed Action's s adverse effects on other resources fall disproportionately within environmental justice communities, either due to the location of these communities in relation to the Proposed Action or due to their higher vulnerability to impacts.

Air emissions: Emissions at offshore locations associated with construction and O&M are expected to have regional impacts, with no disproportionate impacts on environmental justice communities. Emissions at onshore locations associated with the Proposed Action, such as the PMT, proposed onshore export cable corridors, and points of interconnection, could create disproportionate air quality impacts for existing environmental justice communities, depending on the chosen location for this infrastructure. The Proposed Action's contributions to increased air emissions at the PMT are anticipated to be minor during the construction, operation, and decommissioning, with the greatest quantity of emissions produced from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during offshore construction activities. However, most emissions are expected to occur temporarily during construction at both onshore and offshore locations with Project infrastructure. These increased short-term and variable emissions from the Proposed Action construction and operations would have negligible to minor disproportionate adverse impacts on environmental justice communities near the PMT, though they are not to be considered disproportionately high.

However, net reductions in air pollutant emissions resulting from the Proposed Action would result in long-term benefits to communities, regardless of environmental justice status, by displacing emissions from fossil fuel-generated power plants. Once operational, the Proposed Action would result in annual avoided emissions of 2,803 tons of NO_X, 375 tons of $PM_{2.5}$, 4,396 tons of SO_2, and 5,867,210 tons of CO_2. Estimates of annual avoided health effects would range from $257 to $518 million in health benefits and 23 to 53 thousand avoided mortality cases (Section 3.4, *Air Quality,* Table 3.4-3). 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 in or near the geographic analysis area.

Lighting: Nighttime aviation safety lighting on the 202 WTGs as part of the Proposed Action could be visible up to 36.8 miles (59 kilometers) away from coastal locations in the geographic analysis area depending on weather and viewing conditions. Dominion Energy is committing to the use of ADLS, which would activate the WTG safety lighting only when aircraft approach the WTGs, to minimize the number of hours per day that the aviation lighting is in full effect. If implemented, the system has the potential to decrease the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur under the standard continuous FAA hazard lighting. If ADLS is used, the lighting of offshore structures would result in a long-term, continuous, negligible impact on environmental justice communities as a result of the negligible impacts on recreation and tourism. There may also be impacts from nighttime light on vessels, which may potentially affect viewer experience. As described in Section 3.20, *Scenic and Visual Resources,* nighttime lighting from vessels would be possible and short-term during construction and decommissioning, and possibly long term, however, with less vessels, during O&M. The Proposed Action's impact of lighting on environmental justice communities is anticipated to be negligible. Therefore, BOEM has determined that impacts of the Proposed Action would not be disproportionately high and adverse for environmental justice populations.

New cable emplacement and maintenance: Offshore cable emplacement associated with the Proposed Action would temporarily affect commercial and for-hire fishing businesses, marine recreation, and subsistence fishing during the cable installation and infrequent maintenance. As noted in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, the installation of submarine cables for the Proposed Action would result in localized, temporary, and minor impacts on marine businesses such as commercial fishing or recreation businesses. Disruptions associated with cable emplacement and infrequent maintenance during the Project lifespan are expected to be temporary, but it is conceivable that low-income workers engaged in commercial fisheries and for-hire fishing would be more vulnerable to job or income losses should Project construction disrupt fishing activities. As described in Section 3.12.1, *Impacts of the Proposed Action on Environmental Justice*, the majority of these workers are members of minority or low-income groups. Cable emplacement would occur in offshore areas with medium commercial fishing engagement, high recreational fishing engagement, and low commercial and recreational fishing reliance (Figure 3.12-3). Cable installation could temporarily affect fish and mammals of interest for fishing and sightseeing through dredging and turbulence; however, species are expected to recover upon completion of installation activities (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat,* and Section 3.15, *Marine Mammals*). Specific cable locations associated with future offshore wind projects have not been identified in the geographic analysis area, but cable emplacement is expected to affect over 750 statute miles (1,207 kilometers) (Appendix F, Table F2-1). Installation of cables for the Proposed Action could, therefore, have a short-term, minor impact on low-income and minority workers in businesses that support commercial and for-hire recreational fishing.

The geographic extent and intensity of subsistence fishing in the vicinity of cable routes are not well documented. BOEM expects that subsistence fishing by low-income or minority residents near cable routes would be predominantly shore-based or nearshore. Public fishing access points in proximity to proposed landfalls in Virginia Beach that could be used by subsistence anglers include the Virginia Beach Fishing Pier, 1st Street Beach, Sandbridge Beach, and North Wall Rudee Inlet (NOAA 2023). Because cable laying would occur predominantly farther offshore, BOEM expects that subsistence anglers would experience only minor, short-term disruptions during cable emplacement and maintenance.

Because impacts of Proposed Action cable emplacement and maintenance on environmental justice populations would be short term and minor, BOEM has determined that impacts on environmental justice populations would not be high and adverse for the purpose of the environmental justice analysis.

Noise: Noise generated by equipment and vehicles used during the construction, O&M, and decommissioning of offshore facilities associated with the Proposed Action, primarily due to pile driving, has the potential to temporarily affect fish and marine mammal species, which has the potential to affect the fishing and sightseeing businesses that rely on these species, if the fishing or sightseeing coincides with pile-driving activity (Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing,* and Section 3.11, *Demographics, Employment, and Economics*). 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 's staging operations at ports could have impacts on environmental justice communities. The PMT is located in a low-income environmental justice community. This port has other ongoing commercial and industrial operations, as well as major roads, which would continue to generate ongoing noise. In addition, noise levels generated by onshore construction are expected for general construction activities using typical construction equipment, and for impact and vibratory pile driving implemented with noise mitigation strategies. Noise generated by construction, operation, and decommissioning of onshore infrastructure would be in areas with and without environmental justice populations. The installation of onshore interconnection cables, depending on whether installed entirely overhead or a combination of overhead and underground transmission facilities, leading ultimately to the PMT would occur in areas of environmental justice populations.

Noise from the Proposed Action alone would have short-term, variable, minor impacts on environmental justice communities. Therefore, BOEM has determined that noise generated by construction, operation, and decommissioning of onshore infrastructure would not disproportionately affect environmental justice populations.

Port utilization: Dominion Energy plans on using a portion of the existing PMT in the City of Portsmouth, Virginia, to serve as the construction port for the Proposed Action. The construction port would be used to store monopiles and transition pieces and to store and pre-assemble wind turbine generation components. Utilization of this port for activities related to manufacturing, staging, and loadout of WTG components of the Proposed Action would be similar to existing and designated activities for the port and would not displace businesses in environmental justice communities or change the nature of land use at the ports. Air emissions and noise generated by the Proposed Action activities could affect the environmental justice communities in and around the PMT (see discussions for the air emissions and noise IPFs). There would not be high and adverse effects on environmental justice populations, although impacts may be disproportionate. BOEM expects increased port utilization would likely have minor impacts and beneficial impacts on environmental justice populations due to greater economic activity and increased employment at ports, primarily during construction and decommissioning and to a lesser extent during operations (Section 3.11, *Demographics, Employment, and Economics*).

Presence of structures: The construction of up to 202 WTGs and three offshore substations under the Proposed Action would result in both adverse and beneficial impacts for marine businesses and subsistence fishing. The reef effect created by the presence of the offshore structures has the potential to provide additional opportunity for subsistence fishing, charter boat tours, and for-hire recreational fishing businesses. Additionally, the WTGs themselves could create a new demand for sightseeing trips or charter tours. More information can be found in Section 3.18, *Recreation and Tourism*. It is possible that these benefits could be felt by environmental justice communities through increased job opportunities.

Impacts on commercial fishing and for-hire recreational fishing would have greater impacts on communities that have a high level of commercial or recreational fishing engagement or reliance. As shown on Figure 3.12-3, there is a high level of recreational fishing engagement and a medium level of commercial fishing engagement in the coastal communities of Hampton City, Norfolk City, and Virginia Beach. There are low levels of commercial and recreational fishing reliance across the geographic analysis area. Because there are medium to low levels of commercial fishing engagement and reliance across the geographic analysis area, and because impacts on commercial fishing would vary by fishery, BOEM determined that commercial fishing impacts on environmental justice populations in the geographic analysis area would be minor and would not be disproportionately high and adverse. However, some areas in the geographic analysis area have a high level of recreational fishing engagement, including areas where environmental justice populations are present. Impacts of the Proposed Action could include long-term minor adverse and minor beneficial impacts on for-hire recreational fishing due to space-use conflicts and the artificial reef effect as previously mentioned. Because of this, BOEM has determined that impacts of the Proposed Action on for-hire recreational fishing would not be disproportionately high and adverse for environmental justice populations.

The presence of the WTGs and offshore substations has the potential to alter marine usage as they present new navigational hazards, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hard cover, which could lead to possible equipment loss and limiting certain commercial fishing methods. Overall, the offshore structures for the Proposed Action would have minor to moderate impacts on marine businesses, resulting in long-term, minor to moderate 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.

Section 3.20, *Scenic and Visual Resources*, identifies those areas where the proposed WTGs could be visible. There are several key observation points (KOPs) in the area with ranging impacts. There are five observation points in identified environmental justice communities. KOP-13 Cape Henry Lighthouse/Fort Story Military Base,[3] KOP-15a North End Beach Residential View 1 – Daytime, KOP-15b North End beach Residential View 1 – Nighttime, KOP-22 King Neptune Statue/Boardwalk, and KOP-23 Naval Aviation Monument Park are all located in identified low-income areas. KOP-13, KOP-22 and KOP-23 carry a high sensitivity rate meaning that the residents in the area will have views of the project/presence of structures. Impacts on viewer experience in the geographic analysis area would range from minor to moderate. Views of WTGs would be sustained from many viewpoints across the geographic analysis area and would not disproportionately affect environmental justice populations. Therefore, BOEM has determined that impacts of the Proposed Action on viewer experience would not be disproportionately high and adverse for environmental justice populations.

Vessel traffic: The Proposed Action would generate vessel traffic in and near the PMT in the City of Portsmouth, Virginia during construction and operations. Increased traffic near the port during construction is likely to have a short-term, minor impact on environmental justice communities that rely on subsistence fishing or employment and income from commercial fishing and marine recreation, due to increased vessel traffic near ports and potential displacement from berths and docks. Because vessel traffic is anticipated to be limited during operations, it would have a long-term, negligible impact on environmental justice communities. Impacts during decommissioning would be similar to the impacts during construction and installation. Further information can be found in Section 3.16, *Navigation and Vessel Traffic*.

Vessel traffic would increase if multiple offshore wind projects use the same ports during overlapping construction periods or during operations. It is anticipated to have a minor impact on commercial and for-hire recreational fishing (Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*).

Land disturbance: Land disturbance for construction, operation and decommissioning of the onshore export cable and onshore substations would temporarily disturb neighboring land uses through construction noise, vibration and dust, and delays in travel along affected roads resulting in short-term disturbance and variable, negligible impacts on environmental justice communities. Impacts of land disturbance on environmental justice populations would be negligible because impacts would be small and measurable but would not disrupt the normal or routine functions of the affected population. Because impacts of Proposed Action land disturbance on environmental justice populations would be short term and negligible, BOEM has determined that impacts of this IPF on environmental justice populations would not be high and adverse.

The Harpers Switching Station site is located north of Harpers Road in the City of Virginia Beach and is located between two minority environmental justice communities. The switching station would be constructed in an area where there is currently a golf maintenance facility and would generate some

[3] The Fort Story Military Base in the VIA refers to the Joint Expeditionary Base Little Creek-Fort Story, of which the Fort Story Historic District is a part.

operational noise, and portions of the route considered traverse through census block groups with environmental justice populations.

3.12.1.4 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

As noted in Appendix F, two other offshore wind projects (Kitty Hawk Offshore Wind North and Kitty Hawk Offshore Wind South) using ports in the geographic analysis area for environmental justice populations would overlap with the Proposed Action construction and operations phase. Short-term air quality impacts during the construction phase would likely vary from minor to moderate. The impacts at PMT close to environmental justice communities cannot be evaluated because port usage has not been identified; however, most air emissions would occur at offshore locations rather than at the port. In addition to air emissions at ports, offshore wind in the Virginia and North Carolina lease areas would result in greater potential displacement of fossil fuel power generation than the Proposed Action alone.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined air quality impacts on environmental justice populations from ongoing and planned activities would likely be negligible to minor, due to short-term emissions near ports. The Proposed Action could also have beneficial effects for environmental justice populations, due to long-term reduction in air emissions from fossil fuel power generation.

The Proposed Action, in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas. In context of reasonably foreseeable environmental trends, the Proposed Action, in combination with ongoing and planned activities, would have minor to moderate adverse and minor beneficial impacts on environmental justice populations.

In the context of reasonably foreseeable environmental trends offshore cable emplacement impacts for the Proposed Action, in combination with ongoing and planned actions, would likely result in a short-term and minor impact, resulting from the impact on subsistence fishing and reduced employment and income of workers employed in industries supporting commercial fishing.

In context of reasonably foreseeable environmental trends, noise from the Proposed Action, in combination with ongoing and planned activities, would have a variable, temporary, minor impact on environmental justice communities, reflecting existing ambient noise in the area, and ongoing and planned activities that could generate intermittent, short-term increases in noise levels.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined port utilization impacts on environmental justice populations from ongoing and planned activities, including the Proposed Action, would likely be negligible to minor adverse due to air emissions and noise, and there would also be minor beneficial impacts from port activities on environmental justice communities, due to increased employment opportunities and economic activity.

The Proposed Action in combination with the other offshore wind energy projects in the environmental justice geographic analysis area would result in a greater number of offshore structures affecting a larger offshore area. In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts on environmental justice populations from ongoing and planned activities would likely be long term, continuous, and minor to moderate and minor beneficial.

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to combined vessel traffic impacts on environmental justice populations from ongoing and planned activities would likely be short term and minor during construction due to the potential impacts of increased vessel traffic near ports on subsistence fishing and low-income employees of the commercial and for-hire recreational fishing industries and would be negligible during operations. There may also be beneficial impacts on environmental justice communities through increased employment and economic activity for marine transportation and supporting businesses.

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 other offshore wind projects, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined onshore land disturbance impacts on environmental justice populations from ongoing and planned activities would likely be temporary, variable, and negligible to minor.

3.12.1.5 Conclusions

Impacts of the Proposed Action. BOEM anticipates that the impacts of individual IPFs from the Proposed Action alone would likely have negligible to moderate impacts on environmental justice populations in the geographic analysis area due to impacts during construction, operations and decommissioning relating to low-income employees of marine industries and supporting businesses, such as the commercial fishing and for-hire recreational fishing industry and subsequent onshore support services, as well as recreational fishing. The Proposed Action would result in negligible impacts on environmental justice communities due to lighting and land disturbance. Air emissions and port utilization would result in negligible to minor impacts on environmental justice populations. Minor impacts on environmental justice populations would result from disruption of marine activities during offshore cable installation, noise, and vessel traffic. Minor to moderate impacts are anticipated on environmental justice populations from commercial and for-hire recreational fishing and viewer experience, based on the location of some of the KOPs in the geographic analysis area, due to the long-term presence of offshore structures in the geographical analysis area. 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 the Proposed Action displaces fossil fuel energy generation in locations that improve air quality and health outcomes for environmental justice populations (Section 3.4, *Air Quality*).

None of the individual IPFs considered in this environmental justice analysis are expected to result in disproportionately high and adverse impacts on environmental justice populations. Considering the combined impacts of all IPFs, BOEM anticipates that the Proposed Action would have overall **negligible** to **moderate** adverse impacts and **minor beneficial** impacts on all environmental justice populations.

Cumulative impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of individual IPFs on environmental justice populations from ongoing and planned activities would range from **negligible** to **moderate** adverse impacts and **minor beneficial** impacts on all environmental justice populations. BOEM anticipates that the impacts of the Proposed Action on environmental justice communities would not be disproportionately high and averse. Impacts on low-income employees of marine industries and supporting businesses would be minor, based on 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 minor to moderate impacts on marine-dependent businesses resulting from the long-term presence of offshore structures.

The Proposed Action, in combination with other offshore wind energy projects would result in additional offshore and onshore construction in the geographic analysis area. Considering all the IPFs collectively, BOEM anticipates that the combined impacts on environmental justice populations from ongoing and planned activities, in context of reasonably foreseeable environmental trends, would be **moderate** overall. The main drivers for the impact ratings are the long-term, minor to moderate impacts associated with the presence of offshore structures that affect marine-dependent businesses, such as commercial fishing, for-hire recreational fishing, boat tours, and other marine recreational businesses, that may hire low-income workers, as well as the viewer experience.

3.12.6 Impacts of Alternatives B and C on Environmental Justice

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, which is described in this section.

Impacts of Alternatives B and C. The impacts of Alternatives B and C on environmental justice communities would be the same as those of the Proposed Action except for the impact of the presence of structures. There would be no additional impacts on environmental justice communities in the direct vicinity of the onshore project components beyond the impacts already identified under the Proposed Action, because there would be no changes to the onshore project components of the project under Alternatives B and C. The impacts resulting from IPFs associated with construction, installation, operation, and decommissioning of the Project under Alternatives B and C would be similar to those described under the Proposed Action. Construction of Alternative B would involve the installation of up to 176 WTGs and associated export cables (26 fewer than the Proposed Action). Similarly, Alternative C would involve the installation of up to 172 WTGs (inclusive of two spare locations) and the removal of and relocation of WTGs and associated infrastructure to minimize impacts on priority sand ridge habitat. Alternatives B and C would reduce the offshore construction impact footprint and installation period compared to the Proposed Action.

Cumulative impacts of Alternatives B and C. Impacts of Alternatives B and C would be similar to those of the Proposed Action for environmental justice communities. Alternatives B and C could reduce visual impacts due to the reduced number of WTGs and associated nighttime aviation safety lighting. However, this would not be noticeable to the casual viewer and would not have a substantial effect. Long-term, continuous, negligible impacts are still anticipated, as Alternatives B and C would not change the impacts on businesses that are a source of employment for low-income populations. Alternatives B and C could reduce gear entanglements and loss, as well as allisions, and recreational fishing may see a slight decrease compared to the Proposed Action due to fewer structures providing reef habitat for targeted species. Because of the reduced number of WTGs installed, fewer vessels and vessel trips would also be expected during construction, which would reduce the risk of discharges, fuel spills, and trash in the area.

3.12.1.6 Conclusions

Impacts of Alternatives B and C. Alternatives B and C would reduce the overall offshore footprint of the Project, which would slightly lessen the impacts on commercial and for-hire and recreational fishing vessels, which are a source of employment for low-income individuals. The impacts resulting from individual IPFs associated with Alternatives B and C would have slight improvements over the Proposed Action's impacts but would not change the overall impact magnitudes, which are anticipated to range from long-term and continuous **negligible** to **moderate** and **minor beneficial** on environmental justice communities. Because impacts would be negligible to moderate, BOEM determined that impacts of Alternatives B and C on low-income and minority populations would not be disproportionately high and adverse.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **moderate** adverse impacts with **minor beneficial** impacts.

3.12.7 Impacts of Alternative D on Environmental Justice

Impacts of Alternative D. The impacts of Alternative D on environmental justice communities would be similar to those of the Proposed Action. Alternative D would have the same offshore layout of project components and number of WTGs; however, Alternative D has two potential cable routes. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). Alternative D-2, Hybrid Interconnection Cable Route Option 6 would follow the same route as Interconnection Cable Route Option 1, except for the switching station, and would be installed via a combination of underground and overhead construction methods. Alternative D-1, Interconnection Cable Route Option 1 would be installed entirely overhead. The overall length of Alternative D-1 and Alternative D-2 would be the same at 14.3 miles (22.9 kilometers). The Chicory Switching Station associated with Alternative D-2 is not located in an environmental justice community. In comparison, the Harpers Switching Station would be constructed with Interconnection Cable Route Option 1 (Alternative D-1) and would be located between two census block groups with minority populations. Alternative D-2 would reduce the potential for disproportionate adverse impacts to environmental justice communities with the construction of the Chicory Switching Station, which is not located in an environmental justice community.

Impacts of Alternative D on environmental justice communities would be similar to those of the Proposed Action. Operational noise would not affect environmental justice communities, because Chicory Switching Station identified in Alternative D-2 is not located in an environmental justice community. Temporary, variable, and negligible to minor impacts on land disturbance are anticipated under Alternative D.

Cumulative impacts of Alternative D. The impact of Alternative D in combination with future offshore wind projects would be similar to that described for the Proposed Action. In context of reasonably foreseeable environmental trends, Alternative D and the combined impacts on environmental justice populations from ongoing and planned activities are anticipated to range from **negligible** to **moderate** and **minor beneficial.**

3.12.1.7 Conclusions

Impacts of Alternative D. BOEM anticipates the impacts on environmental justice communities resulting from Alternatives D-1 or D-2 would be similar to those of the Proposed Action. The overall land-based footprint slightly lessens the impacts on land disturbance associated with the interconnection cable route corridor. Depending on which cable route is chosen, the switching station may or may not be in an environmental justice community. The Chicory Switching Station is not located in an environmental justice community, whereas the Harpers Switching Station would be, as it is identified as being constructed between two census block groups with minority populations. The impacts resulting from individual IPFs associated with Alternative D would have improvements over the Proposed Action’s impacts but would not change the overall impact magnitudes on environmental justice communities, which are anticipated to be temporary and range from **negligible** to **moderate** and **minor beneficial**. Because impacts would be negligible to moderate, BOEM determined that impacts of Alternative D on low-income and minority populations would not be disproportionately high and adverse.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the combined impacts from individual IPFs on environmental justice from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **moderate** adverse and **minor beneficial**.

3.12.8 Agency-Required Mitigation Measures

No additional measures to mitigate impacts on environmental justice communities have been proposed for analysis.

3.13 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 3.13-1, includes the Northeast Continental Shelf Large Marine Ecosystem (LME),[1] which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, is likely to capture the majority of movement ranges for most invertebrates and finfish species. The entirety of the geographic analysis area includes only U.S. waters. Due to the size of the geographic analysis area, the analysis in this EIS focuses on finfish and invertebrates that would be likely to occur in the Project area and be affected by Project activities.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 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 Magnuson-Stevens Fisheries Conservation and Management Act as "essential" for the conservation and promotion of specific fish and invertebrate species. More detailed information regarding the impact on species listed under the ESA, as well as on EFH, can be found in the EFH Assessment (BOEM 2023a) and the BA (BOEM 2023b, 2023c). A discussion of benthic species is provided in Section 3.6, *Benthic Resources*, and a discussion of commercial fisheries and for-hire recreational fishing is provided in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*.

3.13.1 Description of the Affected Environment for Finfish, Invertebrates, and Essential Fish Habitat

This section discusses existing finfish and invertebrate resources and their respective, designated EFH in the geographic analysis area for these aquatic organisms, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.13-1. Specifically, the geographic analysis area for finfish and invertebrates includes the Northeast Shelf LME, which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, and the Southeast Shelf LME, which extends from Cape Hatteras to Florida. The northern portion of the geographic analysis area includes only U.S. waters (Figure 3.13-1). Within this area, species discussed include deep water marine species, estuarine, and diadromous species that use both fresh and marine habitats within one of their life stages.

The coastal Project area falls within the southern extent of the Mid-Atlantic Bight (MAB). This portion of the MAB supports a diverse fish and invertebrate assemblage detailed in the COP Section 4.2.4.2; Dominion Energy 2023) and in Section 3.2.5.1 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment* (BOEM 2014b). Additional descriptions of fish and invertebrate species in the Project area can be found in other regional BOEM EISs (BOEM 2012, 2014a). The *Programmatic EIS for Alternative Energy Development* (MMS 2007) also describes the affected environment for this section of the Atlantic OCS.

[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.

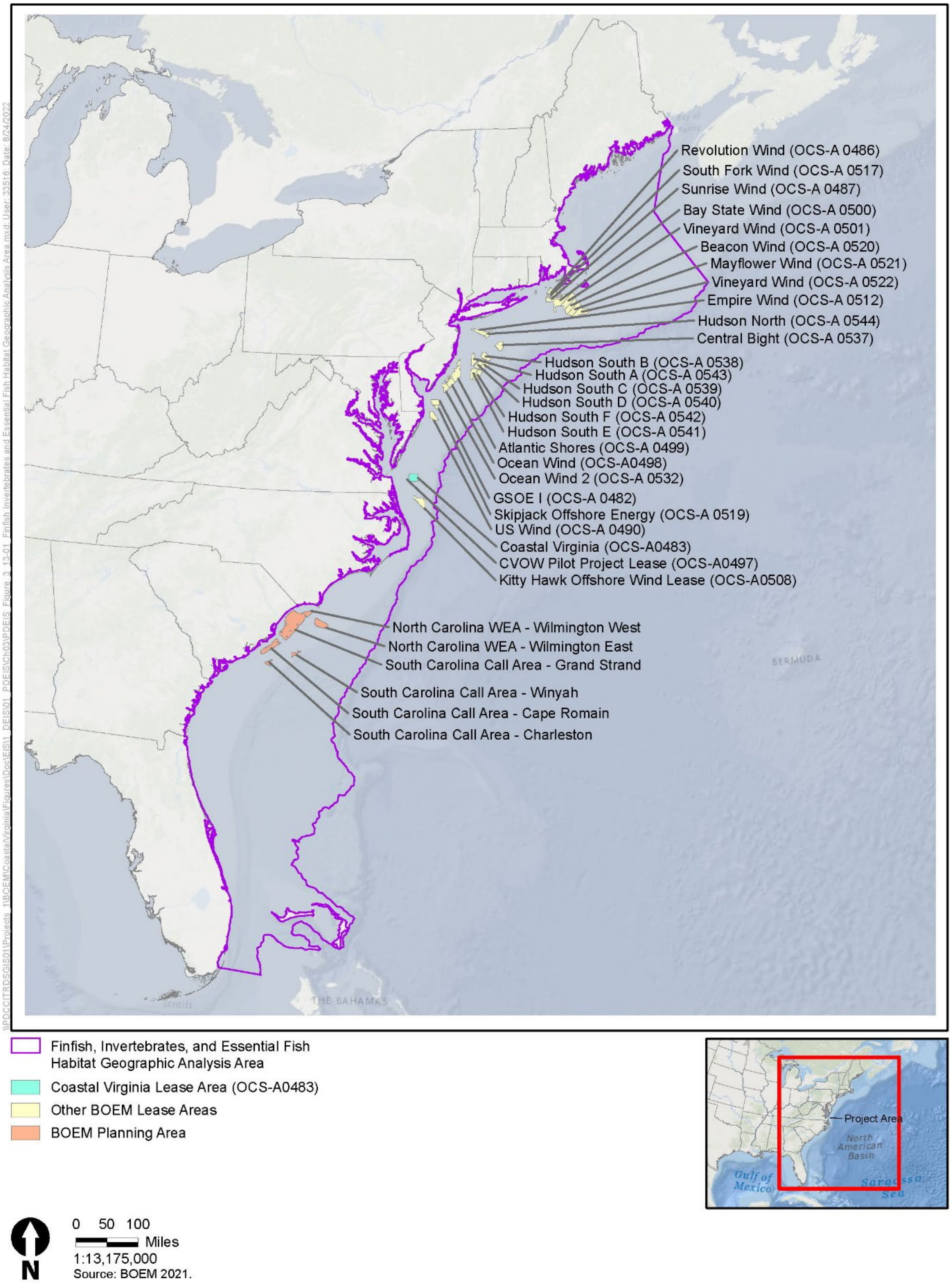


Figure 3.13-1 Finfish, Invertebrates, Essential Fish Habitat, and Scientific Research and Surveys Geographic Analysis Area

3.13.1.1 Finfish

The geographic analysis area was selected based on the likelihood of capturing the majority of the movement range for most finfish species that would be expected to pass through the Project area. This area is large and has very diverse and abundant fish assemblages that can be generally categorized based on life history and preferred habitat associations (e.g., pelagic, demersal, resident, and highly migratory species).

The MAB fish fauna is a mix of demersal and pelagic species with boreal and warm temperate, cold temperate, and subtropical affinities. At least 600 fish species use Virginia's coastal and offshore habitats (BOEM 2014b). A table listing the predominant demersal species and the biogeographic zones they use is found in the *Virginia Offshore Technology Revised Environmental Assessment* (BOEM 2014b).

At the family level, demersal species of the region are represented by a very diverse suite of taxa, including (but not limited to) skates (Rajiidae), dogfishes (Squalidae), requiem sharks (Carcharhinidae), searobins (Triglidae), hakes (Phycidae, Merlucciidae), anglerfishes (Lophiidae), seahorses and pipefishes (Syngnathidae), sculpins (Cottidae), seabasses (Serranidae), drums (Sciaenidae), scup (Sparidae), and flatfishes (Paralichthyidae, Pleuronectidae, Scophthalmidae; Robins and Ray 1986).

The MAB demersal assemblage characteristically varies over space and time driven primarily by seasonal changes in water temperature such as those driven by the seasonal evolution of the MAB cold pool (Fabrizio et al. 2014; Hopkins and Cech 2003; Kohut and Brodie 2019; Secor et al. 2018; Sims et al. 2001). When water temperatures increase in the spring, warm temperate, and some subtropical, fishes move into the MAB from the south; at the same time, several cold-water species migrate back to areas north of the MAB. After shelf waters cool during fall and early winter, warm temperate species migrate back south and offshore while some of the cold temperate forms move into the area (BOEM 2014a). Several fish species historically found south of the MAB have expanded their range northward into offshore Virginia waters and into the MAB. This expansion in range for some species has been attributed to increased seawater temperatures and a gradual shift of the Gulf Stream current to the northeast, moving close to the Virginia coastline (Pinsky et al. 2013; Andres 2016).

Pelagic species found in the MAB are also represented by a diverse suite of taxa, including sharks (Squalidae, Lamnidae, Carcharhinidae), herrings (Clupeidae), anchovies (Engraulidae), mackerels (Scombridae), cobia (Rachycentridae), striped bass (Moronidae), bluefish (Pomatomidae), and butterfishes (Stromateidae). All of these taxa form schools of varying sizes that migrate seasonally with the demersal fishes and most pelagic species found in the MAB being transitory, originating in waters either to the north (Gulf of Maine or Georges Bank) or to the south (south of Cape Hatteras) of the MAB. Their occurrence in the MAB is generally a response to seasonal changes in water temperature that trigger southerly or northerly movements by species of southern or northern origin, respectively. Many large-scale migrations of pelagic fishes in the MAB are related to spawning.

The MAB additionally contains diadromous species such as the catadromous American eels (*Anguila rostrata*), anadromous alewife (*Alosa pseudoharengus*), and the blueback herring (*Alosa aestivalis*). The catadromous American eel spends most of its life in the freshwater rivers or estuarine habitats (between 8 and 24 years) and migrates to spawning grounds in the Sargasso Sea (Owens and Geer 2003). The Gulf Stream transports the eels as they metamorphize from leptocephalus larvae into glass eels that begin to make their way into brackish waters. Once the eels are elvers, or in the juvenile stage, they migrate back into the freshwater habitats, where they feed primarily on invertebrates and smaller fish. The eels begin to migrate as yellow eels and mature into migratory adults (silver eels) that later return to the Sargasso Sea to spawn.

The eel fishery primarily targets the yellow eel life stage, though silver eels are also caught during their fall migration. Glass eel fisheries are prohibited except in South Carolina and Maine (ASMFC 2012a). The American eel is an important commercial species within Chesapeake Bay, where 60 percent of the U.S. commercial American eel landings occur (ASMFC 2012a). The American eel, particularly during the glass eel life stage, holds spiritual, cultural, and natural resource value for the Upper Mattaponi Indian Tribe and Nansemond Indian Nation within the Chesapeake Bay Tribal communities.

The anadromous alewife and the blueback herring are important prey species for many commercially and recreationally important finfish species within the MAB and most of the eastern seaboard of the US. Both species range from estuarine habitats in northern Florida to Canada. Both species spawn in freshwater river systems between the ages of 3 to 6 years (Messieh 1977; Loesch and Lund 1977) and repeatedly spawn within the same natal freshwater rivers over their lifespan. The commercial landings for the alewife and blueback herring are combined in most commercial landings and reported as river herring along the Atlantic Coast (NMFS 2019). Coastal Virginia made up to 50 percent of all river herring landings mainly derived from Chesapeake Bay, Potomac River, York River, and offshore harvest (NMFS 2019). Adults and juveniles are known to occur in the Project area. Because of the precipitous declines in river herring populations that occurred in the 1990s, moratoria on commercial fishing on river herring began within the New England region and now include most of the Atlantic coast states from Massachusetts to Florida (ASMFC 2012b, ASMFC 2017a,b). Virginia Marine Resources Commission imposed a moratorium on January 1, 2012, on the possession of river herring in tidal waters (BOEM 2023d).

American shad (*Alosa sapidissima*) also have a moratorium in the Chesapeake Bay and its tributaries, which began on January 1, 1994 (BOEM 2023b). This anadromous fish spends most of its life in the ocean, only returning to coastal rivers and estuaries in the spring to spawn. While at sea, American shad juveniles take 3 to 6 years to reach sexual maturity before they return to natal water in large schools to batch spawn, usually at night (ASMFC 2023). Depending on their range, adult males and females may die after spawning or live up to 13 years (ASFMC 2023). Along with river herring, American shad were once the largest commercial and recreational fisheries of the Atlantic (ASFMC 2023; NMFS 2019). Due to the dramatic stock decline, the at-sea fishery for American shad was closed in 2005, though an estimated 195,642 pounds were landed in 2021 from bycatch fishery (ASFMC 2023).

General migration patterns include (1) cross-shelf movements to offshore spawning areas, (2) movements along the shelf to southerly spawning areas, and 3) movements between coastal rivers and the coastal ocean for spawning or the reverse (diadromy) (BOEM 2014b; South Fork Wind 2021)).

3.13.1.2 Invertebrates

Invertebrate resources assessed in this section include the planktonic zooplankton community and megafauna species that have benthic, demersal, or planktonic life stages. Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.6. *Benthic Resources*. In general, the sediments of the Virginia WEA are mostly sandy with large pockets of muddy sand on the western side, and increased gravel on the eastern side (Guida et al. 2017). The benthic infauna is dominated by polychaetes, while the epifauna is dominated by sand shrimp, snails, surfclams, calico scallops, hermit crabs, dog whelk snails, and sea slugs (Guida et al. 2017). Additional invertebrates within the geographic analysis area include crustaceans (e.g., amphipods, crabs, lobsters), mollusks (e.g., gastropods, bivalves), echinoderms (e.g., sand dollars, brittle stars, sea cucumbers), and various other groups (e.g., sea squirts, burrowing anemones) (Guida et al. 2017). Benthic invertebrates are commonly characterized by size (i.e., megafauna, macrofauna, or meiofauna). Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.6, *Benthic Resources*. In this section, the description of invertebrate resources focuses on the planktonic zooplankton community and megafauna species that have one or more of the following life stages: benthic, demersal, or planktonic.

Demersal, epibenthic, and infaunal invertebrates found within the Offshore Project area include ecologically and commercially important species such as sea scallops (*Placopecten magellanicus*), surfclams (*Spisula solidissimus*), ocean quahogs (*Arctica islandica*), calico scallop (*Argopecten gibbus*), and the channeled whelk (*Busycotypus canaliculatus*) (Guida et al. 2017). These species reside either on the seafloor (scallops and channeled whelk) or buried within the seafloor sediments (ocean quahog and surfclams). The primary pelagic macroinvertebrates in the region are longfin inshore squid (*Doryteuthis pealeii*) and northern shortfin squid (*Illex illecebrosus*). Longfin squid adults move offshore in fall and remain there until April, at which time adults and young migrate back into shelf waters for the summer. Longfin inshore squid egg clusters (known as mops) were found within the lease footprint and accounted for 33 percent of the total biomass for trawl samples collected during the NOAA 2017 survey (Guida et al. 2017). The presence and magnitude of the longfin squid egg mops biomass was acknowledged by Guida et al. (2017) as a notable finding since the Lease Area is well south of the longfin squid mop EFH (see also Welch et al. 2018). The magnitude of the biomass of longfin squid mop outside of its designated EFH should be considered relative to the potential impact benthic disturbance activities could cause during this immobile life stage of this important finfish prey species.

3.13.1.2.1 Zooplankton

Zooplankton are a type of heterotrophic plankton in the marine environment that range from small, microscopic organisms to large species, such as jellyfish. These invertebrates play an important role in marine food webs and include both organisms that spend their whole life cycles in the water column and those that spend only certain life stages (larvae) in the water column (meroplankton). In the marine environment, zooplankton dispersion patterns vary on a large spatial scale (from meters to thousands of kilometers) and over time (hours to years). Zooplankton exhibit diel vertical migrations up to hundreds of meters; however, horizontal large-scale distributions over large distances are dependent on ocean currents and the suitability of prevailing hydrographic regimes. Northward shifts of more than 10° latitude have been attributed to the increase in atmospheric temperatures (Burkill and Reid 2010), which heat ocean surface temperatures and therefore increased zooplankton regionally (Kane 2011).

3.13.1.2.2 Megafaunal Invertebrates Associated with Soft and Hard Substrates

Some of the megafaunal invertebrates found in the geographic analysis area are migratory while others are sessile or have more limited mobility. Generally, mobile invertebrates with broad habitat requirements are more adaptable to disturbance and anthropogenic impacts compared to invertebrates that require specific habitats during one or more life stages, and/or have limited mobility.

No hard-bottom habitats were observed or detected within the offshore survey area during the most recent benthic survey (COP, Appendix D; Dominion Energy 2023). All samples were dominated by sand, with fine sand, accounted for 93.2 percent of all sample particle size distribution. Meanwhile, gravel only accounted for 3.7 percent, and 3.0 percent were total fines (COP, Appendix D; Dominion Energy 2023). This habitat supports soft-sediment invertebrates such as annelids (polychaete worms), mollusks (moon snails, whelks, quahogs), arthropods (horseshoe crabs, hermit crabs, spider crabs), and echinoderms (sand dollars). Nearly 90 percent of the benthic grab samples were annelids and arthropods (COP, Appendix D; Dominion Energy 2023). Amphipods were very common across all project samples, accounting for 34 percent of all identified individuals. These sessile species are more likely to be impacted by local disturbances and anthropogenic impacts. The biomass and number of benthic individuals are important factors in determining the availability of food resources to bottom-feeding organisms and fishes (Cutter and Diaz 1998).

3.13.1.2.3 General Biological Trends in Primary Invertebrate Species

Though annual temperatures varied, seasonal fluctuations as large as 15°C at the sea floor play a large role in migratory patterns and timing (Guida et al. 2017). Patterns of thermal stratification are also present, beginning in April and increasing through the summer. By September and October vertical turnover occurs and the temperature gradient is negligible. A steep decline of up to 12°C is present by early winter (Guida et al. 2017). These patterns in temperature play a large role in signaling seasonal migrations and the settlement of demersal and benthic organisms.

The most recent trends in primary invertebrate species have been summarized in the State of the Ecosystem report for the Mid-Atlantic (NOAA 2021b). They indicated that long-lasting climactic events such as heatwaves can greatly impact invertebrate species, including those of commercial importance such as the lobster fishery. These industries have had to adapt as their target species shift north to cooler waters. In the same regard, changes in the cold pool were observed. The cold pool is a mass of colder water trapped on the ocean floor over the continental shelf. This distinctive feature of the MAB is becoming increasingly warmer, and the water column becomes homogenized earlier in the year. These physical changes to the ocean temperature contribute to ecosystem-level changes that are observed in many fishing industries.

3.13.1.3 Essential Fish Habitat

The Magnuson-Stevens Fisheries Conservation and Management Act requires fishery management councils to:

1. Describe and identify EFH for managed species (and their prey) in their respective regions;
2. Specify actions to conserve and enhance EFH; and
3. Minimize the adverse effects of fishing on EFH.

The Magnuson-Stevens Fisheries Conservation and Management Act requires federal agencies to consult on activities that may negatively affect EFH identified in FMPs. In the MAB, fishery species and EFH are managed by MAFMC, SAFMC, and the Office of Highly Migratory Species (HMS). The Atlantic States Marine Fisheries Commission (ASMFC) manages some species and habitat at the state level. Section 3.2.5.1 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment* (BOEM 2014b) and Section 4.3.1.2 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment Research Activities Plan* (Tetra Tech 2015) provide a formal EFH assessment including relevant managed species within the Project area.

BOEM has prepared an EFH Assessment for the Project (BOEM 2022a). In summary, EFH has been designated for 41 fish species in the Lease Area and the OECC. Both substrate and water habitats are cited as EFH within both the Lease Area and OECC. Approximately 600 fish species are resident or transient through the benthic and pelagic habitats of Virginia's coastal waters (Robins and Ray 1986). Benthic or pelagic EFH has been designated in the Offshore Project area for one or more life stages of 41 species.

The following species with EFH in the Offshore Project area were identified using the NOAA Fisheries EFH Mapper (NOAA Fisheries 2022a), NEFMC Omnibus Amendment 2 (2017), MAFMC FMPs, NOAA Fisheries Highly Migratory Species Amendment 10 (2017), and NOAA Fisheries EFH source documents.

- Atlantic albacore tuna (*Thunnus alalunga*)

- Atlantic angel shark (*Squatina dumeril*)
- Atlantic bluefin tuna (*Thunnus thynnus*)
- Atlantic butterfish (*Peprilus triacanthus*)
- Atlantic cod (*Gadus morhua*)
- Atlantic herring (*Clupea harengus*)
- Atlantic mackerel (*Scomber scombrus*)
- Atlantic sea scallop (*Placopecten magellanicus*)
- Atlantic sharpnose shark (*Rhizoprionodon terraenovae*) (Atlantic stock)
- Atlantic skipjack tuna (*Katsuwonus pelamis*)
- Atlantic surfclam (*Spisula solidissima*)
- Atlantic yellowfin tuna (*Thunnus albacares*)
- Basking shark (*Cetorhinus maximus*), species of concern
- Black sea bass (*Centropristis striata*)
- Blacktip shark (*Carcharhinus limbatus*)
- Bluefish (*Pomatomus saltatrix*)
- Clearnose skate (*Raja eglanteria*)
- Cobia (*Rachycentron canadum*)
- Spanish mackerel (*Scomberomorus maculatus*)
- King mackerel (*Scomberomorus cavalla*)
- Common thresher shark (*Alopias vulpinus*)
- Dusky shark (*Carcharhinus obscurus*)
- Little skate (*Leucoraja erinacea*)
- Longfin inshore squid (*Loligo pealeii*)
- Monkfish (*Lophius americanus*)
- Pollock (*Pollachius virens*)
- Red hake (*Urophycis chuss*)
- Sand tiger shark (*Carcharias taurus*), species of concern
- Sandbar shark (*Carcharhinus plumbeus*)
- Scup (*Stenotomus chrysops*)
- Shortfin mako shark (*Isurus oxyrinchus*)
- Smooth dogfish (*Mustelus canis*)
- Spiny dogfish (*Squalus acanthias*)
- Summer flounder (*Paralichthys dentatus*)

- Tiger shark (*Galeocerdo cuvier*)
- White shark (*Carcharodon carcharias*)
- Windowpane flounder (*Scophthalmus aquosus*)
- Winter skate (*Leucoraja ocellata*)
- Witch flounder (*Glyptocephalus cynoglossus*)
- Yellowtail flounder (*Limanda ferruginea*)

Three basic marine habitat types occur in the region: pelagic (water column), soft bottom demersal, and hard bottom demersal. Within inshore waters, additional biogenic habitats such as emergent vegetation, submerged vegetation, and oyster reefs are important. Various managed species use these inshore habitats for shelter, feeding, growth, and reproduction. MAB pelagic habitats support northern shortfin and longfin inshore squids, coastal pelagic fishes (Atlantic mackerel [*Scomber scombrus*], Atlantic herring [*Clupea harengus*], Atlantic butterfish [*Peprilus triacanthus*], bluefish [*Pomatomus saltatrix*], spiny dogfish [*Squalus acanthias*]), and oceanic pelagic fishes (tunas [*Thunnus* spp.], swordfish [*Xiphias gladius*], and sharks [Carcharhinidae, Lamnidae, Squalidae]). Members of the oceanic pelagic group (HMS) can span the entire MAB through migratory, feeding, and reproductive activity (NMFS 2006, 2017). Within this group, NMFS has incorporated FMPs for 12 Atlantic species that can range from the South Atlantic Bight (SAB) up into the Northern MAB on a seasonal basis (NMFS 2017; BOEM 2014b).

Managed soft bottom demersal species are included in Table 3.13-1 and include Atlantic surfclam, Atlantic sea scallop, and ocean quahog. Soft bottom fishes with EFH in the Project area include summer flounder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), and spiny dogfish. Black seabass (*Centropristis striata*) is an example of a hard bottom species with EFH in the Project area. Inshore habitats provide shelter for early life stages of summer flounder, striped bass (*Morone saxatilis*), bluefish, weakfish (*Cynoscion regalis*), black seabass, and scup. All major MAB habitats produce prey such as benthic invertebrates, anchovies (Engraulidae), silversides (Atherinidae), herrings (Clupeidae), and sand lances (Ammodytidae), which are important to many managed species (Kritzer et al. 2016).

The fishery management councils also identify habitat areas of particular concern (HAPC) within FMPs. HAPCs are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation. The Project area and the cable routes do not overlap with any designated HAPC. However, sandbar shark and summer flounder HAPCs have been designated within potential vessel transit routes into Hampton Roads, Virginia. Additionally, the summer flounder HAPC has not been spatially defined by NOAA but does overlap with native species of macroalgae, seagrasses, and freshwater and tidal macrophytes within their defined EFH and the MAB. The Sandbar shark HAPC is in the lower Chesapeake Bay and mouth of the Bay and presented on Figure 3.13-2.

Table 3.13-1 Species in the Offshore Project Area Managed by Federal, Regional, and State Agencies

Common Name	Scientific Name	Essential Fish Habitat (EFH) Life Stages Designated within the Offshore Project Area
New England Fishery Management Council		
Atlantic cod	*Gadus morhua*	Egg, Larva
Atlantic herring [1]	*Clupea harengus*	Juvenile, Adult
Atlantic sea scallop	*Placopecten magellanicus*	All
Clearnose skate	*Raja eglanteria*	Juvenile, Adult
Monkfish [2]	*Lophius americanus*	All
Pollock	*Pollachius virens*	Larva
Red hake	*Urophycis chuss*	Adult
Windowpane flounder	*Scophthalmus aquosus*	All
Winter skate	*Leucoraja ocellata*	Juvenile
Witch flounder	*Limanda ferruginea*	Larva
Mid-Atlantic Fishery Management Council		
Atlantic butterfish	*Peprilus triancanthus*	All
Atlantic mackerel	*Scomber scombrus*	Egg, Juvenile, Adult
Atlantic surfclam	*Spisula solidissima*	Juvenile, Adult
Black sea bass	*Centropristis striata*	Larva, Juvenile, Adult
Bluefish	*Pomatomus saltatrix*	All
Longfin inshore squid	*Doryteuthis pealeii*	Egg, Juvenile, Adult
Scup	*Stenotomus chrisops*	Juvenile, Adult
Spiny dogfish	*Squalus acanthias*	Sub-adult Female, Adult, Female, Adult Male
Summer flounder	*Paralichthys dentatus*	All
NOAA Fisheries—Highly Migratory Species		
Albacore tuna	*Thunnus alalunga*	Juvenile
Atlantic angel shark	*Squatina dumeril*	All
Atlantic bluefin tuna	*Thunnus thynnus*	Juvenile, Adult
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	Juvenile, Adult
Blacktip shark	*Carcharhinus limbatus*	Juvenile, Adult
Common thresher shark	*Alopias vulpinus*	Juvenile, Adult
Dusky shark	*Carcharhinus obscurus*	Juvenile, Adult
Sand tiger shark	*Carcharias taurus*	All
Sandbar shark	*Carcharhinus plumbeus*	All
Skipjack tuna	*Katsuwonus pelamis*	All
Smoothhound shark complex (smooth dogfish)	*Mustelus canis*	All
Tiger shark	*Galeocerdo cuvier*	All
Yellowfin tuna	*Thunnus albacares*	Juvenile, Adult

Common Name	Scientific Name	Essential Fish Habitat (EFH) Life Stages Designated within the Offshore Project Area
Atlantic States Marine Fisheries Commission & Virginia Marine Resources Commission		
Amberjack [3]	*Seriola dumerlli*	N/A—EFH is designated only for federally management species
American eel	*Anguilla rostrata*	
American lobster	*Homarus amereicanus*	
American shad	*Alosa sapidissima*	
Atlantic croaker	*Micropogonias undulatus*	
Atlantic menhaden	*Brevoortia tyrannus*	
Atlantic sturgeon	*Acipenser oxyrinchus*	
Billfish [3]	*Istiophoriformes*	
Black drum	*Pogonias cromis*	
Blue crab [3]	*Callinectes sapidus*	
Bluefish	*Pomatomus saltatris*	
Channeled whelk [3]	*Busycotypus canaliculatus*	
Cobia	*Rachycentron canadum*	
Grouper [3]	*Epinephelinae*	
Horseshoe crab	*Limulus polyphemus*	
Jonah crab	*Cancer borealis*	
Red drum	*Sciaenops ocellatus*	
River herring	*Clupeidae*	
Sheepshead [3]	*Archosargus probatocephalus*	
Spadefish [3]	*Chaetodipterus faber*	
Spot	*Leiostomus xanthurus*	
Spotted seatrout	*Cynoscion nebulosus*	
Striped bass	*Morone saxatilis*	
Tautog	*Tautoga onitis*	
Tilefish [3]	*Malacanthidae*	
Weakfish	*Cynoscion regalis*	

[1] Joint management with ASMFC.
[2] Joint management by NEFMC and MAFMC.
[3] VMRC only.

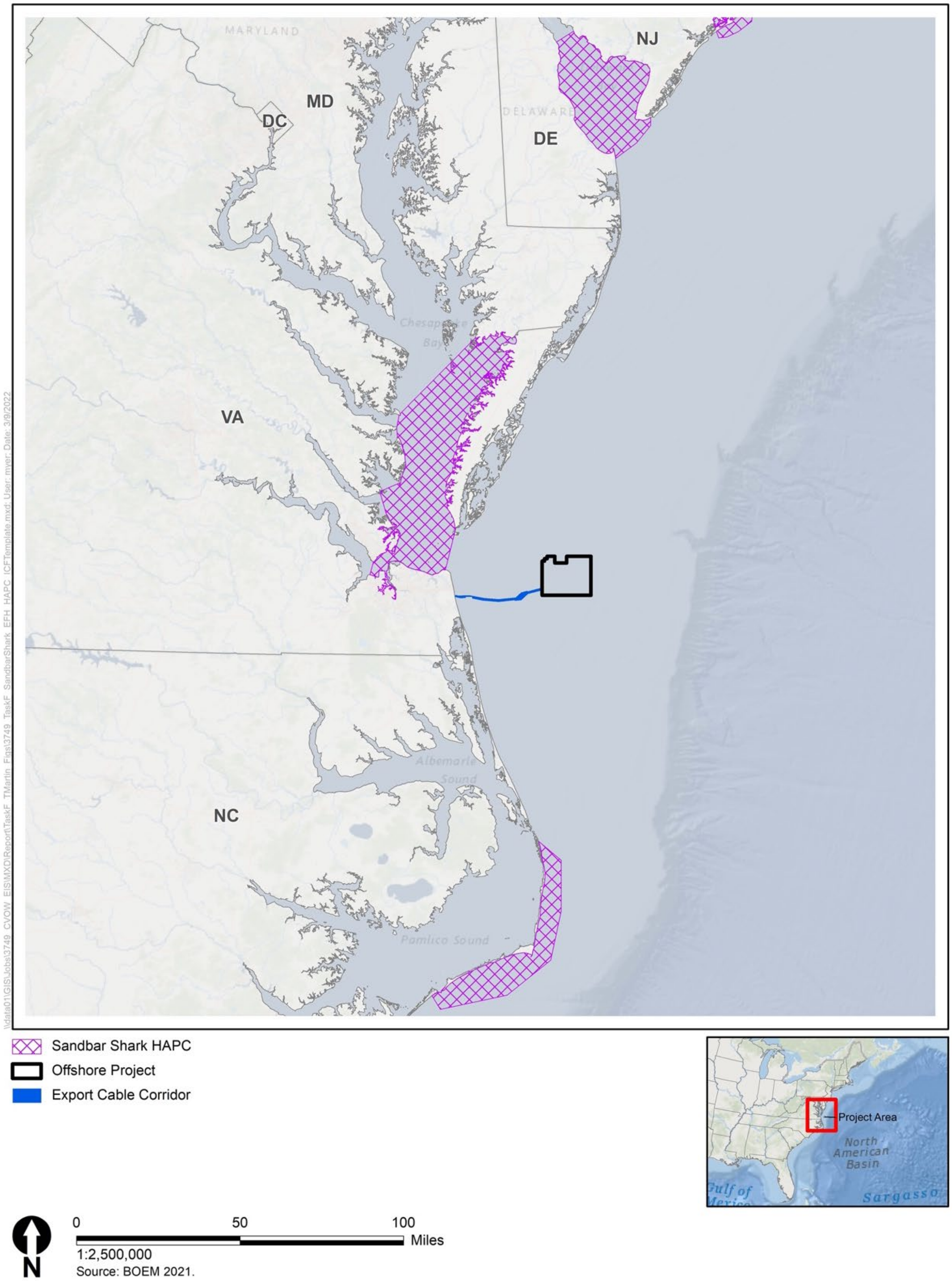


Figure 3.13-2 Sandbar Shark Habitat Areas of Particular Concern in the Project Area

3.13.1.3.1 ESA-Listed Species

Fish species from the geographic analysis area, and specifically within the Offshore Project area of offshore Virginia, listed under the ESA by NOAA as endangered are the shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus*) (NOAA Fisheries 2022b). Three additional MAB fish species listed as threatened that occur offshore Virginia are the giant manta ray (*Mobula birostris*), oceanic whitetip shark (*Carcharhinus longimanus*), and scalloped hammerhead shark (*Sphyrna lewini*) (NOAA Fisheries 2022c). The giant manta ray and oceanic whitetip shark are listed as threatened throughout their range, while the scalloped hammerhead is listed as threatened within the central and southeast Atlantic distinct population segment (DPS). The scalloped hammerhead would most likely transit through the Project site following prey species migrations (herring, mackerel, sardines, and squid). The giant manta and oceanic whitetip sharks are found within New England and the MAB mainly from July through September when waters reach 19 to 22°C (NOAA Fisheries 2022d). All four of the ESA-listed fish are considered to have potential interactions with the Proposed Action, and discussions related to the presence and frequency of these species in the Project area is presented. More information on these ESA-listed species may be found in the BA, which presents the analysis of the impacts related to the potential five species of ESA-listed finfish. Out of the five, the Atlantic sturgeon was the only species that is demersal and may be resident within the Lease Area during construction and conceptual decommissioning operations.

Atlantic Sturgeon—Endangered

When the Atlantic sturgeon Chesapeake Bay Distinct Population Segment was listed as Endangered by the ESA, the only known spawning population was in the James River (Balazik et al. 2012; Balazik and Musick. 2015). Since listing, the York River spawning population has been confirmed (Hager et al. 2014), and it is likely that spawning is occurring in the Nanticoke River and possibly the Rappahannock River (ASMFC 2017c).

Adult Atlantic sturgeon use the Chesapeake Bay seasonally, just as demonstrated in other systems. York River Atlantic sturgeon overwinter in oceanic waters and begin moving into Chesapeake Bay as the waters begin to warm. Females were recorded within the bay during pre-spawning beginning in late February to early October and can remain in the bay until January. Males entered the bay in early March and remained throughout until early September. Timing of peak occupation ranges from April to August and again from mid-October to early December. Females tend to remain in the bay longer than males before spawning, but they leave faster than males after spawning (draft Fishery Bulletin pending publication in August 2023).

Kahn et al. (2019) used a closed population mark-recapture model to estimate the population of Atlantic sturgeon from 2013 to 2018 in the York River, Virginia. Population estimates (95 percent confidence interval) ranged from 73 to 222 individuals across their study. Since Atlantic sturgeon do not spawn every year, the trend in these estimates do not suggest a recovering or declining population, but a variability in the number of adults that return to spawn each year. Adult sex ratios are estimated to approximately 0.51 (95 percent confidence intervals of 0.43 to 0.58) (Kahn et al. 2021).

Both spawning and non-spawning Atlantic sturgeon are known to use Chesapeake Bay, with females and males arriving as early as late February (7.7°C) and early March (6.4°C) and departing as late as the end of January (6.4°C). In a recent acoustic tagging study on Atlantic sturgeon within the Project area, detections within the cable route were found during November through April, and within the Lease Area December through May (Hager and Breault pers com to G. Fulling). The sedentary preferences of the sturgeon were in water depth ranging from 82 to 108 feet (25 to 33 meters).

The three main IPFs that could affect the Atlantic sturgeon are pile driving, which could result in noise impacts; fish monitoring projects; and a potential for vessel strike. Vessel strikes are generally restricted to shallow inshore waters (Balazik et al. 2012) and would be unlikely in the Lease Area, where water depths are up to 98 feet (30 meters). The potential for vessel strike increases within the OECC in shallow nearshore depths close to the mouth of the Chesapeake Bay where Atlantic sturgeon are more likely to inhabit and because of the frequency and duration (9 to 12 months) of support activity required for OECC cable installation. Fish monitoring programs employing otter trawl or gillnets could catch Atlantic sturgeon incidentally. Bycatch in commercial fisheries is another source of mortality for Atlantic sturgeon in the region (Stein et al. 2004).

Giant Manta Ray—Endangered

As the largest ray species, the giant manta ray occurs globally in tropical, sub-tropical, and temperate waters in both offshore and coastal regions (NMFS 2023a). They are slow growing, highly migratory animals with sparsely distributed and fragmented populations throughout the world. Regional population sizes are small, estimated to be between 100 and 1,500 individuals (Marshall et al. 2020; NMFS 2023a). They occur off the U.S. East Coast, most commonly in waters ranging from 66°F to 72°F (19°C to 22°C) from Florida to the Carolinas, though they can also occur off the Mid-Atlantic and Northeast (Farmer et al. 2022). Giant manta rays undergo seasonal migrations, which are thought to coincide with the movement of zooplankton, ocean current circulation and tidal patterns, seasonal upwelling, sea surface temperature, and possibly mating behavior (NMFS 2023a). The giant manta ray is a seasonal visitor to coastlines, oceanic island groups, and offshore pinnacles and seamounts that feature high levels of primary and secondary productivity. They primarily feed on planktonic organisms, including euphausiids and copepods (NMFS 2023a). Giant manta rays use a wide variety of depths during feeding, including aggregations in waters less than 33 feet (10 meters) deep and dives 656 to 1,476 feet (200 to 450 meters), which are likely driven by vertical shifts in their prey location (NMFS 2023a).

A compilation of giant manta ray detections from Farmer et al. (2022) showed regular sightings within the Mid-Atlantic during standardized surveys. Records north of Cape Hatteras were concentrated during the summer months (mainly June through September) and showed use of OCS, slope, and nearshore waters; most abundant sightings for the region occurred on the shelf and near the slope edge (Farmer et al. 2022). Giant manta rays were reported in bays and estuaries in the southern U.S. and Gulf of Mexico (Farmer et al. 2022). The detection information was used to model potential distribution, which showed preference for sea surface temperatures from 63°F to 90°F (17°C to 32°C), with a strong affinity for thermal fronts (Farmer et al. 2022). As expected from the sighting records, the model predicted highest probability of occurrence north of Cape Hatteras during warmer months when sea temperatures are highest (May to October). Forward predictions by the model show a northward shift for this species distribution through 2024 (Farmer et al. 2022).

Oceanic Whitetip Shark—Threatened

The oceanic whitetip shark (*Carcharhinus longimanus*) can be found globally in tropical and warm-temperate waters. It is a pelagic species with a preference for open ocean waters but can also be found on the OCS or around oceanic islands in deeper waters (NMFS 2023b). The species is typically found in water temperatures between 59°F and 82°F (15°C and 28°C), though is most common in waters above 68°F (20°C) (Bonfil et al. 2008; Carlson and Gulak 2012; Tolotti et al. 2015; NMFS 2023b). In the Northwest Atlantic, the oceanic whitetip shark is most commonly observed south of Virginia, though records of occurrence do include the Mid-Atlantic and northeast U.S. (Kohler et al. 1998; Young and Carlson 2020; Vaudo et al. 2022). The overall range of the shark in the North Atlantic expands northward during the summer and fall in response to seasonally warming temperatures and prey availability (Vaudo et al. 2022). Oceanic whitetip sharks may, therefore, be encountered in the geographic analysis area; however, these occurrences would be rare. Due to the low probability and frequency of this species occurring in the geographic analysis area, the potential for adverse effects from the proposed action to occur is extremely low.

Scalloped Hammerhead Shark—Endangered

Scalloped hammerhead sharks are moderately large sharks with a global distribution. Animals from the Eastern Atlantic DPS, which occur in the Eastern Atlantic and Mediterranean Sea (79 *Federal Register* 38213), and the Central and Southwest Atlantic DPS, which range as far north as central Florida, may occur in the geographic analysis area but are not expected to be present in the Project area. The primary factors responsible for the decline of the listed scalloped hammerhead shark DPSs are overutilization, due to both catch and bycatch of these sharks in fisheries, and inadequate regulatory mechanisms for protecting these sharks, with illegal fishing identified as a significant problem (79 *Federal Register* 38213). ESA-listed scalloped hammerhead sharks in the Action Area would only be encountered by Project vessels transiting from ports in Europe or the Gulf of Mexico. Because only a limited number of Project vessels would transit from Europe or the Gulf of Mexico to the wind farm area and reported vessel strikes for this species are low, the potential for vessel strikes occurring that result in serious injury or mortality is low and the potential for adverse effects from the Proposed Action to occur is extremely low.

3.13.1.3.2 Other Fish Species

As identified in BOEM (2021b), finfish and invertebrate populations and the EFH they require within the geographic analysis area are affected by ongoing activities, especially commercial and recreational harvest, commercial bycatch, water quality impacts, dredging, and climate change. In the 2000s, the majority of commercially exploited stocks within the geographical analysis area were categorized as overfished. According to the most recent assessment, 17 fish stocks are in an overfished condition with another 5 stocks subject to overfishing (NOAA 2021a). NOAA (2021a) reports that unseasonably high water temperatures and elevated pH levels in the MAB have caused a shift in the distribution of surfclam and ocean quahogs. The ranges of both species have begun to overlap, with surfclam and ocean quahog distributions moving into deeper water and trending to the northeast (NOAA 2021a).

Changes in baseline abundance and distribution of fauna within the geographic analysis area arise from factors external to wind energy development and require quantification to separate potential Wind Energy Area impacts from other sources. Changes in fish and invertebrate fauna within coastal waters result from a variety of anthropogenic impacts, including water quality, extractive fishing, and climate change. Degradation of water quality can translate into impacts on estuarine and marine habitats and their corresponding food webs. Water quality may also be adversely affected by dredging activities for navigation, port development, and marine minerals extraction. Commercial fishing not only extracts finfish and invertebrates, affecting stocks and ecosystem function, but also generates sediment plumes and modifies the topography of the seafloor through the use of bottom trawls and dredge fishing methods. These fishing methods disturb benthic habitat on a seasonal basis. Bycatch of undersized fish and non-targeted finfish and invertebrates by both commercial and recreational fishing have an effect on the flow of energy within the food web. Commercial net fishing including gillnets, purse seines, longlines, and pot lines and some recreational fish equipment (i.e., cast nets) can result in lost and derelict equipment, the latter of which continues to capture and entangle fish and invertebrates, causing the mortality of many finfish and invertebrate species within broad swaths of the geographic analysis area. Trends in the decline and changing species distributions and assemblage structure of finfish and invertebrate species present within the geographic analysis area have been correlated to several factors, such as historical fishing pressure and recent climate change impacts, including a shift in the Gulf Stream towards the New England U.S. coastline. Recent NOAA recovery programs have returned some fisheries stocks to stable levels within the geographic analysis area, but assessments of fisheries distributions have shown shifts of species ranges related to warming trends within the Mid-Atlantic (NOAA 2021b).

Collectively, baseline changes in species abundance and distribution will occur in the geographic analysis area arising to various degrees from water quality, fishing, and climate change.

Under the No Action Alternative, the proposed Project would not be built. If the Project is not approved, then impacts from the proposed Project (Section 3.13.5, *Impacts of the Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat*) would not occur as proposed. Impacts from ongoing, future non-offshore wind, and offshore wind activities would likely still occur resulting in similar impacts on finfish and invertebrates and their respective EFH. However, the exact nature of these impacts would not be the same due to spatiotemporal differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area.

3.13.2 Environmental Consequences

3.13.2.1 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

Definitions of potential impact levels are provided in Table 3.13-2.

Table 3.13-2 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.
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.
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.

3.13.3 Impacts of the No Action Alternative 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 non-offshore wind activities and ongoing offshore 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 F.

3.13.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH described in Section 3.13.1, *Description of the Affected Environment for Finfish, Invertebrates, and Essential Fish Habitat*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, EFH-managed species and ESA-listed species are generally associated with commercial harvesting and fishing activities, fisheries bycatch, water quality degradation and pollution, effects on benthic habitat dredging and bottom trawling, accidental fuel leaks or spills, and climate change.

Some mobile invertebrates can migrate long distances and encounter a wide range of stressors over broad geographical scales (e.g., longfin and shortfin squid). Their mobility and broad range of habitat requirements may also mean that limited disturbance may not have measurable effects on their stocks (populations). This would apply to finfish, where populations are composed largely of long-range migratory species; it would be expected that their mobility and broad ranges would preclude many temporary and short-term impacts associated with ongoing offshore impacts throughout the geographic analysis area. A recent study by Kahn et al. (2023) estimated telemetry-based survival estimates of the York River population of Atlantic sturgeon and found that four males and one female died between 2013 and 2019. Their last known location was near the shipping channels at the mouth of the Chesapeake Bay, suggesting this as an area of future studies to best manage the endangered fish species (Kahn et al. 2023). Invertebrates with more restricted geographical ranges or sessile invertebrates or life stages can be subject to the above stressors over time and can be more sensitive (Guida et al. 2017).

Seafloor habitat is routinely disturbed through dredging (for navigation, marine minerals extraction, and military purposes) and commercial fishing use of bottom trawls and dredge fishing methods. Abandoned or lost fishing gear remains in the aquatic environment for extended time periods, often entangling or trapping mobile invertebrate and fish species. Based on data from NOAA, bycatch affects many species throughout the geographic analysis area—most notably, windowpane flounder, blueback herring, shark species, and hake species; the majority of bycatch is a result of open area scallop trawls, large-mesh otter trawls, conch pots, and fish traps (Benaka et al. 2019). Water-quality impacts from ongoing onshore and offshore activities affect nearshore habitats, and accidental spills can occur from pipeline or marine shipping. Invasive species can be accidentally released in the discharge of ballast water and bilge water from marine vessels. The resulting impacts on invertebrates, finfish, and ESA-listed species depend on many factors but can be widespread and permanent, especially if the invasive species becomes established and outcompetes native species.

Global climate change has the potential to affect the distribution and abundance of invertebrates and their food sources, primarily through increased water temperatures but also through changes to ocean currents and increased acidity. Finfish and invertebrate migration patterns can be influenced by warmer waters, as can the frequency or magnitude of disease (Hare et al. 2016). Regional water temperatures that increasingly exceed the thermal stress threshold may affect the recovery of the American lobster fishery off the East Coast of the United States (Rheuban et al. 2017). 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 result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016).

Based on a recent study, marine, estuarine, and riverine habitat types were found to be moderately to highly vulnerable to stressors resulting from climate change (Farr et al. 2021). In general, rocky and mud bottom, intertidal, special areas of conservation, kelp, coral, and sponge habitats were considered the most vulnerable habitats to climate change in marine ecosystems (Farr et al. 2021). Similarly, estuarine habitats considered most vulnerable to climate change include intertidal mud and rocky bottom, shellfish, kelp, submerged aquatic vegetation, and native wetland habitats (Farr et al. 2021). Riverine habitats found to be most vulnerable to climate change include native wetland, sandy bottom, water column, and submerged aquatic vegetation habitats (Farr et al. 2021). As invertebrate habitat, finfish habitat, EFH-managed species, and ESA-listed species may overlap within these habitat types, Farr et al.'s 2021 environmental study suggests that marine life and habitats could experience dramatic changes and decline over time as impacts from climate change continue.

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on finfish, invertebrates, and EFH.

- Continued O&M of the Block Island Project (5 WTGs) installed in state waters.
- Continued O&M of the CVOW-Pilot Project (2 WTGs) installed in OCS-A 0497.
- 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 Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect finfish, invertebrates, and EFH through the primary IPFs of noise, presence of structures, and disturbance. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and seabed disturbance that are described in detail in Section 3.13.3.2, *Cumulative Impacts of the No Action Alternative*, for planned offshore wind activities, but the impacts would be of lower intensity.

3.13.3.2 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 that may affect finfish, invertebrates, and EFH include new submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, military use, marine transportation, fisheries use, and management, global climate change, and oil and gas activities (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). These activities would result in the same types of impacts as described for ongoing non-offshore wind activities.

Appendix F, Table F1-11 provides additional information on finfish, invertebrates, and EFH impacts associated with ongoing and planned activities. The main IPFs that could affect Atlantic sturgeon, giant manta ray, or other ESA-listed species are presence of structures and noise from the ongoing wind activities, as well as regulated fishing through periodic disturbance of the seafloor with bottom-tending gear and bycatch. Dredging in nearshore waters or estuaries may result in impacts on various life stages of ESA-listed and other finfish and invertebrate species.

3.13.3.3 Offshore Wind Activities (without Proposed Action)

BOEM expects offshore wind activities to affect finfish, invertebrates, and EFH through the following primary IPFs.

Accidental releases: Using the assumptions in Appendix F, *Planned Activities Scenario*, there would be a low risk of hydrocarbon products release from any of the more than 3,135 WTGs comprising approximately 36 offshore wind projects, with a total of approximately 27.4 million gallons (103.8 million liters) of fuel/fluids/hazardous materials contained in all offshore wind facilities (Appendix F, Table F2-3) (COP, Appendix Q, Dominion Energy 2023). According to BOEM modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,533 liters) is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years. The probability of an accidental discharge or spill occurring simultaneously from multiple WTGs is extremely low. Therefore, the potential of a spill larger than 2,000 gallons (7,571 liters) occurring and the resultant impacts are extremely unlikely. Based on these rates, the additional impact of releases from offshore wind facilities, the risk of which would primarily exist during construction, but also during operations and conceptual decommissioning, would fall within the range of accidental releases that already occur on an ongoing basis.

Marine invasive species have been accidentally introduced into habitats along the U.S. Atlantic seaboard in multiple instances. Pederson et al. (2005) list the numerous vectors that transport invasive organisms and inoculate new areas. Some of the dominant vectors are shipping and hull fouling, aquaculture, marine recreational activities, commercial and recreational fishing, and ornamental trades. Still, canals, offshore drilling, hull cleaning activities, habitat restoration, research, and floating marine debris (particularly plastics) may also facilitate the transfer of invasive organisms (Pederson et al. 2005). Ballast water exchange/discharge and biofouling are the two main vectors for invasive species introduction (Carlton et al. 1995; Drake 2015). The offshore wind industry would increase the risk of accidental releases of invasive species due to increased maritime traffic to support installation and potentially conceptual decommissioning operations. The impacts related to the release and establishment of invasive species on finfish, invertebrates, and EFH are multifaceted. Invasive species such as the Asian shore crab (*Hemigrapsus sanguineus*) have spread throughout most of the MAB and northern areas of the SAB. The Asian shore crab was first collected in the Delaware Bay area in 1988 and extended north to Maine and south to North Carolina (Epifanio 2013). There is a potential for invasive species being introduced and established as a result of offshore wind activities. Vessels required for the importation of components of the WTGs, OSSs, and submarine power cables and the specialized construction vessels from international ports could potentially represent transport vectors. The impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent. The introduction and impact of the Asian shore crab in the geographical analysis areas is a prime example of a species that became established and has out-competed native fauna and adversely modified the coastal habitat. The increase in this risk related to the offshore wind industry would be slight compared to the risk from ongoing activities. The vessels used by the offshore wind energy industry are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and USEPA National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim to prevent the release of ballast waters contaminated with an invasive species. As such, accidental releases from the construction activities related to the planned offshore wind energy industry would not be expected to contribute appreciably to overall impacts on finfish, invertebrates, and EFH-managed species. As such, accidental releases from offshore wind development would not be expected to contribute appreciably to overall impacts on ESA-listed species, finfish, invertebrates, and EFH; impacts on these resources would be considered negligible.

Anchoring: Vessel anchoring related to ongoing, commercial, and recreational activities continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Spud barges, jack-up vessels, or DP vessels may be required for other offshore wind projects; only spud barges and jack-up vessels will affect the seafloor during emplacement and removal. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish). Impacts from anchoring would occur during construction and installation activities related to the placement of WTGs and their scour protection, placement of OSSs, and installation of the submarine power cable arrays, depending upon the vessels used. Impacts resulting from anchoring or bottom contact would include increased turbidity levels and potential for contact causing mortality of demersal species and, possibly, degradation of sensitive habitats. All impacts would be localized; turbidity would be temporary; impacts from anchor contact (or spud can or leg emplacement) would recover in the short term. Degradation of sensitive habitats such as certain types of hard bottom or eelgrass, if it occurs, could cause long-term to permanent impacts. Construction operations within the proposed Project footprint would not occur simultaneously and the footprint of each anchoring would be relatively small and of short duration and would represent a minor impact on the finfish and invertebrate community.

Electromagnetic fields: EMFs emanate continuously from installed electrical power transmission cables. Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for alternating current (AC) cables (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) present near operating direct current (DC) cables (Hutchison et al. 2018). Haddock (*Melanogrammus aeglefinus*) larvae alter their swimming behavior in DC-generated magnetic fields in laboratory settings (Cresci et al. 2022a). Conversely, similar trails with sand lance larvae (*Ammodytes marinus*) showed no response to magnetic fields (Cresci et al. 2022b). Invertebrates tend to be attached to the substrate (sessile) or have low motility and are likely to experience long-term exposure if located close to submarine power cables (Albert et al. 2020). Recent laboratory studies with benthic invertebrates suggest physiological effects on individuals close to magnetic fields are possible (Harsanyi et al. 2022; Jakubowska-Lehrmann et al. 2022).

These impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMFs from undersea AC power cables negatively affect commercially and recreationally important fish species (CSA Ocean Sciences Inc. and Exponent 2019). The combined impacts of EMFs over the geographical extent of all of the wind energy lease areas on finfish, invertebrates, EFH, and ESA-listed species from ongoing and planned actions would likely range from negligible to minor.

Light: Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles (e.g., spawning), possibly leading to short-term impacts. Marine vessels have an array of lights, including navigational lights and deck lights. There is little downward-focused lighting and, therefore, only a small fraction of the emitted light enters the water. Light impacts from vessels can be mitigated through application of BOEM's *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM 2021a). Light sources from the estimated 3,135 WTGs and multiple OSSs would occur during their operational phase, and these would be incrementally added over time. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM guidance. This would increase the amount of light over time within the geographic analysis area. The impacts from lighting related to the planned offshore wind activities is highly localized and spatially restricted in comparison to future non-offshore wind activities. In the context of reasonably foreseeable environmental trends, the combined impacts of this sub-IPF on finfish, invertebrates, and EFH from offshore wind activities would likely be short term and limited to highly localized attraction and include some potential disruption of spawning cycles. Light impacts on finfish, invertebrates, EFH, and ESA-listed species would be considered negligible.

New cable emplacement and maintenance: The proposed offshore wind activities would require cable installation and maintenance activities that would disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local and limited to the cable corridor. Cable installation and maintenance would use jetting, jet-plowing, or dredging equipment to install and support cable burial maintenance operations. The total area of direct seafloor disturbance related to new cable emplacement and maintenance is estimated at up to 13,888 acres (5,620 hectares), though not all disturbance would be simultaneous. Cable installation and burial maintenance activities have the potential to disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations, depending on the benthic habitat type. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur (see also the IPF of *Sediment deposition and burial*). Overall, these impacts would likely be moderate but temporally short for most areas, with potential long-term habitat alteration for certain habitats.

Noise: Anthropogenic noise on the OCS associated with offshore wind development, including noise from aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic, has the potential to cause temporary effects on some finfish and invertebrate species and their EFH resources by displacing them and, potentially, temporarily changing their feeding and migratory behavior. BOEM anticipates that these impacts would be localized and temporary. Potential impacts could be greater if avoidance and displacement of finfish and invertebrates occurs during seasonal migration periods.

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 (Ladich and Bass 2011; Rice et al. 2022). 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). Additionally, there are some species that do not appear to produce sounds but still have acute hearing (e.g., the goldfish), which has led researchers to surmise that animals glean a great deal of information about their environment through acoustic cues (Fay 2009).

All fishes and invertebrates are capable of sensing the particle motion component of underwater sound (for additional information about particle motion, see Appendix J). 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. 2021). Particle motion is the displacement, or back and forth motion, of water molecules. As it 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 dense structures statolith which sit within a body of hair cells; when the animal is moved by particle motion, it results in a shearing force on the hair cells, similar to that described for fish (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). Available research shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper et al. 2021).

In addition to particle motion detection shared across all fishes, some species are also capable of detecting the pressure component of underwater sound (Fay and Popper 2000). Special adaptations of the swim bladder in these species (e.g., anterior projections, additional gas bubbles, or bony parts) bring it close to the ear, and, 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. 2021). These species can typically detect a broader range of acoustic frequencies (up to 3 to 4 kHz; Wiernicki et al. 2020) and are therefore considered to be more sensitive to underwater sound than those that can only detect 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 only detect sound through particle motion, limiting their range to sounds below 1 kHz, while the most sensitive ("hearing specialists") possess specialized structures that enable pressure detection, which expands their detection frequency range (Popper et al. 2021). A few species in the herring family can detect ultrasonic (>20 kHz) sounds (Mann et al. 2001), but this is considered very rare among the bony fishes. Another important distinction for species that do possess swim bladders is whether they are open or closed; species with open swim bladders can release pressure through 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 and Hawkins 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 (Kenyon 1996).

The type of effect will depend on the type of noise, the noise level to which an animal is exposed, and the duration of the exposure. Sources of anthropogenic noise can generally be categorized in two ways; impulsive noise which is characterized by a rapid increase in sound pressure over a short period of time, and non-impulsive noise, which does not have the characteristic rapid rise in sound pressure seen in impulsive sources. Noise can also be characterized as intermittent or continuous depending on how often noise is generated over time. Both types of noise may be produced by activities related to offshore wind projects. Acoustic thresholds, which represent the minimal sound level at which the onset of a particular effect may occur, are available for fish grouped either by size (less than 2 grams and greater than or equal to 2 grams) as recommended by the Fisheries Hydroacoustic Working Group (FHWG 2008) and adopted by the Greater Atlantic Region Fisheries Office (GARFO 2021) or by physiology as recommended by Popper et al. (2014), and are provided in Table 3.13-3.

Noise from construction and installation of approximately 3,135 WTGs and associated OSSs would result in local and temporary impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species. The main source of noise via construction would be through impact piling driving. Other sources of noise would be related to vessel operations supporting the construction and maintenance of offshore wind projects; high-resolution geophysical (HRG) survey activities in support of site characterization surveys before and during construction; vibratory pile driving used during installation of export cables; cable trenching activities; and operational noise produced by the WTGs.

3.13.3.3.1 Vessel Noise

Noise from large commercial ships, as well as smaller fishing and recreational vessels, is likely be present and persistent in the geographical analysis area. In comparison to future non-offshore activities, vessel activities during the planned offshore wind activities would be expected to produce similar impacts on finfish, invertebrates, and their EFH resources. A description of the physical qualities of vessel noise can be found in Appendix J, *Acoustic Analysis*. Note that the specific effects of dynamic positioning noise on fishes and invertebrates have not been studied but are expected to be similar to those of transiting vessels as described below.

Avoidance of vessels and vessel noise has been observed in several pelagic, schooling fishes (Vabo et al. 2002; Handegard 2003; De Robertis and Handegard 2013). Fish may dive toward the seafloor, move horizontally out of the vessel's path, or disperse from their school (De Robertis and Handegard 2013), which could render individual fish more vulnerable to predation. However, these behavioral responses are unlikely to have population-level effects. The overlap in the frequency of vessel noise and fish auditory capabilities could also lead to masking of 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 not involved in hearing) would be significantly reduced in the presence of vessel noise, which is frequent in their habitat in Cape Cod Bay. Generally, species that are sensitive to acoustic pressure would experience masking at greater distances than those that are only sensitive to particle motion (i.e., who don't have a swim bladder). Rogers et al. (2021) and Stanley et al. (2017) theorize that fish may be able to use the directional nature of particle motion to extract meaning from short range cues (e.g., other fish vocalizations), even in the presence of distant noise from vessels.

Table 3.13-3 Acoustic Thresholds for Fish for Each Type of Impact for Impulsive and Non-Impulsive Noise Sources

Fish Category	Impulsive Sounds				Non-impulsive Sounds		
	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Behavior	Recoverable Injury	TTS	Behavior
Fish <2 grams	--	$L_{p,pk}$ 206 dB re 1 μPa $L_{E,24hr}$ 183 dB re 1 μPa^2 s	--	L_P 150 dB re 1 μPa	--	--	L_P 150 dB re 1 μPa
Fish ≥2 grams	--	$L_{p,pk}$ 206 dB re 1 μPa $L_{E,24hr}$187 dB re 1 μPa^2 s	--		--	--	
Fishes without swim bladders	$L_{p,pk}$ 213 dB re 1 μPa $L_{E,24hr}$ 219 dB re 1 μPa^2 s	$L_{p,pk}$ 213 dB re 1 μPa $L_{E,24hr}$216 dB re 1 μPa^2 s	$L_{E,24hr}$186 dB re 1 μPa^2 s		--	--	
Fishes with swim bladder not involved in hearing	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$ 210 dB re 1 μPa^2 s	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$203 dB re 1 μPa^2 s	$L_{E,24hr}$186 dB re 1 μPa^2 s		--	--	
Fishes with swim bladder involved in hearing	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$ 207 dB re 1 μPa^2 s	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$ 203 dB re 1 μPa^2 s	$L_{E,24hr}$ 186 dB re 1 μPa^2 s		L_P 150 dB re 1 μPa	L_P 150 dB re 1 μPa	
Eggs and larvae	$L_{p,pk}$ 207 dB re 1 μPa $L_{E,24hr}$ 210 dB re 1 μPa^2 s	--	--		--	--	

Sources: FHWG 2008; GARFO 2021; Popper et al. 2014.
- = not available for the fish category and/or impact type; μPa = micropascal; $L_{p,pk}$ = peak sound pressure level; $L_{E,24hr}$ = sound exposure level over 24 hours; L_P = root-mean-square sound pressure level.

The limited research available regarding invertebrates' response to vessel noise has yielded inconsistent findings. Some crustaceans showed increased oxygen consumption (Wale et al. 2013) or increased stress indicators in the blood (Filiciotto et al. 2014), while other showed no stress indicators but spent less time handling food, defending food, and initiating fights with competitors (Hudson et al. 2022). While there does seem to be evidence that certain behaviors and stress biomarkers in invertebrates could be adversely affected by vessel noise, it is difficult to draw conclusions from the available research since it is limited to laboratory studies and, in most cases, did not measure particle motion as the relevant cue.

The planktonic larvae of fishes and invertebrates may also experience acoustic masking from continuous sound sources like vessels. Several studies have shown that larvae are sensitive to acoustic cues and may use sound signals to navigate toward suitable settlement habitat (Simpson et al. 2005; Montgomery 2006), metamorphosize into their juvenile forms (Stanley et al. 2012), or 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 (Holles et al. 2013); however, these effects are expected to be short term, would occur over a limited area around the operating vessel, and would likely qualify as negligible.

3.13.3.3.2 HRG Surveys

Ongoing and future HRG surveys conducted for offshore wind development produce noise around sites of investigation. Of the sources that may be used in HRG surveys for planned offshore wind development projects, 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 (Crocker et al. 2019; Ruppel et al. 2022). The remaining sources—such as side-scan sonars, multibeam echosounders, and some SBPs—would not be audible and would not affect finfish, invertebrates, and their EFH resources. Additional detail on the sound characteristics of HRG sources is provided in Appendix J.

For the HRG sources that are audible for fishes and invertebrates, it is important to consider other factors such as source level, beamwidth, and duty cycle when assessing the potential risk of adverse effects (Ruppel et al. 2022). Boomers, sparkers, hull-mounted SBPs, and bubble guns have source levels close to the threshold for injury for hearing specialist fish with swim bladders involved in hearing (Table 3.13-3), indicating a fish would have to be within a few meters of the source to experience sufficient sound energy to exceed the thresholds, and injury is highly unlikely to occur (Popper et al. 2014, Crocker et al. 2019). Behavioral impacts could occur over slightly larger spatial scales, given the SPL threshold of 150 dB re 1 µPa recommended for behavioral disturbance GARFO (2022). For HRG sources operated at the highest possible power setting, the range over which the behavioral disturbance thresholds may be exceeded could extend to 6,549 feet (1,996 meters; Baker and Howsen 2021). However, for sources operated at lower power settings in which estimated source levels are closer to 190 dB re µPa m, it can be estimated with spherical spreading loss that noise would fall below this threshold approximately 328 feet (100 meters) from the source (Crocker et al. 2019). Towed SBPs are generally lower in power than hull-mounted systems, so the risk of behavioral impacts resulting from operation of these sources would occur over smaller spatial scales. It is worth noting 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 who don't have a swim bladder. Additionally, because HRG equipment are considered intermittent sources, where they are typically "on" for short periods with silence in between, the amount of noise emitted from a moving vessel towing an active acoustic source that would reach fish or invertebrates below is limited, so behavioral effects would be intermittent and temporary. Overall, in the context of reasonably foreseeable environmental trends, 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.

3.13.3.3.3 WTG Operational Noise

The operation of turbines on nearby windfarms may introduce low-level, continuous sound into the marine environment. A description of the physical qualities of turbine operational noise can be found in Appendix J, *Acoustic Analysis*. Elliot et al. (2019) compared field measurements during offshore wind operations from the Block Island Wind Farm to the published audiograms of a few fish species. They found that, even at 164 feet (50 meters) distance from an operating turbine, particle acceleration levels were below the hearing thresholds of several fish species, meaning that the turbine 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 near the pile (i.e., those that have settled there due to the structure it provides). In addition, even if it is audible, it may not be bothersome.

3.13.3.3.4 Impact and Vibratory Pile Driving

Noise from impact pile driving is transmitted through water column and through the seabed. The intensity and magnitude of this energy could result in injury to finfish and invertebrates in a localized area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. Information on the physical characteristics of both impact and vibratory pile driving is provided in Appendix J. Impact pile driving is characterized as an impulsive sound, which means that it could cause injury and mortality of fishes and invertebrates in the vicinity of each pile, and could cause short-term stress, behavioral changes, and masking over greater distances. Vibratory pile driving is characterized as a non-impulsive, continuous noise source and could lead to auditory masking or behavioral effects, similar to those expected from vessel noise (described above). Overall, the effects of pile-driving noise on fishes and invertebrates will vary based on the habitats they use and the life history stage they encounter.

Early observations of dead fish near a bridge construction project (Caltrans 2004) suggested that fish could be killed only when very close (<33 feet [10 meters]) to pile-driving operations. Only one field study since then has measured potential mortality of fishes near pile-driving operations, and it found no increase in mortality of juvenile European seabass at received $L_{p,pk}$ of 210 – 211 dB re 1 µPa within 148 feet (45 meters) of the pile (Debusschere et al. 2014). Since 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 (Table 3.13-3) to predict potential effects.

Ainslie et al. (2020) used a damped cylindrical spreading model informed by empirical measurements from the North Sea to derive effect ranges based on the acoustic criteria provided in the Popper et al. (2014) Sound Exposure Guidelines. They estimated that using 7,000 strikes to drive a 20-foot (6-meter) diameter pile in water depths of 92 feet (28 meters) with 10 dB noise mitigation at the source, fish without a swim bladder could experience mortal injury up to 128 feet (39 meters) from the pile, and recoverable injuries up to 253 feet (77 meters) from the pile. These effect ranges were estimated to be larger for fish that have a swim bladder involved in hearing, as mortal injury could occur up to 1,749 feet (533 meters) from the pile and recoverable injury could occur up to 0.7 mile (1.2 kilometers) from the pile. In similar water depths of the Western North Atlantic, modeling predictions for installing an 11-meter-diameter monopile assuming 2,202 strikes, a 4,000-kJ energy hammer, and 10 dB of noise mitigation yielded similar exposure ranges. Fish without a swim bladder could experience recoverable injury out to 220 meters, while fish with a swim bladder involved in hearing could experience recoverable injury out to 1.52 kilometers (Appendix R-2; BOEM 2022c). 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 0.6 to 1.2 miles (1 to 2 kilometers); these distances assume 10 dB of noise mitigation at the source.

The estimates above from available acoustic modeling analyses are described in terms of acoustic pressure, which is relevant for fishes with swim bladders. However, particle motion is the more appropriate cue for other species. 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 pin piles. At 1,640 feet (500 meters) from the pile, in-water particle acceleration ranged from 30 to 65 dB re 1 $\mu m/s^2$ in the 10 to 1,000 Hz range, but closer to the seabed it was significantly higher, at 50 to 80 dB re 1 $\mu m/s^2$. When comparing these received levels to the published hearing capabilities of several fish species, it was 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 below have focused on acoustic pressure, which is relevant for only a sub-set of fishes. It also underscores 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 and field studies have examined other behavioral and physiological effects in fishes beyond non-recoverable and recoverable injuries. Adult seabass generally dove deeper and increased swimming speed and group cohesion when exposed to intermittent and impulsive sounds like pile driving (Neo et al. 2014, 2018), while 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 (Bruintjes et al. 2016; Neo et al. 2016; Radford et al. 2016). Results from field studies showed that free-swimming cod and sole both exhibited changes in swimming behavior in response to pile-driving sounds (Mueller-Blenkle et al. 2010). Hawkins et al. (2014) found that schools of sprat were more likely to disperse, while mackerel were more likely to change water depth, and that both species, despite different hearing anatomy, responded at a similar received peak-to-peak sound pressure levels ($L_{pk\text{-}pk}$); 50 percent of the time they responded to $L_{pk\text{-}pk}$ of 163 dB re 1 μPa, which could be expected to occur up to tens of kilometers from the source. 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) saw 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 when pile driving is completed, 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 pile-driving noise. Species that have swim bladders involved in hearing would be more susceptible to physiological effects and behavioral disturbance, and this risk would occur at greater distances than those considered hearing generalists. 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 they occur 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. However, fish that avoid an area during pile-driving are likely to return following completion of pile-driving activity so no long-term impacts on habitat availability are expected.

Since marine invertebrates detect sound via particle motion and not sound 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; Wale et al. 2021; Popper et al. 2022). Most of the currently available research has focused on water-borne particle motion, or even sound pressure, in relation to invertebrate sound detection. A recent study by Jézéquel et al. (2022) exposed scallops to a real pile-driving event at 26 and 164 feet (8 and 50 meters) from the pile, where the measured peak particle acceleration was 110 dB re 1 μm/s^2 and 87 dB re 1 μm/s^2, respectively. None of the scallops exhibited swimming behavior, an energetically expensive escape response. At 26 feet (8 meters) from the pile, scallops increased valve closures during pile-driving and did not show any habituation 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 and could therefore be injured from high sound exposures. 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 that exposure to pile-driving noise at median peak particle velocities of 40 dB re 1 m/s within a tank elicited alarm responses such as inking and jetting in longfin squid. While their initial responses diminished quickly, after 24 hours, the squid were re-sensitized to the noise and showed no signs of habituation. 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, which diminished quickly (within approximately 4 seconds). Responses were only observed in squid located 26 feet (8 meters) from the pile, 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/s2 and Lpk was 160 to 180 dB re 1 μPa, which Jones et al. (2021) surmised was similar to field conditions within 1,640 feet (500 meters) of a 4.2-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.

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 (Payne et al. 2007; Day et al. 2016; 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 also been shown to affect certain behaviors in crustaceans, such as reducing locomotor activity in Norway lobster (Solan et al. 2016), decreasing feeding activity in crabs (Corbett 2018), or inhibiting attraction to chemical cues in hermit crabs (Roberts and Laidre 2019). The available research 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.

A handful of studies have directly investigated the effects of impulsive sounds on eggs and larvae of marine fishes. Laboratory work by Bolle et al. (2012, 2014) showed that larvae of sole, seabass, and herring were relatively resilient to mortality even at high received SEL (> 206 dB re 1 uPa^2 s), which was estimated to be equivalent to the received level at approximately 328 feet (100 meters) from a 13-foot (4-meter) diameter pile. Research on invertebrate larvae is even more 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 in response to received SEL 185 dB re 1 uPa^2 s (Day et al. 2016) or of crabs in response to received SPL of 231 dB re 1 μPa (Pearson et al. 1994). Conversely, Aguilar de Soto et al. (2013)

indicated scallop larvae exposed to sounds of seismic airguns showed body abnormalities and developmental delays. The larvae were held 5 to 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 used 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.

Because most planned offshore wind projects would likely be restricted to only conducting impact pile driving activities outside of the season when NARW are most likely to occur (see Section 3.15, *Marine Mammals*, for further discussion), finfish species who are also present during this period would subsequently benefit from the quiet periods where no impact pile driving occurs. Noise produced by impact pile driving would be intermittent and temporary, and finfish and invertebrate individuals would recover completely after construction. Overall, impacts of impact pile-driving noise on finfish, invertebrates, EFH-managed species, or ESA-listed species are expected to be moderate, while impacts on eggs and larvae are expected to be negligible.

3.13.3.3.5 Cable Laying and Trenching

Given the physical qualities of noise associated with cable laying and trenching (described in Appendix J), injury and auditory impairment are unlikely, but fishes and invertebrates could experience behavioral disturbance or masking close to the emplacement corridor. No research has specifically looked at responses to these noise sources, but the impacts are likely to be similar, but less intense, than those observed with vessel noise described above, since these activities are not as widespread or frequent as vessel transits. Cable burial maintenance operations would be infrequent over the life of the proposed offshore wind sites; related noise impacts would be temporary, local, and extend only a short distance beyond the cable corridor, resulting in negligible impacts that are temporary, short, and spatially localized to the trenching/burial operations.

Activities associated with the development of offshore wind projects will contribute to noise impacts on finfish, invertebrates, and EFH. These noise sources will be generated by pile-driving activities, HRG surveys, offshore construction, WTG operations, and vessel traffic. The sub-IPF for impact pile driving may cause the greatest level of impact related to noise, but these impacts would be local and short in duration and considered moderate for finfish, invertebrates, and EFH in the geographic analysis area.

In the context of reasonably foreseeable environmental trends, the combined effect of pile-driving noise (both impact and vibratory) on finfish, invertebrates, and EFH from future proposed wind energy development, would likely qualify as moderate. Above-threshold noise may extend several kilometers from the source, and over a longer time scale, noise from impact pile driving could affect the same populations or individuals multiple times in one year or in sequential years, but it is currently unknown whether a reduction in impact would be possible if piles were driven either sequentially or concurrently (BOEM 2021b). However, it is expected that fish would move to avoid more severe impacts, and with mitigation such as noise attenuation systems (COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2023), no long-lasting impacts are expected.

Port utilization: The major ports in the U.S. are seeing increased numbers of vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 37 years. Multiple ports along the Atlantic seaboard are investing in expanding and modifying port facilities to accommodate supporting offshore wind energy projects. These development expansion activities are in part directly associated with the offshore wind developments within the geographic analysis area. Progressive increases in port utilization due to offshore wind energy development would lead to increased vessel traffic through 2030. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species, life stages, or both may lead to impacts on finfish and invertebrates beyond the vicinity of the port. Based on the expected level of port utilization and related activities (e.g., dredging), impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species from offshore wind activities would be expected to be negligible.

Presence of structures: The addition of structure to an open sand bottom seascape can produce the potential for multiple IPFs on species of finfish and invertebrates and their associated EFHs within the geographic analysis area. The impacts can include direct displacement and possible mortality of some slow moving and infaunal invertebrate species. Other sub-IPFs will include attraction to these artificial substrates by both finfish and invertebrates and the loss of commercial and recreational fishing gear that is fouled with these structures. The risks of impact from the listed sub-IPFs are proportional to the amount of structure present. Offshore wind projects are estimated to add up to 3,135 WTGs foundations with potentially each WTG requiring scour protection to be emplaced around each foundation. Projects may also install additional offshore substations, buoys, and met towers. Using estimates for surface area to be affected (Appendix E, *Project Design Envelope and Maximum-Case Scenario*, Table E-2), the monopole foundations and scour protections will require nearly an acre (0.95 acre [0.4 hectare]) of seafloor per foundation. This would result in permanent impacts on benthic and demersal finfish, invertebrates, and their respective EFHs by approximately 2,684 acres (1,086 hectares) of habitat within the geographic analysis area, resulting in a moderate impact.

Impacts related to commercial and recreational gear loss is localized but can affect finfish and motile invertebrate assemblages and other marine vertebrates (e.g., marine mammals, sea turtles) through entanglement issues. This risk of entanglement and harm to individuals from fouled commercial and recreational gear on any offshore structure would increase with the addition of hard substrate. Fouled gear would result in highly localized, periodic, short-term impacts on finfish, invertebrates, and EFH. The occurrence of gear losses specifically related to WTGs is generally rare, and the impacts related finfish and invertebrates through this sub-IPF from proposed offshore wind project would likely be negligible.

Human-made structures, especially tall vertical structures that extend from the seafloor to the surface such as foundations for towers, continuously alter local water flow at a fine scale. Although water flow typically returns to background levels within a relatively short distance from a structure and impacts on finfish, invertebrates, and EFH are typically undetectable (BOEM 2021b), the cumulative effects of the presence of multiple structures on local or regional-scale hydrodynamic processes are not currently well understood. Daewel et al. (2022) through numerical modeling conditions within the North Sea has demonstrated that depending on wind speed and direction and structural characteristics of the WTGs, the wake field behind WTGs can affect the atmospheric, hydrodynamic, pelagic, and benthic environments. A recent study using a numerical model completed by BOEM assessed the mesoscale effects of offshore wind energy facilities on coastal and oceanic environmental conditions and habitat by examining how oceanic responses will change after turbines are installed, particularly with regards to turbulent mixing, bed shear stress, and larval transport (Johnson et al. 2021). This study focused on the Massachusetts-Rhode Island marine areas where proposed wind energy lease areas are in the licensing review process. The modeling study assessed four post-installation scenarios. Two species of finfish (silver hake and summer flounder) and one invertebrate (Atlantic sea scallop) were selected as focal species. The results of this modeling effort indicate that, at a regional fisheries management level, these shifts are not considered overly relevant with regards to larval settlement. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are also not well understood. Overall, BOEM anticipates that offshore wind activities (exclusive of the Proposed Action) would cause a negligible impact on finish, invertebrates, and EFH through this sub-IPF based on currently available information.

A number of new structures will be installed within the geographic area of analysis through 2030. These added structures may attract finfish and invertebrates that approach the structures during routine movement or during migration. Such attraction could alter or slow migratory movements. However, temperature is expected to be a bigger driver for habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018; Rothermel et al. 2020). Migratory fish and invertebrates have exhibited an ability to move away from structures unimpeded. In the context of reasonably foreseeable environmental trends, the presence of many distinct structures from ongoing and planned actions, exclusive of the Proposed Action, could increase the time required for migrations, resulting in a minor impact.

The geographic analysis area is primarily a sandy seascape exhibiting both flat bottom relief and benthic features such as ripples, sand waves, and ridges (MARCO n.d.; Stevenson et al. 2004; USGS n.d.). Benthic features such as ripples and ridges are important contributors to diversity and abundance of benthic macrofauna (Stevenson et al. 2004). Areas of heterogenous, hard-bottom, and other complex habitats also exist within the geographic analysis area (MARCO n.d.; Stevenson et al. 2004; USGS n.d.). Habitat complexity is an important contributor to diversity and abundance of a large number of commercially and ecologically important fish and invertebrate species (e.g., through facilitating refuge from prey during early life stages, providing areas of post-larval settlement; Coen and Grizzle 2007; Malatesta and Auster 1999). This complexity can be due to soft bottom features such as sand ridges, waves, and ripples as well as natural and artificial hard-bottom. Wind energy structures, including WTG foundations and the scour protection around the foundations, create hard-bottom relief in areas that are predominately sandy with varying levels of bedform complexity. Structure-oriented fishes are attracted to these hard substrate installations. Impacts on the soft sediment habitats and the soft-bottom finfish and invertebrates and EFH-managed species from structure presence are local and can be short term to permanent for the life of each wind energy project, potentially for as long as each structure remains in place. Fish aggregations found in association with seafloor structures can provide localized, short-term to permanent, beneficial impacts on hard-bottom-associated fish and invertebrate species due to increases in forage resources and prey species availability. Initial recruitment to these hard substrates may result in the increased abundance of certain fish and epifaunal invertebrate species (Claisse et al. 2014; Smith et al. 2016; BOEM 2021b); such recruitment may result in the development of diverse demersal fish and invertebrate assemblages. However, such high initial diversity levels may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). These processes will likely alter trophic pathways around the structures (Mavraki et al. 2020; Degraer et al. 2020). The WTG foundations will likely become enriched by constant input of organic matter and sloughing of the epibiota attached to the structures (Degraer et al. 2020). Further, colonization by non-indigenous biota (e.g., invasive or nuisance species) may alter localized benthic or epipelagic communities (Glasby et al. 2007; Whitfield et al. 2014). Considering the above information, BOEM anticipates that the impacts of the presence of structures on finfish, invertebrates, and EFH would be minor and include minor beneficial impacts. All impacts would be permanent as long as the structures remain. However, while an increase in prey may be beneficial, it may be offset by the risk of entanglement impacts on ESA-listed Atlantic sturgeon or giant manta ray and other ecologically and commercially important finfish, invertebrates, and EFH-managed species due to derelict or abandoned fishing gear or fishing line.

Regulated fishing effort: While primarily an ongoing activity, regulated fishing effort impacts finfish, invertebrates, EFH-managed species, and ESA-listed species by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). Regulated fishing effort results in the removal of a substantial amount of the annually produced biomass of commercially regulated finfish and invertebrates and can also influence bycatch of non-regulated species. Offshore wind development other than the proposed Project could influence finfish, invertebrates, and EFH through this IPF by influencing the management measures chosen to support fisheries management goals, which may alter the nature, distribution, and intensity of fishing-related impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species. Section 3.9, *Commercial Fisheries and For Hire Recreational Fishing*, provides additional details.

Seabed profile alterations: The process of cable installation can cause localized short-term impacts (habitat alteration, change in complexity) through seabed profile alterations, as well as through sediment mobilization and redeposition. Assuming the extent of such impacts is proportional to the length of cable installed (Appendix E, *Project Design Envelope and Maximum-Case Scenario*, Table E2), such impacts from offshore wind activities could be extensive within the proposed inter-array cables and offshore export cable routes proposed. Dredging was removed from consideration. Potential disturbances to a particular sand wave may not recover to the same height and width as pre-disturbance. However, the habitat function would largely recover post-disturbance, although full recovery of faunal assemblage may require several years (Boyd et al. 2005). Therefore, seabed profile alterations, while locally intense, are expected to have minor impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species on a regional scale.

Sediment deposition and burial: Cable installation and burial activities supporting the proposed offshore wind development projects will be the primary cause for sediment deposition and burial impacts within the geographic analysis area. Cable installation activities in certain regions of the geographic analysis area would use jet-plowing and dredging installation methodologies to install and bury the IARs and ECR cables associated for each project. Generally, permit requirements for these operations will mandate mitigation activities to reduce the temporal and spatial impacts related to both dredging and jet-plow activities. Even with stringent adherence to mitigation procedures, sediment dispersion and redisposition could have negative impacts on eggs and larvae of finfish and invertebrates. This is particularly critical for demersal eggs such as longfin squid, which are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial (BOEM 2021b). Impacts related to sediment deposition and burial may vary based on season/time of year and regional conditions within each proposed future project areas. In the context of reasonably foreseeable environmental trends, the impacts of sediment deposition and burial on finfish, invertebrates, EFH-managed species, and ESA-listed species from offshore wind development projects other than the proposed Project would likely be minor.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, have the potential to result in long-term, potentially high-consequence risks to finfish and invertebrates, EFH-managed species, and ESA-listed species. Ocean acidification has been shown to have negative impacts on the settlement and survival of shellfish (BOEM 2021b citing PMEL 2020). These impacts could lead to changes in prey abundance and distribution, changes in migratory patterns, and timing. Appendix F, Table F1-1, provides more details on the expected contribution of offshore wind to climate change. The intensity of impacts resulting from climate change are uncertain but are anticipated to qualify as minor to moderate.

3.13.3.4 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative finfish, invertebrates, and EFH would continue to be affected by existing environmental trends. Ongoing activities are expected to have continuing temporary (or short-term) and permanent (or long-term) impacts (disturbance, displacement, injury, mortality, and habitat conversion) on finfish, invertebrates, and EFH. These effects are primarily driven by offshore construction impacts and presence of structures.

Ongoing activities and offshore wind would continue to have temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on finfish, invertebrates, EFH-managed species, and ESA-listed species primarily through resource exploitation/regulated fishing effort, dredging, bottom trawling, bycatch, anthropogenic noise, new cable emplacement, the presence of structures, and climate change. Ongoing activities, especially interactions with commercial fisheries, bottom disturbance, and climate change, would be **moderate**. In addition to ongoing activities, the impacts of planned actions other than offshore wind development, including new submarine cables and pipelines, marine minerals extraction, port expansions, and the installation of new structures on the OCS would be **minor**. The combination of ongoing activities and reasonably foreseeable activities other than offshore wind would result in **moderate** impacts on finfish, invertebrates, EFH, ESA-listed species in the geographic analysis area.

Cumulative impacts of the No Action Alternative. 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. Planned activities would contribute to impacts on finfish, invertebrates, and EFH due to increased offshore construction and operations. The main IPFs that could affect Atlantic sturgeon, giant manta ray, or other ESA-listed species are presence of structures and noise from the ongoing wind activities, as well as regulated fishing through periodic disturbance of the seafloor with bottom-tending gear and bycatch. Dredging in nearshore waters or estuaries may result in impacts on various life stages of ESA-listed and other fish species.

Considering all the IPFs together, the overall impacts associated with offshore wind activities in the geographic analysis area other than the proposed Project would result in **minor** to **moderate adverse** impacts but could include **minor beneficial** impacts because of presence of structures. Most of the offshore structures in the geographic analysis area would be a result of the development of offshore wind if each proposed project is installed. Finfish and invertebrates that use soft-bottom, sandy habitats would lose access related to the placement of WTGs and scour protection features, but structure-oriented organisms would gain an estimated 1,890 acres (765 hectares) of hard-bottom habitat. Potentially, this increase in demersal and demersal-pelagic finfish and invertebrates would increase the biomass and carrying capacity of these habitats. The ongoing activities and planned offshore wind development would also be responsible for most of the impacts related to new cable emplacement and pile-driving noise; however, impacts on finfish and invertebrates, EFH-managed species, and ESA-listed species resulting from these IPFs would be localized and temporary and result in **minor** impacts.

3.13.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E*, Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on finfish, invertebrates, and EFH.

- The number, size, and location of WTGs and placement of the OSSs.
- The time of year during which construction occurs.

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

- **WTG number and location:** the level of impact related to the installation of WTGs and the concomitant scour protection is proportional to the number of WTGs installed; fewer WTGs would present less hazard to soft-bottom, demersal finfish and invertebrates and their associated EFHs.
- **Season of construction:** The diversity and abundance of the offshore assemblage of finfish and invertebrates is typically highest in late spring through early fall (Eklund and Targett 1991). Construction/installation activities occurring outside of these timeframes would have a reduced impact on finfish and invertebrates, particularly as compared to construction occurring during the active spring spawning and summer migratory seasons.

3.13.5 Impacts of the Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

Accidental releases: 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 finfish, invertebrates, and their respective EFHs resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of Project personnel, reducing the likelihood of occurrence to a very low risk. Likewise, utilizing BMPs for ballast or bilge water releases specifically from vessels transiting from foreign ports would reduce the likelihood of accidental release. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and temporary negligible impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species resulting from these accidental releases.

Anchoring: Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish). Impacts from anchoring relative to the Proposed Action occur during construction and installation but would be limited. The use of DP vessels would preclude the use of anchors, while utilization of jack-up vessels or spud barges would directly affect the benthos. Further, the placement of up to 202 WTGs, three OSSs, corresponding scour protection, and the emplacement of offshore export cables and inter-array cables would affect the benthos, with potential for impacts on demersal finfish and invertebrate species. These impacts would include increased turbidity levels and potential for contact causing mortality of benthic species and, possibly, degradation of sensitive habitats. Impacts related to sensitive resources would be avoided by following mitigation measures and BMPs when operating near or within the any areas with sensitive resources. All impacts would be localized; turbidity would be temporary; impacts from anchor, spud can, or leg contact would recover in the short term. Construction operations under the Proposed Action would not occur simultaneously, and the footprint of each anchor, spud can, or leg placement would be relatively small, of short duration, and would represent a minor impact on the demersal portions of the finfish and invertebrate community.

Electromagnetic fields: EMF emanates continuously from installed electrical power transmission cables. Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). The impacts from EMF are localized and affect the animals only while they are within relatively close proximity to the EMF source. There is no evidence to indicate that EMFs from undersea AC power cables negatively affect commercially and recreationally important fish species (CSA Ocean Sciences Inc. and Exponent 2019; see also Section 3.9, *Commercial Fisheries and For Hire Recreational Fishing*). EMFs would emanate from AC cables during operation. Under the Proposed Action, the shielding and burial depths would minimize EMF intensity and extent (Normandeau et al. 2011). Although the EMFs would exist as long as a cable was in operation, previous studies indicate that the EMFs from AC cables within the Project area are not expected to affect commercial and recreational fisheries (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015).

Potential thermal effects from the cable are affected by distance from the cable; the likelihood that burrowing invertebrates would encounter warmed sediment; the likelihood that an encounter with warmed sediment would be adverse; and heat dissipation in the context of ambient water and regional climate change. The cable vendor modeled heat transfer from the OECC at cable burial depth of 8 feet (2.5 meters) (COP, Section 4.2.4.3; Dominion Energy 2023). Results predicted that the minor increases in sediment temperatures above the buried cable would not degrade benthic habitat and would be biologically insignificant. In instances where target burial depth could not be achieved, the protective material would hinder burrowing of invertebrates, while the heat would dissipate as ocean water flows through and around the mattresses. Thermal impacts of subsea export cables would be extremely localized, negligible, and not ecologically significant. Therefore, impacts on pelagic finfish species would be expected to be negligible, and impacts on bottom-dwelling finfish and motile invertebrate species and ESA-listed species would be expected to be minor.

Light: The Proposed Action incremental contribution of 202 WTGs and three OSSs would all be lit with navigational and Federal Aviation Administration (FAA) hazard lighting. Per BOEM guidance (BOEM 2021a) and outlined in the COP Section 3.5.3 (Dominion Energy 2023), each WTG would be lit in accordance with USCG, FAA, and BOEM requirements and only a small fraction of the emitted light would enter the water. Therefore, light resulting from the Proposed Action would be minimal and would be expected to lead to a negligible impact, if any, on finfish, invertebrates, and EFH.

The expected negligible impact of the Proposed Action alone would not noticeably increase the impacts of light beyond the impacts described under the No Action Alternative (Section 3.13.3, *Impacts of the No Action Alternative on Finfish, Invertebrates, and Essential Fish Habitat*). Lighting of turbines under the Proposed Action and other offshore structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021a) guidance.

New cable emplacement and maintenance: The Proposed Action would potentially result in up to 6,347.3 acres (2,568.64 hectares) of seafloor being temporarily disturbed by cable installation, 8.92 acres (3.61 hectares) of seafloor being temporarily disturbed by cable protection, and 1.19 acres (0.48 hectare) of permanent impact from cable protection. The resultant impacts include turbidity effects that have the potential to displace finfish and motile invertebrates and cause the mortality of infaunal invertebrates within the cable corridor during emplacement (COP, Table 4.2-17; Dominion Energy 2023). The impacts resulting in mortality for some infauna would be permanent but impacts on finfish, motile invertebrates, and some infauna would be temporary and localized. Infaunal invertebrate species such as Atlantic surfclam, ocean quahogs, Atlantic sea scallops, and calico scallops could be displaced, or mortality may result from cable emplacement due to a potential direct burial impact. More broadly, impacts on infaunal invertebrate individuals and communities are expected to be temporary and localized to the emplacement corridor. However, recovery of these infaunal invertebrate assemblages would be expected to occur within months after cable emplacement resulting in minor impacts, if any, on the infaunal assemblages and would be expected given the localized and temporary nature of the impacts. Suspended sediment concentrations during activities other than cable emplacement would be within the range of natural variability for this location.

Gear utilization: Dominion Wind has committed to a Fisheries Monitoring Plan to assess fisheries status in the Project area before and after construction to establish baseline resource conditions and characterize specific resources (i.e., surf clams, welk, and black sea bass). Survey types include baited stationary pots and a novel dredge for surf clams.

Both the welk and black sea bass surveys would set a combination of vented and ventless baited pots that are typical to the fishing industry, but with the strings connecting the pots and the groundlines modified to reduce entanglement risk to nontarget species. The welk surveys would occur twice a month for 3-day durations during November through March and once a month for 3-day durations during April through October. The black sea bass surveys would occur monthly with each set of pots deployed for approximately 2 days, and pots would be moved to different areas throughout the Project area for each sampling event. Surf clam monitoring would use a modified sampling dredge towed by a fishing vessel and would include sampling within the Project area at 20 sites and the use of control sites for sampling 20 sites. Each dredge tow would sample the bottom for 5 minutes and would occur in the late spring/early summer.

The fisheries monitoring activities would not add significant additional vessel traffic. Black sea bass and welk fisheries already occur in the project area; therefore, the monitoring plans would not measurably contribute to the existing habitat disturbance from trap placement. Therefore, the baited trap surveys for welk and black sea bass are not likely to adversely alter the composition and complexity of EFH relative to the environmental baseline; any associated effects would be insignificant and would not cause any impacts on EFH or EFH-designated species. BOEM therefore concludes that these surveys would not change the effects determinations for EFH for any species in the EFH Assessment (BOEM 2022a).

The surf clam monitoring surveys would employ methods that are similar to activities that regularly occur in the area. The towed sampling dredge would cause localized and direct impacts on benthic EFH 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. Therefore, BOEM concludes that these surveys would not change the effects determination for EFH for any species in the EFH Assessment (BOEM 2022a).

In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the impacts on finfish from ongoing and planned activities, including offshore wind, which would be negligible. Impacts from fisheries surveys are expected to be localized. Finfish are highly mobile, and impacts would be expected be short term, temporary, and localized behavioral impacts where finfish may be displaced or captured by the monitoring activities. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts (disturbance, displacement, injury, and mortality) on invertebrates and EFH, which would likely be negligible and short term, as impacts from surveys are expected to be localized. However, 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: A short-term increase in underwater noise is the most likely IPF that could affect finfish, invertebrates, and EFH, predominantly during installation of the WTG and OSS foundations, cofferdams, and nearshore goal post structures during construction of the Proposed Action. The Project PDE includes both impact and vibratory pile driving as an option for installation of the WTG monopile foundations OSS jacket foundations, as well as vibratory pile driving, which would be used to install the cofferdams and impact pile driving of the nearshore (goal post piles [COP, Appendix Z; Dominion Energy 2023]). All these activities have potential to produce noise above recommended fish acoustic thresholds (Table 3.13-3). Underwater acoustic modeling was conducted for the Project (COP, Appendix Z; Dominion Energy 2023) for both activities, and the results are summarized in Table 3.13-4. Results represent the thresholds for potential mortal injury for impact pile driving and recoverable injury for vibratory pile driving. For the purposes of this assessment, the deep modeling location using the maximum hammer energy with the noise attenuation that will be applied for each activity based on the Letter of Authorization (LOA) application (Tetra Tech 2022) is provided for each modeled scenario in Table 3.13-4.

Effects on finfish, invertebrates, and their respective EFH could occur during the construction phase of the Proposed Action, because of equipment noise, particularly impact pile-driving noise. Potential impacts on finfish and invertebrates, as described in Section 3.13.3.2*, Cumulative Impacts of the No Action Alternative*, include injury and behavioral disturbances. Potential for injury is characterized using two metrics, peak sound pressure level ($L_{p,pk}$) and sound exposure level over 24 hours ($L_{E,24hr}$). The $L_{p,pk}$ metric characterizes the potential for injury resulting from the rapid rise in sound pressure that occurs within the immediate vicinity of the pile when it is struck by the hammer, whereas the $L_{E,24hr}$ metric characterizes the potential for injury resulting from cumulative exposure to sound above a given threshold (Table 3.13-3) within a full 24-hour period.

Table 3.13-4 Distances to Acoustic Thresholds (in meters) from the Underwater Acoustic Modeling Conducted for the Coastal Virginia Offshore Wind Commercial Project Construction and Operations Plan

Scenario	Noise Attenuation (dB)	Fish with No Swim Bladder		Fish with Swim Bladder Not Involved in Hearing		Fish with Swim Bladder Involved in Hearing		Eggs and Larvae		Fish <2 g		Fish ≥2 g		Behavioral (L_P)
		$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	All Fish
Standard Driving Installation – Impact Pile Driving	10	242	352	402	748	402	955	402	748	445	6,131	445	4,501	15,010
Standard Driving Installation – Vibratory Pile Driving	10	--	--	--	--	--	--	--	--	--	1,216	--	796	903
Hard-to-Drive Installation – Impact Pile Driving	10	242	389	402	829	402	1,041	402	829	445	6,824	445	5,085	15,010
Hard-to-Drive Installation – Vibratory Pile Driving	10	--	--	--	--	--	--	--	--	--	886	--	601	903
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	10	242	477	402	1,042	402	1,266	402	1,042	445	8,291	445	5,880	15,010

Scenario	Noise Attenuation (dB)	Fish with No Swim Bladder		Fish with Swim Bladder Not Involved in Hearing		Fish with Swim Bladder Involved in Hearing		Eggs and Larvae		Fish <2 g		Fish ≥2 g		Behavioral (L_P)
		$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	$L_{p,pk}$	$L_{E,24hr}$	All Fish
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	10	--	--	--	--	--	--	--	--	--	1,442	--	961	903
OSS Piled Jacket – Impact Pile Driving	10	0	213	74	488	74	633	74	488	94	4,000	94	2,959	5,530
OSS Piled Jacket – Vibratory Pile Driving	10	--	--	--	--	--	--	--	--	--	569	--	427	393
Cofferdam Installation – Vibratory Pile Driving	0	--	--	--	--	--	--	--	--	--	567	--	506	470
Goal Post Pile Installation – Impact Pile Driving	0	--	--	--	--	--	--	--	--	--	--	--	--	6,750

-- = not applicable; dB = decibel; $L_{p,pk}$ = peak sound pressure level in units of dB referenced to 1 micropascal; $L_{E,24hr}$ = sound exposure level accumulated over 24 hours in units of dB referenced to 1 micropascal squared second; L_P = root-mean-square sound pressure level in units of dB referenced to 1 micropascal.

Potential injury from the $L_{p,pk}$ metric is unlikely to occur, as the maximum range with 10 dB noise attenuation is 1,460 feet (445 meters) which would be easily avoided by fish during construction consider the physical space occupied around the pile by the noise mitigation system and other mitigation measures in place during impact pile driving (COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2023). With 10 dB noise attenuation, the $L_{E,24hr}$ threshold may be exceeded out to approximately 5.2 miles (8.3 kilometers) depending on the type of fish. However, as previously stated, this is based on fish remaining within the ensonified area for the full duration of the pile installation which is unlikely to occur. Additionally, though their primary focus is marine mammals and sea turtles, the implementation of mitigation measures such as soft start procedures (COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2023) will inadvertently benefit finfish and invertebrates by decreasing the total amount of time the water column is ensonified to above-threshold levels within a 24-hour period. This reduces the risk of exposure and injury to fish during pile driving under the Proposed Action and is, therefore, unlikely to occur.

The predominant impact expected during impact pile driving on finfish and invertebrates is behavioral responses such as startle responses or avoidance of the ensonified area during construction. However, as discussed in Section 3.13.3.2, *Cumulative Impacts of the No Action Alternative,* the recommended threshold for the onset of behavioral disturbances is based on observations of fish in captivity and should be viewed as a conservative estimate of potential impacts as they are based on studies of fish studied in an enclosed area and may therefore not capture how free-ranging fish may behave. The primary considerations for the impact of behavioral disturbances in response to noise would be if said disturbances disrupt biologically important behaviors such as spawning or foraging. Because no critical habitat, EFH, or HAPC overlaps with the area in which pile-driving noise would occur (Section 3.13.1, *Description of the Alternative on Finfish, Invertebrates, and Essential Fish Habitat*), a long-term disruption to behaviors related to spawning or foraging is not expected. Ranges to the injury and behavioral thresholds for vibratory pile driving proposed for the foundations were all smaller than those estimated for impact pile driving (Table 3.13-4), and because this activity would only occur for up to 90 minutes per pile (COP; Dominion Energy 2023), no injury or would occur during vibratory pile driving for foundation installation. The mitigation proposed by Dominion Energy but not finalized consists of a double big bubble curtain (BBC) for far field noise mitigation. The use of noise-reduction technologies during all pile-driving activities to ensure the minimum attenuation of 10 dB would reduce the area of high noise levels during construction and subsequently minimize potential noise-related impacts to surrounding water column. A BBC system is a compressed air system (air bubble barrier) for sound absorption in water. Sound stimulation of air bubbles at or close to their resonance frequency effectively reduces the amplitude of the radiated sound wave by means of scattering and absorption effects. A BBC functions as follows: air is pumped from a separate vessel with compressors into nozzle hoses lying on the seabed, which then escapes through holes that are provided for this purpose. Thus, bubble curtains are generated within the water column due to buoyancy. Noise emitted by pile driving must pass through those ascending air bubbles and is thus attenuated. Overall, the duration of impact pile driving activities would be relatively short term (~4 hours per day) and only occurring as a singular installation operation. Once construction is complete and pile driving has ceased, impacts from this sub-IPF would dissipate. However, the implementation of mitigation (COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2023) would not completely eliminate the risk of behavioral disturbances such as changes in swim speed or behavior (described in Section 3.13.2, *Environmental Consequences*), given the large range over which behavioral impacts may occur (up to 9.3 miles [15 kilometers). Therefore, behavioral disturbances for individuals would be unavoidable but would not result in population-level effects, and moderate impacts on finfish, invertebrates, and EFH would be expected.

Vibratory pile driving during installation of the cofferdams may exceed acoustic injury thresholds up to approximately 1,040 feet (317 meters) from the source with 10 dB noise attenuation (Table 3.13-4); however, this is based on the $L_{E,24hr}$ metric, which, as discussed for impact pile driving, requires fish to remain in the ensonified area for the full duration of the activity, which is unlikely to occur. Behavioral threshold may be exceeded up to 813 feet (248 meters) from the source but given the nearshore location of potential vibratory pile driving activities and the limited duration (i.e., a few hours) no long-lasting effects would be expected, and impacts on finfish, invertebrates, and EFH would be negligible.

All other noise-producing activities under the Proposed Action (i.e., HRG survey activity, vessel activity, WTG operations, cable trenching) would not be expected to exceed the impacts expected under the No Action Alternative described in Section 3.13.3.2, *Cumulative Impacts of the No Action Alternative*. The additional vessels, HRG survey equipment, and WTGs would result in a nominal increase in potential sources within the context of reasonably foreseeable environmental trends and impacts would similarly be negligible.

Port utilization: The Proposed Action would not be anticipated to cause any port expansion or otherwise affect finfish, invertebrates, and EFH that are present near ports to be used under the Proposed Action, and impacts are anticipated to be negligible.

Presence of structures: A primary impact on finfish, invertebrates, and EFH the Proposed Action would be the construction and placement of WTGs and OSSs in the Project area. These hard structures would displace and cause mortality among the soft bottom non-motile, infauna, and demersal soft bottom fauna that use this habitat. Each WTG would require approximately 0.94 acre (0.39 hectare [COP Table 4.2-17; Dominion Energy 2023]) of surface area, most of which is related to the scour protection apron. The area of substrate needed for all WTGs including scour protection under the Proposed Action is estimated at 191.9 acres (77.66 hectares). Along with the WTGs for the Proposed Action, three OSSs would be installed, resulting in another 12 leg supports with a scour protection area required for each leg. The total seafloor surface needed for the three OSSs and scour protection would be 11.4 acres (4.61 hectares). In addition, 1.19 acres (0.48 hectares) would have permanent impacts from cable protection. In total, 204.49 acres (82.75 hectares) (COP, Table 4.2-17; Dominion Energy 2023) of seafloor habitat would be permanently affected as a result of the installation of the WTGs, inter-array cables, and offshore export cable for Proposed Action. Temporary impacts from the WTG work area and the offshore substation would include 3526.50 acres (1,427.13 hectares) of seafloor disturbance (COP, Table 4.2-17; Dominion Energy 2023). Species such as the Atlantic surfclam, Atlantic sea scallops, calico scallops, Channeled whelk and the longfin squid would have their available habitat resources reduced, resulting in a minor impact.

The placement of each WTG for the Proposed Action would additionally attract structure-oriented species that would benefit from the creation of hard substrate (Claisse et al. 2014; Smith et al. 2016); however, the diversity of these structure-associated assemblages may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). This novel habitat will be colonized by fishes and epibiota, which will increase biodiversity and biomass while converting or eliminating portions of soft bottom habitat (Bergstrom et al. 2014; Degraer et al. 2020). The epibiota form fouling assemblages on the surfaces of vertical monopiles and horizontal scour protection (Glarou et al. 2020). In addition to increased biomass and diversity, there may be alterations of existing trophic pathways (Mavraki et al. 2020). Most fouling organisms (e.g., barnacles, mussels, hydroids, tunicates) are suspension feeders, which draw in plankton and organic matter from the surrounding water column. These organisms assimilate the pelagic production then cast waste products down to the seafloor. This process affects water column production and greatly enriches organic content of sediments around the WTG foundation. Fouling organisms such as mussels and barnacles will slough off the pilings and settle to the seafloor around the foundation, where they are eaten by consumers such as crabs, American lobsters, flounders (summer, winter, and windowpane), and hakes (e.g., Degraer et al. 2020; Wilber et al. 2022).

The impacts of invasive species that might settle the introduced hard structure on finfish, invertebrates, and EFH depend on many factors but could be widespread and permanent. Releases of invasive species may or may not lead to the establishment and persistence of invasive species. Invasive species becoming established as a result of offshore wind activities is possible. As documented in observations of colonial sea squirt (*Didemnum vexillum*) at the Block Island Wind Farm (HDR 2020), the impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent if the species were to become established and outcompete native fauna or modify habitat. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities. For example, colonial sea squirt is already an established species in New England with documented occurrence in subtidal areas, including on Georges Bank, where numerous sites within a 56,834-acre (23,000-hectare) area are 50 to 90 percent covered by colonial sea squirt (Bullard et al. 2007).

The structures may also provide habitat for the invasive red lionfish (*Pterois volitans/miles*). Red lionfish, native to the Indo-Pacific, are established from North Carolina to the Caribbean Sea and Gulf of Mexico (Schofield 2010). Red lionfish have an affinity for natural and artificial hardbottom and feed opportunistically on fishes and to a lesser extent motile invertebrates (Muñoz et al. 2011). Although young individuals have been recorded from as far north as Massachusetts, the established northern range limit ends at Cape Hatteras, North Carolina (Schofield 2010; Whitfield et al. 2014; Hunter et al. 2021). Water temperature is an important determinant in lionfish distribution. Most observations as well as projections of species distribution models indicate a preference for water temperatures over 16°C (Greive et al. 2016; Kimball et al. 2004). In the near future, the CVOW-C structures may be colonized by lionfish during summer months, but these individuals would not likely survive the winters. Over time and with climate change, the spread of and survival of adults may eventually extend the present range northward into the CVOW Project area. If this happens, control measures such as lionfish spearfishing derbies or dedicated eradication programs could be developed (e.g., de Leon et al. 2013; Harris et al. 2020).

The presence of a WTG field can affect local hydrodynamics by forming a wake in the lee of the structures (Dorell et al. 2022; Christiansen et al. 2022). Models developed for the North Sea have shown that wake effects can extend for as much as 20 km behind the structures (Christiansen and Hasager 2005). Depending on wind speed and direction and structural characteristics of the WTGs, the wake can affect the atmospheric, hydrodynamic, pelagic, and benthic environments (Daewel et al. 2022). Empirical investigations in the North Sea showed destratification of the water column and changes in the plankton density downstream of the structures but no change in fish abundance as measured with echosounders (Floeter et al. 2017). It is not yet clear how these results can be applied to similar structures on the NE US continental shelf as a number of variables are involved in characterizing and modeling wind wakes (van Berkel et al. 2020).

The placement of the structures outlined under the Proposed Action would be expected to result in habitat alteration from soft bottom to hard bottom "reefing" habitat. This would result in short-term to permanent impacts on soft bottom habitat (which include complex sand ridges) within the proposed Lease Area and would impart minor impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species. Localized impacts would likely be greater, particularly in the triangle reefs area.

The expected minor impacts of the Proposed Action alone would not increase beyond the impacts described under the No Action Alternative. The Planned Activities Scenario (Appendix F) indicates that there could be 81 WTGs within the geographic analysis area. The Proposed Action would add up to 202 WTGs, respectively. The structures associated with the Proposed Action and the consequential impacts would remain at least until conceptual decommissioning is complete (33-year Project lifetime).

Regulated fishing effort: Regulated fishing effort can affect finfish, invertebrates, and EFH by modifying the nature, distribution, and intensity of fishing-related impacts (mortality, bottom disturbance). See Section 3.9, *Commercial Fisheries and For Hire Recreational Fishing*, for the contribution of the Proposed Action and other future wind projects on regulated fishing effort. The intensity of impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species under future fishing regulations is uncertain, but would likely be similar to or less than under the status quo and would be moderate.

Seabed profile alterations: Much of the Offshore Project area is characterized as unconsolidated sands arranged in waves, megaripples, and ripples, with some isolated patches of mud and gravel. These features would temporarily be disturbed by pre-construction grapnel runs, seabed preparation, foundation placement, scour protection installation, anchoring, clearing, and trenching for offshore export and inter-array cable installation, and cable protection activities. Sand ripples and waves disturbed by offshore export and inter-array cable installation would naturally reform within days to weeks under the influence of the same tidal and wind-forced bottom currents that formed them initially (COP, Section 4.2; Dominion Energy 2023; Kraus and Carter 2018). Under the Proposed Action, the primary technology that may impact the seabed profile would be a jet-plow for cable installation where an estimated up to 6,347.3 acres (2,568.64 hectares) (COP, Table 4.2-17; Dominion Energy 2023) of seafloor could be disturbed. The impacts related to jet-plowing would be very localized and temporary and would recover completely without mitigation. However, in areas where seabed conditions might not allow for cable burial to the desired depth, other methods of cable protection would be employed, such as rocks, geotextile sand containers, or concrete mattresses which would permanently alter the seabed profile. Therefore, overall, impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species from seabed profile alterations under the Proposed Action would be minor.

The minor impacts of the Proposed Action alone would not increase the impacts beyond those of the No Action Alternative because dredging is not anticipated. Although the amount of seabed profile alteration in the No Action Alternative is not known, it would occur.

Sediment deposition and burial: The Proposed Action would cause sediment deposition of up to approximately 7,174 acres (2,903 hectares). This impact would vary by species. Demersal eggs such as longfin squid, which are not tolerant to burial or abrasion, would experience high rates of egg mortality (BOEM 2021b). In the 2020 benthic survey, squid mops were observed by underwater video (COP, Appendix D; Dominion Energy 2023). With year-round spawning, species such as the longfin squid may not experience maximum benefits from the time-of-year restrictions for construction operations. For the longfin squid, and other species that migrate long distances, their mobility and broad range of habitats could also mean that limited disturbance may not have measurable effects on their stocks (populations). As presented in the cable emplacement IPF discussed previously, sediment deposition impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species would be expected to range between negligible and minor. Sediment deposition and burial under the Proposed Action could cause impacts on sensitive life stages, such as demersal eggs.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, have the potential to result in long-term, potentially high-consequence risks to finfish, invertebrates, and EFH. Ocean acidification has been shown to have negative impacts on the settlement and survival of shellfish (PMEL 2020). These impacts could lead to changes in prey abundance and distribution, changes in migratory patterns, and timing. Appendix F, Table F1-1 provides more details on the expected contribution of offshore wind to climate change. These sub-IPFs would contribute to potential alterations in finfish migration patterns or reductions in growth or decline of invertebrates that have calcareous shells. Because these sub-IPFs are a global phenomenon, the impacts through this IPF from the Proposed Action would be practically the same as those under the No Action Alternative (Section 3.13.3.3, *Offshore Wind Activities (without Proposed Action)*). The intensity of impacts resulting from climate change are uncertain but would be anticipated to qualify as minor to moderate.

3.13.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action reflect the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

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

Anchoring: The expected minor incremental impact of the Proposed Action combined with the planned actions would result in seafloor disturbance and associated turbidity from anchoring. In the context of reasonably foreseeable environmental trends, the combined anchoring impacts from ongoing and planned actions, including the Proposed Action, could occur if impacts are in close temporal and spatial proximity. However, these impacts from anchoring would be expected to be minor and would expect to recover completely.

Electromagnetic fields: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be localized and long term and result in negligible to minor impacts.

Light: In the context of reasonably foreseeable environmental trends, combined lighting impacts on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, would be expected to have negligible, non-measurable impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species. Ongoing and future non-offshore wind activities would be expected to cause permanent impacts, primarily driven by light from offshore structures and short-term and localized impacts from vessel lights.

New cable emplacement and maintenance: The expected minor impact of the Proposed Action combined with the planned actions would result in seafloor disturbance from the offshore export cable and inter-array cables. In context of reasonably foreseeable environmental trends, the combined cable emplacement impacts from ongoing and planned actions, including the Proposed Action, could occur if impacts are in close temporal and spatial proximity. Impacts from cable emplacement under the Proposed Action would be expected to be moderate but temporally short and would recover completely.

Noise: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be moderate for finfish, invertebrates, and EFH. The main activity that would result in adverse effects on these resources is impact pile driving during installation of WTG and OSS foundations. The expected moderate incremental impact from pile driving under the Proposed Action combined with offshore wind activities would result in increased underwater noise levels during construction starting in 2022 and continuing through 2030. Alternatively, these sound impacts from this activity would be removed once piling had stopped. All other noise-producing activities under the Proposed Action are expected to result in negligible impacts on these resources, and combined impacts with ongoing and planned actions would similarly be negligible. Impacts from other noise-producing activities are lower in intensity relative to impact pile driving, and impacts would be localized, temporary, and not biologically notable for finfish or invertebrates and would not result in any notable effects on EFH.

Port utilization: In the context of reasonably foreseeable environmental trends, combined port utilization impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species from ongoing and planned actions, including the Proposed Action, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be negligible.

Presence of structures: In the context of reasonably foreseeable environmental trends, the combined impacts arising from the presence of structures from ongoing and planned wind energy projects, including the Proposed Action, would be expected to range from negligible to moderate based on the sub-IPFs and may result in minor beneficial impacts for demersal hard-bottom species groups due to the large number of structures and "reefing" effect. However, while an increase in hard-bottom species (reef effect) may be beneficial, this benefit may be offset by the risk of entanglement due to derelict or abandoned fishing gear or fishing line to the finfish, invertebrates and EFH-managed species and particularly ESA-listed Atlantic sturgeon or giant manta ray.

A majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action, as the Proposed Action would account for approximately 6.5 percent (202 of over 3,135) of the new WTGs on the OCS.

Regulated fishing effort: See Section 3.9, *Commercial Fisheries and For Hire Recreational Fishing*, for the contribution of the Proposed Action on regulated fishing effort. The intensity of impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species under future fishing regulations is uncertain, but would likely be similar to or less than under the status quo and would be moderate.

Seabed profile alterations: In context of reasonably foreseeable environmental trends, the combined impacts of this IPF on finfish, invertebrates, EFH-managed species, and ESA-listed species from ongoing and planned actions, including the Proposed Action, would likely be minor.

Sediment deposition and burial: In the context of reasonably foreseeable environmental trends, the impacts of sediment deposition and burial on finfish, invertebrates, EFH-managed species, and ESA-listed species from ongoing and planned actions, the Proposed Action, would likely be minor.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, have the potential to result in long-term, potentially high-consequence risks to finfish, invertebrates, and EFH. The impacts of this IPF on finfish, invertebrates, EFH-managed species, and ESA-listed species from ongoing and planned actions, the Proposed Action, are uncertain but would be anticipated to qualify as minor to moderate.

3.13.5.2 Conclusions

Impacts of the Proposed Action. Project construction and installation and conceptual decommissioning would introduce noise, lighting, EMF, and new structures to the geographic analysis area, as well as result in habitat conversion impacting finfish, invertebrates, and EFH to varying degrees depending on the location, timing, and species affected by an activity. Impacts associated with the Proposed Action activities would be specific to the life stage and habitat requirements of a species as well. Impacts from Project operation and maintenance would occur, although at lower levels than those produced during construction and conceptual decommissioning. Offshore structures would also result in long-term effects to pelagic habitat. BOEM anticipates the impacts resulting from the Proposed Action alone would range from **negligible** to **moderate**, including the presence of structure, which may result in **minor beneficial** impacts. However, while an increase in prey may be beneficial, it may be offset by the risk of ESA-listed Atlantic sturgeon or giant manta ray entanglement due to derelict or abandoned fishing gear or fishing line.

Therefore, BOEM expects the overall impact on finfish, invertebrates, and EFH the Proposed Action alone would be **minor** because the effect would be localized and, for the most part, temporary. Dominion

Energy's proposed mitigation measures (as outlined in COP, Section 4.2.4.4, Table 4.2-13) and any future additional mitigation measures set forth by BOEM or other federal agencies could further reduce impacts (but would most likely not change the impact determinations).

Cumulative impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action, would range from **negligible** to **moderate** and **minor beneficial**. However, while an increase in prey may be beneficial, it may be offset by the risk of finfish, invertebrates and EFH-managed species, as well as ESA-listed species (Atlantic sturgeon or giant manta ray) being adversely affected through entanglement with derelict or abandoned fishing gear or fishing line.

As previously stated in Section 3.13.1.1, *Finfish*, the Atlantic sturgeon and giant manta ray are the most likely of the ESA-listed species to be present in the Lease Area. According to the BA, the physical and biological features essential for Atlantic sturgeon include hard-bottom substrate in low salinity waters (0.0 to 0.5 ppt) for early life stages such as that found within James River, where critical habitat is designated. The risk of vessel strike is very low for Project-related activities. Giant manta rays are found in coastal and offshore waters and are highly migratory. Their seasonal migration patterns are believed to be linked with zooplankton movement, currents and tides, upwellings, and possibly mating behavior. Giant manta rays can be found in aggregations in shallow waters less than 33 feet (10 meters) or diving 656 to 1,476 feet (200 to 450 meters) to follow prey. Although the hearing range is not known, like all elasmobranchs, their inner ear is capable of detecting sound and their lateral line helps them to detect motion from sound (Popper and Hastings 2009). Their potential presence of ESA-listed species within the Lease Area, their known hearing ranges and ability to detect particle motion, would result in the greatest potential impacts.

Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action, would result in **moderate** impacts on finfish, invertebrates, and EFH in the geographic analysis area. The main drivers for this impact rating are fishing mortality, climate change, recurring bottom disturbance from bottom-tending fishing gear, and mortality resulting from offshore construction. The Proposed Action would contribute to the overall impact rating primarily through the temporary disturbance due to new cable emplacement and permanent impacts from the presence of structures (cable protection measures and foundations). Therefore, the overall impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species would likely qualify as **moderate** because a notable and measurable impact is anticipated, but the resource would likely recover completely when the WTGs are removed and/or remedial or mitigating actions are taken.

3.13.6 Impacts of Alternatives B and C on Finfish, Invertebrates, and Essential Fish Habitat

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. The primary difference between Alternative B and the Proposed Action is the development of exclusion areas established in the Lease Area to avoid impacts on artificial reefs, shipwrecks, and complex habitats. Alternative B would exclude the Fish Haven area within the northern portion of the Lease Area from development, reducing the number of WTGs to up to 176. Alternative B would remove 26 WTGs and concomitantly reduce the length required for inter-array cable networks connecting the removed 26 WTGs. The avoidance of the Fish Haven area from development under Alternative B would reduce soft-bottom habitat impacts of the Proposed Action by 28.1 acres (11.4 hectares). The number of cables within the offshore export corridor would not change, but the length of the offshore export cables would be reduced by 70.2 miles (112.1 kilometers) and the length of inter-array cables would decrease by 80.1 miles (127.2 kilometers). With the removal of inter-array cables between WTGs and rerouting of the export cables there would be a reduction of 150.3 acres (483.7 hectares) in temporary disturbance to the benthic habitat related to cable installation for Alternative B.

With the exception of the reduction in the number of WTGs and reduction in the length of inter-array and export cables for Alternative B, impacts from the construction and installation, operations, and maintenance, non-routine activities, and conceptual decommissioning of Alternative B would be similar to those described under the Proposed Action. However, the micrositing of WTGs to avoid the NOAA-designated Fish Haven area and shipwrecks under Alternative B would decrease impacts related to the duration of noise impacts from pile-driving and jet-plowing operations and the potential displacement of soft-bottom organisms within the footprint of each construction activity. Avoiding the Fish Haven area would greatly reduce the potential impacts on the demersal and pelagic finfish species that utilize the artificial reef structures. Structure-oriented finfish species documented on the reef habitats identified during fisheries surveys include species such as monkfish, red hake, black sea bass, scup, spiny dogfish, tunas and sharks (COP, Appendix E, Section E.2.3.3; Dominion Energy 2023). The decrease in overall seafloor impacts would be reduced between 15 percent for the WTG impacts and 21 percent in relation to cable installation for Alternative B. When compared to the Proposed Action, impacts would remain minor.

NMFS has identified the sand ridge habitat within the Lease Area as significant and unique benthic resources to be avoided to reduce the Project impact on the finfish, invertebrates, and EFH that use these unique resources. Offshore ridge/trough complexes within the MAB OCS have been shown to support diverse finfish and invertebrate assemblages with faunal differences found between the ridge top and trough habitats (Rutecki et al. 2014). Multiple MAB species of finfish and invertebrates utilize the ridge trough complexes for several ecological services such as migration, spawning, foraging and larval recruitment (Rutecki et al. 2014). Preserving viable natural fish habitat may be more beneficial and outweigh any beneficial impacts related to the artificial reef effect related to WTG and OSS presence of structure. The sand ridge habitat area encompasses 17 WTG locations, one OSS location, and associated inter-array and offshore export cables. Alternative C has been developed to avoid and minimize impacts on sand ridge habitat and shipwrecks through a combination of removal, relocation, and micrositing of Project infrastructure. Alternative C as designed would remove four WTGs and one OSS from the sand ridge habitat and their associated inter-array cables. The OSS is to be moved from its original position to a site that will provide a 500-foot (152.4-meter) buffer from any significant sand ridge habitats. A secondary minimization will develop by extending the cross-cutting trenching activities between two summer construction seasons. Separating the construction seasons with a 6-month recovery period will allow the ridge habitats to recover and reestablish their unique sand ridge benthic invertebrate and finfish assemblages. Recovery of trenched areas will depend on prevailing physical conditions as well as life history characteristics of the colonizing species and could take from less than 1 year to more than 3 years (CSA International 2009; Sciberras et al. 2016). All WTGs in Alternative C would be 14 MW, and under Alternative C a total of up to 172 WTGs would be installed in the Lease Area. This alternative would result in a reduction of benthic and pelagic resource impacts within the Lease Area in comparison to the Proposed Action. Approximately 169.7 acres (68.7 hectares) of benthic resources would be permanently impacted due to the installation of the up to 172 WTGs and the scour protection pad installed around each WTG foundation. Under the Proposed Action it is estimated that 201.7 acres (81.6 hectares) of benthic habitat would be permanently impacted. If Alternative C were selected as part of the Project design and there is a reduction of 4 WTGs from Alternative B (up to 176 WTGs) the permanent impact on benthic resources would be reduced by 32 acres (13 hectares). There would be an additional reduction in the impacts related to cable installation with the removal of the inter-array cables connecting the 4 removed WTGs in Alternative C. Alternative C would result in a reduction of 16 percent of soft bottom converted to hard-bottom habitat within the Lease Area. However, this portion of soft bottom primarily includes sand ridge features, which represent complex seafloor habitat. These sand ridges will support different species and life stages of fishes and invertebrates than will the artificial hard-bottom (Vasslides and Able 2008; Slacum et al. 2010).

With the exception of the reduction in the number of WTGs and length of inter-array and export cables installed for Alternative B and the Sand Ridge Impact Minimization Alternative C, impacts from the construction and installation, operations, and maintenance, non-routine activities, and conceptual decommissioning of these alternatives would be similar to those described under the Proposed Action. However, the micrositing of WTGs to avoid the NOAA-designated Fish Haven area and shipwrecks for Alternative B and avoidance of complex sand ridge habitat in Alternatives C would decrease impacts. The impacts reduced are related to the duration of noise impacts from pile-driving, jet-plowing operations, the potential of displacement of soft-bottom organisms within the footprint of each construction activity, and the permanent conversion of soft bottom to hard substrate. The decrease in overall seafloor impacts would be reduced to 15 to 16.8 percent for Alternatives B and C when compared to the Proposed Action. With this reduction in impacts, however, the impact level would remain minor and predominately permanent due to the conversion of existing soft-bottom habitat to hard-bottom habitat in relation to the WTG scour protection pads.

Cumulative impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species from ongoing and planned actions, including Alternatives B or C, would be similar to those described under the Proposed Action.

3.13.6.1 Conclusions

Impacts of Alternatives B and C. The Proposed Action and Alternatives B or C may result in fewer impacts on NOAA trust resources, including finfish and invertebrates, that use soft-bottom habitats (including sand ridge features); the final impact determinations would not differ from those noted under the Proposed Action. Effects for soft-bottom organisms and assemblages under Alternatives B or C would be slightly lower but close to the same level as under the Proposed Action, and they would remain **minor**. This impact rating is driven primarily by ongoing IPFs such as climate change, as well as disturbance and habitat removal associated with WTG and cable emplacement activities. As described for the Proposed Action, Dominion Energy’s proposed mitigation measures (as outlined in COP, Section 4.2.3.3, Table 4.2-13; Dominion Energy 2023) and any future additional mitigation measures set forth by BOEM or other federal agencies could further reduce impacts (but would most likely not change the impact determinations).

Cumulative impacts of Alternatives C and B. In the context of reasonably foreseeable environmental trends, the combined impacts on finfish, invertebrates, and EFH from ongoing and planned actions, including Alternative B or C, would be similar to those described under the Proposed Action, with individual IPFs leading to impacts ranging from **negligible** to **moderate** with potentially **minor beneficial** impacts. However, while an increase in prey may be beneficial, this may be offset by the entanglement risk of ESA-listed species (Atlantic sturgeon or giant manta ray) and other ecologically and commercially important finfish, invertebrates and EFH-managed species due to derelict or abandoned fishing gear or fishing line.

3.13.7 Impacts of Alternative D on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternative D. Alternative D differs from the Proposed Action only regarding onshore routing of the interconnection cable. Because the onshore portion of the Project lies outside of the zone of influence for finfish, invertebrates, and EFH, the Interconnection Cable Route Options D1 or D2 onshore export cable route extends from the trenchless installation landing (HDD) in Virginia Beach with two proposed terrestrial routes utilizing both buried cable and aerial routes to onshore switching stations. Both Interconnection Cable Route Options D1 and D2 are designed to minimize impacts on aquatic habitats (streams and wetlands) with an undetectable level of impact on the marine environmental offshore Virginia. Impacts of Alternative D would be the same as those under the Proposed Action and would range from negligible to moderate depending on the IPF. Overall impacts would be minor.

Cumulative impacts of Alternative D. For the same reason, overall impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species in the context of reasonably foreseeable environmental trends and planned actions would be the same (i.e., moderate) under Alternative D.

3.13.7.1 Conclusions

Impacts of Alternative D. Although Alternative D would minimize impacts on onshore habitats, BOEM does not anticipate a measurable benefit for finfish, invertebrates, and EFH in the geographic analysis area. Therefore, overall potential impacts would be same the Proposed Action and would range from **negligible** to **moderate**.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on finfish, invertebrates, EFH-managed species, and ESA-listed species from ongoing and planned actions, including Alternative D, would be the same as those described under the Proposed Action, with individual IPFs leading to **negligible** to **moderate** impacts, with potential for **minor beneficial** impacts. However, these beneficial effects may be offset by the entanglement risk of ESA-listed species (Atlantic sturgeon or giant manta ray) and other ecologically and commercially important finfish, invertebrates and EFH-managed species due to derelict or abandoned fishing gear or fishing line.

While Alternative D is designed to minimize impacts on onshore habitats, the overall impacts of Alternative D on finfish, invertebrates, EFH-managed species, and ESA-listed species would be the same as under the Proposed Action and would remain **moderate**.

3.13.8 Agency-Required Mitigation Measures

The monitoring measures included in Table 3.13-5 are recommended for inclusion in the Preferred Alternative.

Table 3.13-5 Measures Resulting from Consultations: Finfish, Invertebrates, and Essential Fish Habitat[1]

Measure	Description	Effect
Whelk Survey	Perform whelk surveys to help determine the relative abundance, length frequency and demographic characteristics (age structure and reproduction) of whelk within the geographic analysis area before and after construction in accordance with the Whelk Monitoring Plan.	Determine differences in whelk relative abundance pre- and post-construction.
Black Sea Bass Surveys	Perform black sea bass surveys to help determine the relative abundance, length frequency and demographic characteristics (age structure and reproduction) of black sea bass within the geographic analysis area before and after construction in accordance with the Black Sea Bass Monitoring Plan.	Determine differences in black sea bass relative abundance pre- and post-construction.
Atlantic Surf Clam Surveys	Perform Atlantic surf clam surveys to examine abundance and population structure within the CVOW Lease Area in accordance with the Atlantic Surf Clam Monitoring Plan.	Determine differences in Atlantic surf clam relative abundance pre- and post-construction.

[1] Also Identified in Appendix H, Table H-2.

3.13.8.1 Effect of Measures Incorporated into the Preferred Alternative

No mitigation measures for finfish, invertebrates, and EFH are required through completed consultations, authorizations, or permits as listed in Appendix H, *Mitigation and Monitoring*, Table H-2. However, several monitoring measures are required from completed consultations which are included in the EFH assessment document. These measures, if adopted, would help characterize and determine differences pre- and post-construction in several key and commercially important species (i.e., whelks, black sea bass, Atlantic surf clams).

3.14. 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 described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.14-1, includes the City of Chesapeake; City of Hampton; City of Newport News; City of Norfolk; City of Portsmouth; and City of Virginia Beach, and municipal boundaries surrounding the ports that may be used for the Project.

3.14.1 Description of the Affected Environment for Land Use and Coastal Infrastructure

Within the Project area (subset of City of Virginia Beach and Chesapeake City), land use is diverse, including open water, wetlands, shrub/scrub, forest, and developed and undeveloped land uses.

The proposed cable landing location would be on a proposed[1] surface parking lot that is designated as commercial land use and adjacent to an SMR, which is owned by the Commonwealth of Virginia and primarily used for on-site training for the Virginia National Guard.

The onshore export cable route corridor would be installed underground from the cable landing location to a common location north of Harpers Road, Virginia Beach. The dominant land uses along the onshore export cable route corridor include low-, medium-, and high-intensity developed lands and open space. In addition, the route follows a relatively limited passage through cultivated cropland, deciduous forestland, emergent herbaceous wetlands, evergreen forestland, pastureland, open water, and herbaceous and woody wetlands. The route corridor crosses Lake Christine, General Booth Boulevard, and a tidal tributary area west of General Booth Boulevard (COP, Section 4.4.3.1; Dominion Energy 2023).

The switching station would be located at either a location north of Harpers Road (City of Virginia Beach) (Harpers Road switching station) or a location north of Princess Anne Road (City of Virginia Beach) (Chicory Switching Station) (COP, Section 2.1.2.3; Dominion Energy 2023). Only one switching station will be constructed. The switching station potentially located north of Harpers Road would be located on a mix of forestland, developed open space, and low- and medium-intensity development. The area surrounding the Harpers Switching Station parcel is also made up of the same land classifications, with cultivated crop land to the north, east, and west, and woody wetlands to the south. The switching station potentially located north of Princess Anne Road would be located on a parcel classified as woody wetlands and mixed forest surrounded by woody wetlands, mixed forest, and evergreen forest with low-intensity development to the north and existing roadway to the southwest (COP, Section 4.4.3.1; Dominion Energy 2023). The Harpers Switching Station would require approximately 5.52 acres (2.2 hectares) for stormwater management facilities, approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the adjacent golf course, and 0.93 acre (0.4 hectare) for relocation of Dewey Drive. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station. The operational footprint of the Chicory Switching Station would be approximately 35.5 acres (14.4 hectares) (COP, Section 3.3.2.3; Dominion Energy 2023).

[1] The SMR plans to independently build the parking lot. The parking lot is not expected to be developed as part of the proposed Project. The operational footprint for the cable landing location is anticipated to be approximately 2.27 acres (0.92 hectare).

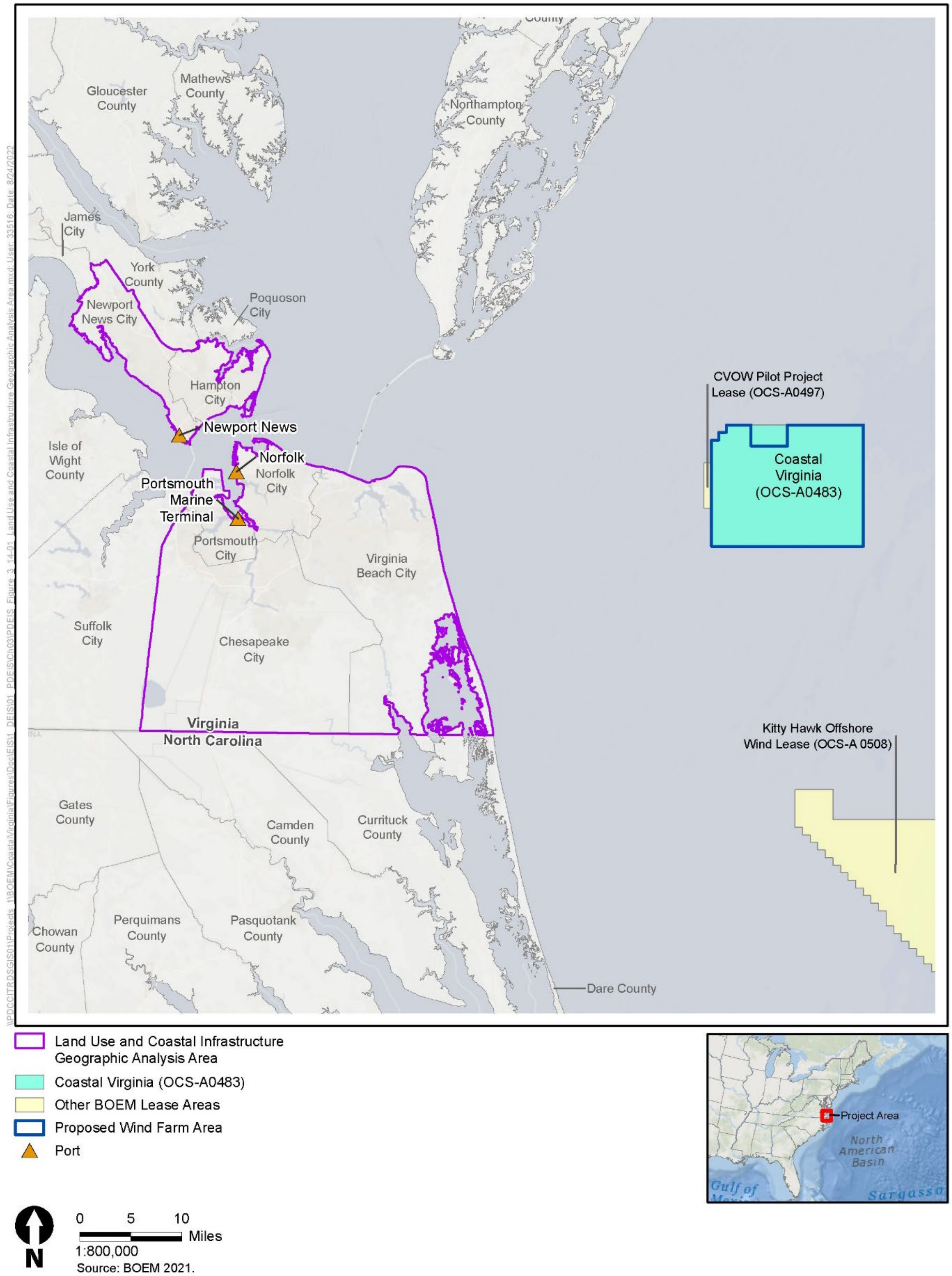


Figure 3.14-1 Land Use and Coastal Infrastructure Geographic Analysis Area

The onshore substation would be located off of Fentress Loop on a site that is currently designated as low density residential. As this site already has an existing substation, the upgrades/expansion to the onshore substation would be consistent with the existing site uses. The parcel is partially developed but surrounded by wooded and wetland areas to the north, east, south, and west. Forested wetlands are present in the west and north. Existing residential neighborhoods with large, single-family homes have been sited to the north, south, and west, with agricultural land to the east. There are also existing overhead transmission lines to the north and northeast of the onshore substation site (COP, Section 4.4.3.1; Dominion Energy 2023).

The interconnection cable routes lie within portions of the heavily developed cities of Virginia Beach and Chesapeake and include portions of the Gum Swamp, associated with the North Landing River wetlands complex, and more rural areas in the south. The two interconnection cable route options are located within areas containing very dense residential and commercial developments, large and numerous publicly owned lands, forested wetlands, major watercourses and associated floodplains, the Intracoastal Waterway, agricultural fields, military airport facilities, sports complexes, and golf courses (COP, Section 4.4.3.1; Dominion Energy 2023).

Important landscape features in the Project area include a combination of natural views such as beaches, shorelines, and scenic vistas, and human-made views such as unique buildings, landscaping, parks, and other cultural features.

3.14.2 Environmental Consequences

3.14.2.1. Impact Level Definitions for Land Use and Coastal Infrastructure

Definitions of potential impact levels are provided in Table 3.14-1.

Table 3.14-1 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.

3.14.3 Impacts of the No Action Alternative 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. 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 F.

3.14.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for land use and coastal infrastructure described in Section 3.14.1, *Description of the Affected Environment for Land Use and Coastal Infrastructure*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on land use and coastal infrastructure are generally associated with onshore construction. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect land use and coastal infrastructure through temporary and permanent land use change, development projects, and port expansion.

The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and regulations. Most construction projects in the geographic analysis area would likely affect land that has already been disturbed from past development, although some development on undeveloped land may also occur. 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. A channel-deepening project at the Port of Virginia is currently underway and is anticipated to be completed in 2024 (Virginia Port Authority 2019). Dredging and port improvements would allow larger vessels to use the port and may result in increased port use and conversion of surrounding land use if the ports are expanded. See Appendix F, Table F1-12 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for land use and coastal infrastructure.

There are no ongoing offshore wind activities within the geographic analysis area that contribute to impacts on land use and coastal infrastructure.

3.14.3.2. 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).

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

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

Lighting: As described in Section 3.20, *Scenic and Visual Resources*, aviation hazard lighting on portions of Kitty Hawk Offshore Wind Projects (encompassing 190 WTGs) could be visible from beaches and coastal areas in the geographic analysis area. 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 majority of the WTG positions associated with other offshore wind activities would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

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

Port utilization: Offshore wind energy projects would make productive use of port facilities for shipping, berthing, and staging throughout construction, operations, and decommissioning. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts, such as greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind. In particular, the Virginia Port Authority is planning improvements to the PMT to support broadscale offshore wind development (COP, Section 3.3.2.6; Dominion Energy 2023).

There are two additional planned offshore wind projects (Kitty Hawk Offshore Wind Projects) in the geographic analysis area that would overlap with construction of the Proposed Action (Appendix F, Table F2-1). Offshore wind energy projects that are constructed at the same time and rely on the same ports have the potential to stress port resources and could increase the marine and road traffic, noise, and air pollution in the area. Overall, the No Action Alternative would have constant, long-term, beneficial impacts on port utilization due to the productive use of ports designated for offshore wind activity, as well as localized, short-term, adverse impacts in cases where individual ports are stressed due to simultaneous project activity. The Kitty Hawk Offshore Wind Projects would use ports in the Lower Chesapeake Bay area for staging project components and construction vessels (Kitty Hawk Offshore Wind North 2021: Section 3.1.1; Kitty Hawk Offshore Wind South 2022: Section 3.1.1). Improvements may be made to these ports to accommodate offshore wind construction and staging activities; port improvements and the associated permitting activities will support multiple projects up and down the Eastern Seaboard and will be the responsibility of port owners/operators (Kitty Hawk Offshore Wind North 2021: Section 3.1.11; Kitty Hawk Offshore Wind South 2022: Section 3.1.1).

Presence of structures: During operations, the views of offshore wind WTGs from coastal locations on the coastlines of Northampton County and the City of Virginia Beach, Virginia could have effects on land use through impacts on recreation, tourism, and property values, if the views influence visitors in selecting coastal locations to visit or buy. While WTGs could be visible from shoreline areas of the Delmarva Peninsula, Virginia Beach, and the Carova and Corolla Beach areas of North Carolina, visual impacts are expected to range from negligible to moderate (COP, Section 4.3.4.3; Dominion Energy 2023). Visibility would vary with distance from shore, topography, and atmospheric conditions and impacts would generally be localized, constant, and long term.

The presence of onshore infrastructure is anticipated to have minor long-term impacts on land use. BOEM anticipates that new substations for offshore wind projects would be within or near existing substations, or in locations designated for such uses. Transmission cables would most likely be above or below ground and collocated with roads or other utilities. As a result, onshore infrastructure would affect existing and planned land uses for the local area.

Land disturbance: Future offshore wind installation would require installation of onshore transmission cable infrastructure that would require land-disturbing activities and could temporarily affect access to adjacent properties. These impacts would only last through construction and occasionally during maintenance events. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects.

Noise: Future offshore wind projects would generate noise, primarily associated with onshore cable trenching and switching station or 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 states. The intensity and extent of noise from construction are difficult to generalize, but impacts would be local and temporary. 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.

Traffic: Future 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 and switching stations for future 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 extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects.

3.14.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, land use and coastal infrastructure would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on land use and coastal infrastructure. These effects are primarily driven by onshore construction impacts and the presence of structures.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary and permanent impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure are accidental releases, nighttime lighting of onshore construction activity and structures, port utilization and expansion, viewshed impacts of offshore structures, presence of onshore infrastructure, and land disturbance, noise, and traffic from construction.

BOEM anticipates that the impacts of ongoing activities, especially onshore and coastal commerce, industry, and construction projects, would have both **minor beneficial** and **minor** adverse impacts on land use in the geographic analysis area. Accidental releases and land disturbances could have temporary 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 the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and land use and coastal infrastructure would continue to be affected by natural and human-caused IPFs. Planned activities other than offshore wind, primarily increased port maintenance and expansion and construction activity, would have impacts similar to those of ongoing activities, with **minor beneficial** and **minor** adverse impacts. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor beneficial** and **minor** adverse impacts on the IPFs affecting land use and coastal infrastructure.

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

3.14.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on land use and coastal infrastructure.

- The number, size, and design of the turbines. The appearance of the turbines and the offshore component of the Project as a whole could affect property use and value.
- The location of the switching station. The proposed Harpers Road switching station is located on and around more disturbed land than the proposed Chicory Switching Station.
- Interconnection cable route paths. The onshore interconnection cable routing and switching station variants in the Onshore Project area cross different land uses and important landscapes, such as the Gum Swamp.
- The time of year during which construction occurs. The Project area experiences a peak tourism season in the summer. 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 could alter the maximum potential impacts on land use and coastal infrastructure for the Project because the capacity could affect onshore infrastructure or port utilization. For example, turbines with a higher capacity would require a greater turbine height, which may affect port utilization by increasing construction duration and intensity.

3.14.5 Impacts of the Proposed Action on Land Use and Coastal Infrastructure

The Proposed Action would likely result in localized impacts that would lead to minor alterations to the overall character of land use and coastal infrastructure in the geographic analysis area. The most impactful IPFs would likely include land use change from switching station construction and substation expansion; land disturbance during cable installation; the visual impact of offshore WTGs; and the utilization of ports.[2] Dominion Energy has indicated that the Virginia Port Authority is planning to improve the PMT to support broadscale offshore wind development and anticipates that the port upgrades would meet the needs for construction of the Project (COP, Section 3.3.2.6; Dominion Energy 2023). Other IPFs would likely contribute impacts of lesser intensity and extent and would occur primarily during construction but may also occur during operations and decommissioning.

Accidental releases: Accidental releases from the Proposed Action could include release of fuel/fluids/hazardous materials as a result of port usage, installation of the onshore cables, switching

[2] The Proposed Action includes no port expansion activities but would use ports that would expand to support the wind energy industry generally.

station, and substation, and substation operation. Potential contamination may occur from unforeseen spills or accidents, and any such occurrence would be reported and addressed in accordance with the local authority. The impact of accidental releases on land use and coastal infrastructure could result in temporary restriction on use of adjacent properties and coastal infrastructure during the cleanup process. Accordingly, accidental releases from the Proposed Action alone would have localized, short-term, negligible to minor impacts on land use.

Lighting: The Proposed Action would include the installation and continuous use of aviation hazard avoidance lighting on WTGs and OSSs during low-light and nighttime conditions. At onshore facilities, downward-projecting lights and lights triggered by motion sensors would be used to mitigate light pollution (COP, Section 4.2.2.2; Dominion Energy 2023). During operations, lighting from the Proposed Action's up to 202 WTGs could be visible from certain coastal and elevated locations in the geographic analysis area. Field observations associated with visibility of FAA hazard lighting under clear-sky conditions indicate that FAA hazard lighting may be visible at 40 miles (64 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. As a result, WTG lighting of the Proposed Action alone would have a long-term, continuous, negligible to minor impact on land use and coastal infrastructure in the geographic analysis area, due to potential effects on property use and value.

Port utilization: The Proposed Action includes no port expansion activities but would use ports that would expand to support the wind energy industry generally. Port upgrades and expansions may occur independent of the Proposed Action. For instance, the Virginia Port Authority is planning improvements to the PMT to support broadscale offshore wind development (COP, Section 3.3.2.6; Dominion Energy 2023).

Land uses and coastal infrastructure affected by construction of offshore components includes the PMT, which would be used to support component and construction vessel staging. The Proposed Action would also involve temporary construction laydown area(s) at port(s) in Europe or North America (COP, Section 3.1; Dominion Energy 2023). These ports are expected to be used during construction but have independent utility and would not be dedicated to the Proposed Action. Proposed uses at existing port facilities would be consistent with the current land uses occurring at these locations.

Activities associated with the Proposed Action construction would generate noise, vibration, and vehicular traffic at the ports temporarily used for construction described above. These impacts are typical for industrial ports and would not hinder other nearby land uses or use of coastal infrastructure.

Dominion Energy has evaluated several options to lease portions of existing facilities in the Hampton Roads, Virginia Region for an O&M facility for the Proposed Action. The selected lease location for an onshore O&M facility for the Proposed Action is Fairwinds Landing, which is on a brownfield site in Norfolk, Virginia (COP, Section 3.3.2.6; Dominion Energy 2023). Fairwinds Landing is an existing port facility operated by Norfolk Southern. Dominion Energy anticipates that they would require approximately 8 acres (3.2 hectares) with a building covering an area of up to approximately 0.8 acre (0.3 hectare), and a height of up to approximately 45 feet (13.7 meters) to meet the needs of an O&M facility for an offshore wind farm off the coast of Virginia (COP, Section 3.3.2.6; Dominion Energy 2023).

O&M of the Proposed Action offshore components would require daily activity at the chosen O&M facility. The increased activity at the chosen port and nearby areas would be consistent with current land uses and provide a source of investment in the coastal infrastructure.

Overall, the construction and installation of offshore components, O&M, and decommissioning for the Proposed Action alone would have minor beneficial impacts on land use and coastal infrastructure by supporting designated uses and infrastructure improvements at ports.

Presence of structures: WTGs could be visible from certain coastal and elevated mainland areas, depending on vegetation, topography, and atmospheric conditions for both the Proposed Action. WTGs would not dominate offshore views as a result of their proposed distance from shore, even under ideal weather and atmospheric conditions for viewing. The Proposed Action alone would have a long-term, continuous, minor impact on land use and coastal infrastructure in the geographic analysis area due to views of WTGs and the potential effects on property use and value.

The visual impacts of the WTGs from the Proposed Action, as well as other future offshore wind development, visible from coastlines and elevated inland locations, could have long-term impacts on land use if the views influence visitor decisions on locations or properties to visit or purchase. Portions of up to 202 WTGs from the Proposed Action and portions of the Kitty Hawk Offshore Wind Projects could be visible from coastal and elevated locations near the geographic analysis area. As noted in Section 3.18, *Recreation and Tourism*, impacts on recreation and tourism activities would be minor. Accordingly, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined visual impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be localized, long term, and minor to moderate.

The cable landing location of the Proposed Action is located on a proposed surface parking lot that is on an SMR.[3] The onshore cable route crosses several water bodies, including Lake Christine, where HDD would be used for construction. The entry and exit pits for the HDD construction would be located on previously disturbed lands and along roadways, to the extent practicable, which would minimize impacts to land use. The Proposed Action interconnection cable infrastructure would be installed either fully overhead (Interconnection Cable Route Option 1) or via a hybrid of overhead and underground installation methods (Interconnection Cable Route Option 6). The interconnection cable route variations cross federal property in some areas and also city-owned land, including the Virginia Beach National Golf Club; however, installation corridors would be predominantly located within existing roadways to minimize impacts on existing land use. Because the offshore export cable route and interconnection cable routes would follow mostly existing road rights-of-way, there would be minimal impacts on existing land uses. Where the onshore cable routes would cross currently undeveloped areas, there would be a permanent conversion of land to utility right-of-way or easement. The height of the overhead cables for all interconnection cable route option would be between 75 feet (22.9 meters) and 170 feet (51.8 meters), which would be well above the minimum height required by Virginia Administrative Code (Code of Virginia § 33.2-210) and sight lines.

The Harpers Switching Station would require approximately 5.5 acres (2.2 hectares) for stormwater management facilities, approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the adjacent golf course, and 0.93 acre (0.4 hectare) for relocation of Dewey Drive. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station (COP, Section 3.3.2.3; Dominion Energy 2023). Approximately 27.02 acres (10.9 hectares) of tree clearing would be required to support relocation of the fairways, construction of the maintenance building, relocation of Dewey Road, construction of stormwater management facilities, and the footprint of Harpers Switching Station. However, the location of the Harpers Switching Station is on and near previously disturbed land and would result in minimal or no changes to existing land use. The onshore substation would be developed through upgrades and expansion of an existing substation. The

[3] The SMR plans to independently build the parking lot. The parking lot is not expected to be developed as part of the proposed Project. The operational footprint for the cable landing location is anticipated to be approximately 2.8 acres (1.1 hectares).

parcel identified for the onshore substation contains forested land, and some vegetation removal would be necessary to accommodate the proposed upgrades/expansion of the onshore substation. However, the proposed upgrades/expansion of the onshore substation would be consistent with existing uses due to the presence of an existing substation, as well as transmission lines to the north and northeast of the onshore substation site (COP, Section 4.4.3.1; Dominion Energy 2023).

Landfall construction methods would minimize land use impacts and areas would be restored to their previous condition after construction. Temporarily increased noise levels, lighting, and traffic during construction may affect local sensitive receptors (e.g., schools, medical facilities), but would be minimized through BMPs and would not change existing land uses. Dominion Energy has committed to implementing a construction schedule to minimize impacts to the extent practicable where appropriate and as deemed necessary by local authorities (COP, Section 4.4.4.2; Dominion Energy 2023). This would include coordination with localities, including the Virginia SMR.

Land disturbance: Based on the existing conditions along the proposed onshore export cable route, the Project would use a combination of open trenches, HDD, and duct banks at varying depths along the selected route (COP, Section 3.4.2.1; Dominion Energy 2023). Construction and installation of the interconnection cable would include a combination of vibrated/driven pipe piles and open trench interconnect ducting depending on the interconnection cable route option.

Installation of the cable landfall sites, cable routes, and construction and expansion of the switching station and substation would temporarily disturb neighboring land uses through construction noise, vibration, dust, and travel delays along the affected roads. These impacts are anticipated to last for the duration of construction; following construction, the cable route corridors and temporary staging areas for switching station and substation construction would be returned to their previous condition and use. In particular, the portion of the parcel not required for long-term operation of the substation would be restored to previous conditions (COP, Section 4.4.3.2; Dominion Energy 2023). The corridors would be maintained through regular vegetation trimming and herbicide application. Installation of the onshore export and interconnection cables would occur within temporary construction corridors. The maximum area of temporary disturbance for the onshore export cable is approximately 26.6 acres (10.8 hectares) (COP, Section 4.4.3.2; Dominion Energy 2023).

Permanent disturbance: The total permanent disturbance for Interconnection Cable Route Option 1 to accommodate new permanent structures (i.e., transmission towers) would be 1.0 acre (0.4 hectare) (COP, Section 4.4.3.2; Dominion Energy 2023). O&M would not result in land disturbance except in the event that cable maintenance or replacement is required. Land use impacts would be minimized through the use of existing rights-of-way, co-locating Project components, using land that is primarily zoned for commercial or industrial development, and restoring areas to pre-disturbed conditions following construction (COP, Section 4.4.3.1; Dominion Energy 2023).

The Harpers Switching Station is located in industrial district. The onshore substation parcel is zoned A-1 Agricultural and R-15S Residential. Interconnection Cable Route Option 1 would travel from a common location north of Harpers Road to the onshore substation and would traverse mainly industrial, business, office, planned developments, residential, and agricultural districts (COP, Section 4.4.3.1; Dominion Energy 2023; City of Virginia Beach 2008, 2017). The construction of the interconnection cable route, new switching station, and expansion of the onshore substation would result in temporary and permanent impacts to land use. In order to implement a zoning use in a district that currently does not allow a specific use, a Conditional Use Permit is typically submitted to the local zoning department for review and approval. Under Virginia law, if a public utility is granted a Certificate of Public Convenience and Necessity from the Virginia State Corporation Commission, the Certificate of Public Convenience and Necessity approval shall be deemed to satisfy the requirements of all local zoning ordinance (COP, Section 4.4.3.1; Dominion Energy 2023; Code of Virginia § 56-265.2).

Noise: The Proposed Action would comply with Virginia Beach City and Chesapeake City Code noise regulations (COP, Section 4.1.4.1; Dominion Energy 2023), to the extent practicable, to minimize impacts on nearby communities. Typical construction equipment ranges from a generator or refrigerator unit at 73 A-weighted decibels (dBA) at 50 feet to an impact pile driver at 101 dBA at 50 feet. Given the extended distances between the Offshore Project area and coastal shorelines (approximately 28 and 42 miles [45 and 67 kilometers]), noise from offshore construction is not expected to result in negative impacts in the Onshore Project area (COP, Section 4.1.4.2; Dominion Energy 2023). Temporarily increased noise levels during construction of onshore components 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.

Traffic: Cable installation within the roadway under the Proposed Action could result in temporary traffic impacts such as lane closures, shifted traffic patterns, or closed roadways with temporary detours. Best management practices and maintenance of traffic plans would be developed and coordinated with local and state agencies. Traffic impacts would be limited to the immediate construction area. Roadways would be returned to pre-construction conditions and changes to the existing land use would not result. Prior to beginning construction, Dominion Energy would develop a Traffic Management Plan to offset any traffic-related impacts as applicable to offset any anticipated traffic-related impacts. Traffic-related impacts include Project-related construction, temporary modifications to roadway traffic patterns during construction, and an increase in O&M vehicle traffic. The Traffic Management Plan would include, but would not be limited to, highly visible markings, signage, and lighting of active construction sites construction parking areas, and development of vehicular travel routes to and from construction sites (COP, Section 4.4.4.2; Dominion Energy 2023).

3.14.5.1. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the accidental release impacts on land use and coastal infrastructure from ongoing and planned activities would increase the risk of (and, thus, the potential impacts from) accidental releases of fuel/fluids/hazardous materials in the geographic analysis area and would result in localized, short-term, negligible to minor impacts on land use and coastal infrastructure.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to WTG lighting impacts on land use and coastal infrastructure from ongoing and planned activities would be continuous, long term and negligible.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts on land use and coastal infrastructure from ongoing and planned activities would have long-term, minor beneficial impacts. Future offshore wind development, including the Proposed Action, would require port facilities for shipping, berthing, and staging, and development activities would support ongoing or new activity at authorized ports.

In context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action to the combined onshore transmission cable infrastructure impacts on land use and coastal infrastructure from ongoing and planned activities are anticipated to be minor. Assuming that new switching stations or substations for offshore wind projects would be in locations designated for industrial or utility uses, and above or belowground cable conduits would primarily be co-located with roads or other utilities, operation of switching stations, substations and cable conduits would not affect the established and planned land uses for a local area.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the land disturbance impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be minor due to construction-related disturbance, access limitations along the cable routes, and land use changes due to the construction of the switching station and onshore substation expansion. Impacts on land use and coastal infrastructure would be additive if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity.

Construction of onshore components of new offshore wind projects near 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.

Impacts on land use and coastal infrastructure would be additive only if construction associated with one or more other projects generates traffic in close spatial and temporal proximity. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to traffic impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be minor, localized, and short term.

3.14.5.2. Conclusions

Impacts of the 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, minor impacts resulting from land disturbance during onshore installation of the cable route and resulting from land use changes from the construction and expansion of the switching station 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.

Cumulative impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, impacts resulting from individual IPFs would range from **negligible** to **minor** adverse and **negligible** to **minor beneficial** impacts. Considering all of the IPFs collectively, BOEM anticipates that the contribution of the Proposed Action to the impacts associated with ongoing and planned activities would result in **minor** adverse impacts and **minor** beneficial impacts on land use and coastal infrastructure in the geographic analysis area. The main drivers for this impact rating are the beneficial impacts of port utilization, minor impacts on the viewshed due to the presence of offshore structures, and minor impacts of land disturbance and land use change. The Proposed Action would contribute to the overall impact rating primarily through short-term impacts from onshore landfall, cable, switching station, and substation installation, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

3.14.6 Impacts of Alternatives B and C on Land Use and Coastal Infrastructure

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, described in this section.

Impacts of Alternatives B and C. The impacts resulting from individual IPFs on land use and coastal infrastructure under Alternatives B and C would be the same as those described under the Proposed Action except for the presence of structures. Compared to the Proposed Action, Alternative B would remove 29 WTGs (for a total of up to 176 WTGs with seven locations identified as spares). Alternative C would remove 33 WTGs (for a total of up to 172 WTGs) from the Offshore Project area. All other offshore and onshore projects components would stay the same. As a result, Alternatives B and C would slightly modify the visibility of the WTGs from coastal and elevated onshore areas in the geographic analysis area, which could affect the potential effects on property use and values compared to the Proposed Action. However, as under the Proposed Action, the majority of the WTGs would still be visible, and there would be no meaningful difference in impacts on land use and coastal infrastructure.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as that of the Proposed Action.

3.14.6.1. Conclusions

Impacts of Alternatives B and C. Alternatives B and C would decrease the number of WTGs, resulting in slightly decreased visual impacts of WTGs on coastal communities compared to the Proposed Action but would not change the overall impact magnitudes. Impacts on land use and coastal infrastructure would be long-term and range from **negligible** to **minor** with **minor** beneficial impacts. Impact ratings associated with individual IPFs would not change.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as that of the Proposed Action, ranging from **negligible** to **minor** impacts for onshore land use and infrastructure and **minor beneficial** impacts. The overall impacts of Alternative B and C combined with ongoing and planned activities on land use would be similar to those of the Proposed Action: **minor** adverse impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change.

3.14.7 Impacts of Alternative D on Land Use and Coastal Infrastructure

Impacts of Alternative D. The impacts resulting from the majority of IPFs on land use and coastal infrastructure under Alternative D would be the same as those described under the Proposed Action except for land disturbance. Alternative D-2 would approve only the Hybrid Interconnection Cable Route Option 6, which would connect with the switching station north of Princess Anne Road (Chicory Switching Station). Alternative D-1 would approve only Interconnection Cable Route Option 1, which would connect with the Harpers Switching Station. The Chicory Switching Station would be located in agricultural and residential districts and would have a smaller total footprint at 35.5 acres (14.4 hectares) than the Harpers Switching Station (46.5 acres or 18.8 hectares), which would be located within an industrial district (COP, Section 3.3.2.3; Dominion Energy 2023). The temporary construction and installation corridors for Interconnection Cable Route Option 1 (Alternative D-1) and Hybrid Interconnection Cable Route Option 6 (Alternative D-2) is anticipated to be the same: 29.0 acres (11.7 hectares), inclusive of existing and proposed rights-of-way and access roads (COP, Section 3.4.2.3; Dominion Energy 2023). However, the Chicory Switching Station location associated with Hybrid Interconnection Cable Route Option 6 (Alternative D-2) would be in a less-disturbed area than the Harpers Switching Station associated with overhead Interconnection Cable Route Option 1 (Alternative D-1). Overall, Alternative D-1 would result in the fewer land-disturbing impacts from construction of the onshore components followed by Hybrid Interconnection Cable Route Option 6 (Alternative D-2).

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action.

3.14.7.1. Conclusions

Impacts of Alternative D. The Proposed Action and Alternative D considers two interconnection cable route options. The Chicory Switching Station location associated with Hybrid Interconnection Cable Route Option 6 (Alternative D-2) covers a smaller footprint but would be in a less disturbed area than the Harpers Switching Station associated with overhead Interconnection Cable Route Option 1 (Alternative D-1). Impacts on land use and coastal infrastructure would range from **negligible** to **minor** with **minor beneficial** impacts. Impact ratings associated with individual IPFs would not change.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action, long-term and ranging from **negligible** to **minor** impacts for onshore land use and infrastructure and **minor beneficial** impacts. The overall impacts of Alternative D combined with ongoing and planned activities for land use would also be the same as those of the Proposed Action: long-term **minor** adverse impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change.

3.14.8 Agency-Required Mitigation Measures

No measures to mitigate impacts on land use have been proposed for analysis.

3.15 Marine Mammals

This section discusses marine mammal resources in the geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and illustrated on Figure 3.15-1, specifically the Scotian Shelf, Northeast Shelf, and Southeast Shelf LME. This area is intended to capture the general movement range for the marine mammal species that could be affected by the Project.

3.15.1 Description of the Affected Environment for Marine Mammals

Marine mammals are highly mobile animals that typically use the waters of the Project area for a range of life-sustaining activities, including migration, foraging, mating, and giving birth; some individuals may remain year-round in the area while others are transitory. Species occurrence in the Project area is not uniform as some species are pelagic and occur farther offshore, some are coastal and are found nearshore, and others occur in both near and offshore areas. Additionally, some species prefer offshore continental shelf waters either seasonally or while feeding due to changes in the abundance and locations of their prey species; however, at other times of the year, these same species can occur in shallower depths closer to shore.

A total of 38 marine mammal species, including 7 large whale, 20 dolphin (includes two distinct common bottlenose dolphin [*Tursiops truncates*] stocks[1]), 5 beaked whale, 1 porpoise, 1 manatee, and 4 seal species, are known to occur year-round, seasonally, and/or incidentally in the Mid-Atlantic OCS, which encompasses the Project area (Table 3.15-1). Current species abundance estimates can be found in the NOAA marine mammal stock assessment reports (SAR) (Hayes et al. 2019, 2020, 2022, 2023; Pace 2021), which use data from a photo-identification recapture database for North Atlantic right whales (*Eubalaena glacialis*) (NARWs), with available records through January 2021; the 2016 NOAA shipboard and aerial surveys; and the 2016 Northeast Fisheries Science Center (NEFSC) and Department of Fisheries and Oceans Canada survey (Hayes et al. 2023). These reports indicate generally patchy and seasonally variable marine mammal density in the Mid-Atlantic OCS region. Table 3.15-1 summarizes the presence, distribution, and population status of marine mammal species known to occur in and around the Offshore Project area. Density estimates for all species that are common or uncommon in the Project area are also provided in the Letter of Authorization (LOA) application addendum dated December 2022 (Tetra Tech 2022b).

[1] The MMPA defines a marine mammal stock as a group of individuals "of the same species or smaller taxa in a common spatial arrangement that interbreed when mature."

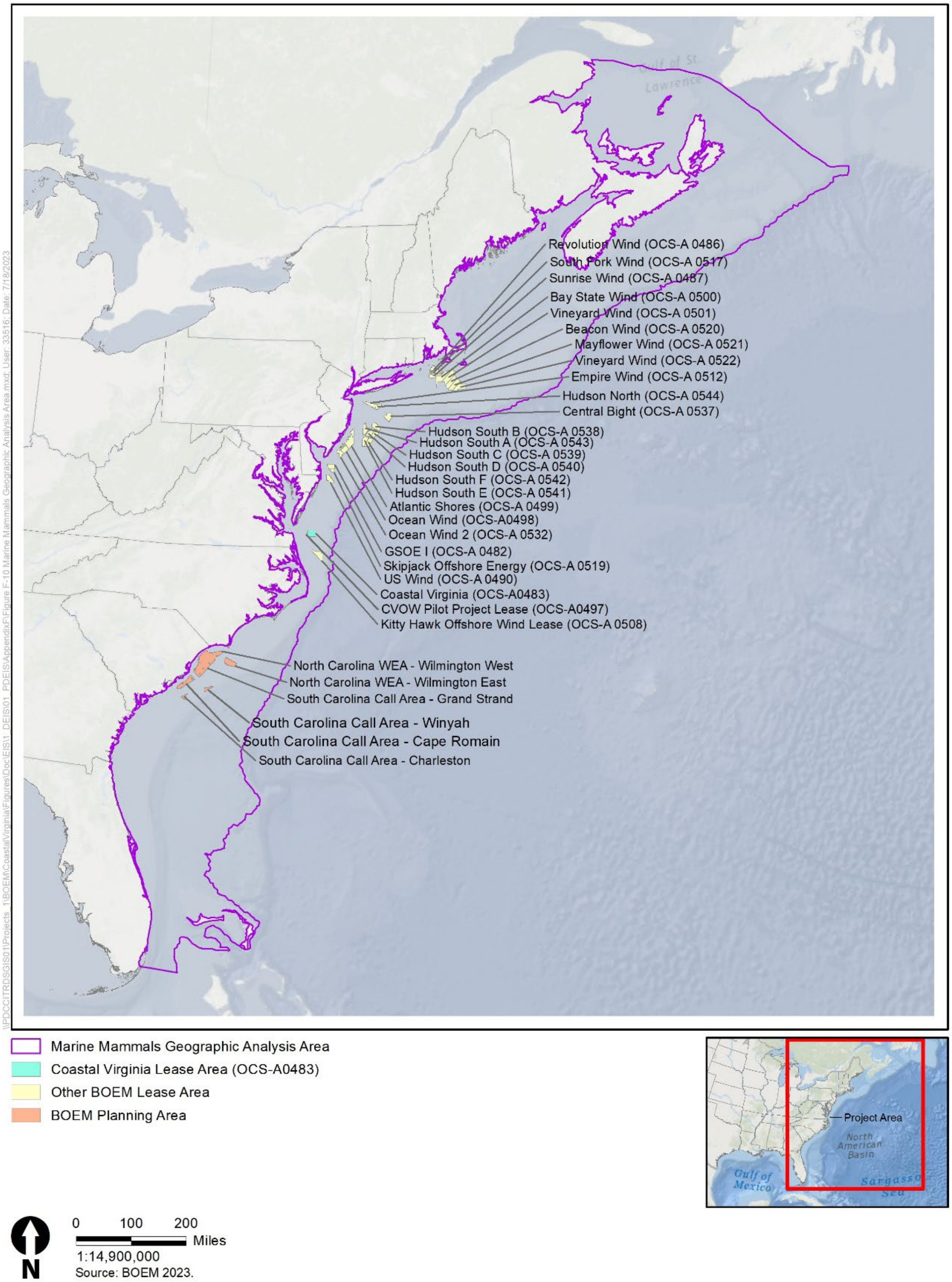


Figure 3.15-1 Marine Mammals Geographic Analysis Area

Table 3.15-1 Presence, Distribution, and Population Status of Marine Mammal Species Known to Occur in Coastal and Oceanic Waters of Virginia Around the Project Area

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status
Odontocetes (Toothed Whales)							
Phocoenidae (Porpoises)							
Harbor Porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	95,543	Shallow nearshore, coastal, and continental shelf waters	Uncommon	Winter/ Spring	MMPA–non-strategic
Delphinidae (Dolphins)							
Atlantic Spotted Dolphin	*Stenella frontalis*	Western North Atlantic	39,921	Continental shelf and slope	Common	Year-Round	MMPA–non-strategic
Atlantic White-Sided Dolphin	*Lagenorhynchus acutus*	Western North Atlantic	93,233	Continental shelf and slope	Uncommon	Winter/ Spring	MMPA–non-strategic
Common Bottlenose Dolphin	*Tursiops truncatus*	Western North Atlantic, Offshore	62,851	Outer continental shelf and slope, >82-foot (>25-meter) water depth	Common	Year-Round	MMPA–non-strategic
		Western North Atlantic, Southern Migratory Coastal	3,751	Shallow, inshore and nearshore, estuarine and coastal waters	Common	Year-Round	MMPA–strategic
Clymene Dolphin	*Stenella clymene*	Western North Atlantic	4,237	Continental shelf, shelf break, slope, and >656-foot (>200-meter) water depth	Uncommon	Summer	MMPA–non-strategic
Common Dolphin	*Delphinus delphis*	Western North Atlantic	172,974	Continental shelf and slope	Common	Year-Round	MMPA–non-strategic

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status
Dwarf Sperm Whale	*Kogia sima*	Western North Atlantic	7,750	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Variable	MMPA–non-strategic
False Killer Whale	*Pseudorca crassidens*	Western North Atlantic	1,791	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Variable	MMPA–non-strategic
Fraser's Dolphin	*Lagenorhynchus hosei*	Western North Atlantic	Unknown	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Variable	MMPA–non-strategic
Killer Whale	*Orcinus orca*	Western North Atlantic	Unknown	Continental shelf and deeper, offshore waters	Rare	Year-Round	MMPA–non-strategic
Long-Finned Whale	*Globicephala melas*	Western North Atlantic	39,215	Continental shelf	Common	Year-Round	MMPA–non-strategic
Short-Finned Whale	*Globicephala macrorhynchus*	Western North Atlantic	28,924	Continental shelf	Common	Year-Round	MMPA–non-strategic
Pan-Tropical Spotted Dolphin	*Stenella attenuata*	Western North Atlantic	6,593	Deeper, offshore waters	Uncommon	Summer	MMPA–non-strategic
Melon-Headed Whale	*Peponocephala electra*	Western North Atlantic	Unknown	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Variable	MMPA–non-strategic
Pygmy Killer Whale	*Feresa attenuata*	Western North Atlantic	Unknown	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Variable	MMPA–non-strategic

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status
Pygmy Sperm Whale	*Kogia breviceps*	Western North Atlantic	7,750	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Year-Round	MMPA–non-strategic
Risso's Dolphin	*Grampus griseus*	Western North Atlantic	35,215	Continental shelf	Common	Year-Round	MMPA–non-strategic
Rough Toothed Dolphin	*Steno bredanensis*	Western North Atlantic	136	Continental shelf, shelf break, slope, and >656-foot (>200-meter) water depth	Uncommon	Year-Round	MMPA–non-strategic
Sperm Whale	*Physeter macrocephalus*	North Atlantic	4,349	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Uncommon	Year-Round	MMPA–strategic; ESA Endangered
Spinner Dolphin	*Stenella longirostris orientalis*	Western North Atlantic	4,102	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Uncommon	Year-Round	MMPA–non-strategic
Striped Dolphin	*Stenella coeruleoalba*	Western North Atlantic	67,036	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Uncommon	Year-Round	MMPA–non-strategic
White Beaked Dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	536,016	Continental shelf	Extralimital	Variable	MMPA–non-strategic
Ziphiidae (Beaked Whales)							
Blainville's Beaked Whale	*Mesoplodon densirostris*	Western North Atlantic	10,107	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Spring/ Summer	MMPA–non-strategic
Cuvier's Beaked Whale	*Ziphius cavirostris*	Western North Atlantic	5,744	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Variable	MMPA–non-strategic

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status
Gervais' Beaked Whale	*Mesoplodon europaeus*	Western North Atlantic	10,107	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Spring/ Summer	MMPA–non-strategic
Sowerby's Beaked Whale	*Mesoplodon bidens*	Western North Atlantic	10,107	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Variable	MMPA–non-strategic
True's Beaked Whale	*Mesoplodon mirus*	Western North Atlantic	10,107	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Rare	Spring/ Summer	MMPA–non-strategic
Mysticetes (Baleen Whales)							
Blue Whale	*Balaenoptera musculus*	Western North Atlantic	402[2]	Continental shelf break, slope, and >656-foot (>200-meter (water depth	Uncommon	Year-Round	MMPA–strategic; ESA Endangered
Fin Whale	*Balaenoptera physalus*	Western North Atlantic	6,802	Continental shelf break, slope, and >656-foot (>200-meter) water depth	Common	Year-Round	MMPA–strategic; ESA Endangered
Humpback Whale	*Megaptera novaeangliae*	Gulf of Maine	1,396	Continental shelf and coastal waters	Common	Year-Round	MMPA—non-strategic[3]
Minke Whale	*Balaenoptera acutorostrata*	Canadian East Coast	21,968	Continental shelf, slope, and coastal waters	Common	Year-Round	MMPA–non-strategic
Sei Whale	*Balaenoptera borealis*	Nova Scotia	6,292	Continental shelf, shelf break, and slope	Uncommon	Summer/ Fall/Winter	MMPA–strategic; ESA Endangered

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Relative Occurrence in Project Area[1]	Seasonality	Federal MMPA and ESA Population Status
Balaenidae (Right and Bowhead Whales)							
North Atlantic Right Whale	*Eubalaena glacialis*	Western Atlantic	338	Continental shelf and coastal waters	Common	Year-Round[4]	MMPA–strategic; ESA Endangered
Sirenia (Sea Cows)							
Trichechidae (Manatees)							
West Indian Manatee	*Trichechus manatus*	Florida	8,810[5]	Coastal, bays, estuaries, and inlets	Rare	Summer/Fall	MMPA–strategic; ESA Threatened
Pinnipeds (Eared and Earless Seals)							
Phocidae (Earless Seals)							
Gray Seal	*Halichoerus grypus*	Western North Atlantic	27,300	Coastal, bays, estuaries, and inlets	Uncommon	Fall/Winter/ Spring	MMPA–non-strategic
Harbor Seal	*Phoca vitulina*	Western North Atlantic	61,336	Coastal, bays, estuaries, and inlets	Common	Fall/Winter/ Spring	MMPA–non-strategic
Harp Seal	*Pagophilus groenlandicus*	Western North Atlantic	Unknown	Coastal, bays, estuaries, and inlets	Rare	Winter/ Spring	MMPA–non-strategic
Hooded Seal	*Cystophora cristata*	Western North Atlantic	Unknown	Coastal, bays, estuaries, and inlets	Extralimital	Summer/Fall	MMPA–non-strategic

Sources: Hayes et al. 2019, 2020, 2021, 2022, 2023; Roberts et al. 2018, 2020, 2023; USFWS 2023; VDWR 2020.

[1] Relative occurrence defined as:

Common: species sightings regularly documented year-round or seasonally. Project area within typical range of the species.

Uncommon: species sightings occasionally documented year-round or seasonally. Project area within typical range of the species.

Rare: occasional or sporadic species sightings or stranding reports. Project area is at the outer extent of typical range of the species.

Extralimital: few species sightings or only stranding reports have been documented. Project area considered outside the typical range of the species.

[2] No best population estimate exists for the blue whale (*Balaenoptera musculus*); the minimum population estimate is presented here (Hayes et al. 2021).

[3] The humpback whale (*Megaptera novaeangliae*) was previously federally listed as endangered; however, based on the revised listing completed by NOAA Fisheries in 2016, the DPS of humpback whales that occurs along the East Coast of the United States, the West Indies DPS, is no longer considered endangered or threatened. The Commonwealth of Virginia has retained the endangered state-listing status for the humpback whale.

[4] NARWs have the potential to occur in the Project area year-round; the overall likelihood of occurrence is highest during the late winter and early spring.

[5] Best population estimate is provided for the West Indian manatee (*Trichechus manatus*) Florida subspecies (*T. m. latirostris*), which is the only subspecies with a range that overlaps with the Project area.

The *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment 2021* (Hayes et al. 2022) and *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment 2022* (Hayes et al. 2023) indicated that there are insufficient data to determine population trends for most marine mammal species found regularly in the coastal and oceanic waters of Virginia. However, there are data that show the NARW population declined in abundance from 2011 to 2020. During the 2023 calving season (defined as calves born between mid-November 2022 and mid-April 2023), 12 calves were observed (down from 15 during the 2022 season and 20 during the 2021 season; NMFS 2023a). However, births remain significantly below what is expected, and the species continues to be in decline (Pettis et al. 2021, 2022; Pace 2021). Data indicate a 29.7 percent decline in annual abundance since 2011 (NMFS 2023a). The total annual average observed human-caused mortality and serious injury for the NARW is 8.1 individuals per year, averaged over the period between 2016 and 2020, though this likely represents an underestimate as not all mortalities are recorded (Hayes et al. 2023). Modeling using the 2015 to 2019 estimated annual means to account for undetected mortality and serious injury suggests the mortality rate could be as high as 31.2 animals per year (Hayes et al. 2023). Importantly, NARW mortalities exceed the species' calculated potential biological removal (0.7 individuals per year). When coupled with the species' low fecundity and small population size, all human-caused mortalities have the potential to impact their population status. There have been elevated numbers of NARW mortalities and injuries reported since 2017, which prompted NMFS to designate an Unusual Mortality Event (UME) for NARWs (NMFS 2023b). These elevated mortalities and injuries have continued into 2023, totaling 36 mortalities, 34 serious injuries, and 45 sublethal injuries or illness to date (NMFS 2023b). Entanglement in fishing gear and vessel strikes are the preliminary cause of mortality, serious injury, and morbidity (sublethal injury and illness) in most of these whales during the ongoing UME. The humpback whale (*Megaptera novaeangliae*) was previously federally listed as endangered. However, based on the revised listing completed by NOAA in 2016, the Distinct Population Segment (DPS) of humpback whales that occurs along the East Coast of the United States (West Indies DPS; inclusive of the Gulf of Maine Stock, which occurs in the Project area) is no longer considered endangered or threatened (Hayes et al. 2020, 2021). The Commonwealth of Virginia has retained the endangered state-listing status for the humpback whale (VDWR 2020). The Gulf of Maine stock exhibits a positive population trend, with an estimated increase in abundance of 2.8 percent per year (Hayes et al. 2020). A UME has also been established for humpback whales (NMFS 2023c), minke whales (NMFS 2023d), the Florida manatee (*Trichechus manatus latirostris;* NMFS 2023e), and Northeast pinnipeds for harbor seal (*Phoca vitulina)* and gray seal (*Halichoerus grypus)* populations along the southern and central coast of Maine (NMFS 2023f) within the geographic analysis area.

All marine mammal species are protected under the Marine Mammal Protection Act of 1972, as amended in 1994. Of the 38 species known to occur in the Project area year-round, seasonally, or incidentally, 6 are listed under the ESA: sperm whale (*Physeter macrocephalus*), NARW, fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), and West Indian manatee (*Trichechus manatus*). Generally, the ESA-listed whale species are migratory and, as such, were historically thought to be present seasonally. However, they are increasingly seen throughout the summer and fall months while foraging and in the winter while migrating to warmer waters. Additionally, some individuals from the larger whale species are known to remain year-round (Salisbury et al. 2016, 2018).

NARW have the potential to occur in the Project area year-round. The offshore waters of Virginia, including waters within the Project area, are used as a migration corridor for NARW and are considered a Biologically Important Area (BIA[2]) for migration between their Northwest Atlantic feeding grounds and their calving grounds off the Southeast United States (LaBrecque et al. 2015). Increasingly important

[2] BIAs 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's Biologically Important Areas Map is available at https://cetsound.noaa.gov/biologically-important-area-map.

NARW foraging habitat exists on and in the vicinity of Nantucket Shoals off southern Massachusetts (Hayes 2022; O'Brien et al. 2022; Meyer-Gutbrod et al. 2021; Quintana-Rizzo et al. 2021). This region, however, is located approximately 400 miles (642 kilometers) northeast of the proposed Project area and would not be affected by Project activities. NARW have been observed and acoustically detected in coastal mid-Atlantic waters year-round; however, the relative abundance and density of NARW peaks in winter along the nearshore portions of the continental shelf, declines in late spring, and is lowest during summer and fall, according to predictive density mapping based on long-term survey data (Roberts et al. 2022, 2023; Tetra Tech 2022b). Fin whales are present year-round throughout Virginia's offshore waters, especially along the continental slope (Engelhaupt et al. 2020, 2021; Palka et al. 2021; Hayes et al. 2022). Likelihood of occurrence begins to increase in winter, peaks in spring and early summer, and declines in fall (Roberts et al. 2022, 2023; OBIS 2020). Using the definitions of occurrence from Table 3.15-1, fin whales are expected to be common year-round with higher likelihood for encounters during winter and spring, particularly along the eastern portion of the Lease Area (COP, Figure 4.2-25; Dominion Energy 2023). Though they may be present offshore Virginia year-round, the relative occurrence and density of humpback whales peaks in early spring along the continental slope, declines in summer, and is lowest in fall and early winter, according to predictive density mapping based on long-term survey data (Engelhaupt et al. 2020; Palka et al. 2021; Roberts et al. 2022, 2023). In general, sperm, blue, and sei whales are more pelagic or northern species, and their presence in the Project area is unlikely (Waring et al. 2007, 2009, 2012, 2013; Palka et al. 2021; Roberts et al. 2022, 2023).

Dolphins, especially some bottlenose stocks, have been observed in Virginia's coastal environment, particularly during warmer months (Gubbins 2002; Toth et al. 2011) and are likely to be common in the Project area (Palka et al. 2021). Other species such as Risso's dolphins (*Grampus griseus*) and common dolphins (*Delphinus delphis*) are likely to be present, but given their preference for deeper waters would be more likely to occur near the Lease Area offshore rather than nearshore portions of the cable corridor (Palka et al. 2021). The West Indian manatee may occasionally be encountered in waters off Virginia; the species is thermally dependent and occurrence in mid-Atlantic waters, though currently relatively rare, may increase as water temperatures and habitat conditions change in the future due to climate change (Cummings et al. 2014; USFWS 2023). Individuals present within the Project area could face risk of impacts from Project activities. However, given their very low abundance offshore Virginia and preference for coastal and estuarine habitats, including the Intracoastal Waterway (Cummings et al. 2014), the species is unlikely to be encountered during Project activities; the West Indian manatee is therefore not considered further in this document. There is a regular seasonal occurrence of seals, including harbor seals (*Phoca vitulina*) and gray seals (*Halichoerus grypus*), between fall and spring in the Project area (Navy Marine Species Monitoring 2018). Harbor seals are the predominantly observed pinniped species. Species that are not expected to occur in the Project area are not considered further in this Final EIS. Additional information regarding marine mammal species present in the Project area can be found in COP, Section 4.2.5.1 (Dominion Energy 2023), and Section 3.2.6.1 of the *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment* (BOEM 2015).

Critical habitat is designated for both the NARW (81 FR 4837) and West Indian manatee (42 FR 47840); however, no critical habitat is located in the Project area. Critical habitat for the NARW within the marine mammal geographic analysis area comprises the Gulf of Maine 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. 2023). The closest designated NARW critical habitat area is approximately 250 miles (400 kilometers) southwest of the Project area. Critical habitat within the geographic analysis area for the West Indian manatee is limited to Florida, with the nearest designated area approximately 560 miles (900 kilometers) southwest of the Project area. These critical habitat areas do not overlap with the Project area.

3.15.2 Environmental Consequences

3.15.2.1 Impact Level Definitions for Marine Mammals

Definitions of potential impact levels for adverse effects are provided in Table 3.15-2 and for intensity, extent, and reversibility are provided in

Table 3.15-3. Definitions for duration and significance criteria are provided in Section 3.3, *Definition of Impact Levels*. Beneficial impacts are also described, as applicable, for each IPF. Beneficial impacts are those that result in a positive effect on marine mammals. Impact levels are intended to serve NEPA purposes only and they are not intended to incorporate similar terms of art used in other statutory or regulatory reviews. For example, the term "negligible" is used for NEPA purposes as defined here and is not necessarily intended to indicate a negligible impact or effect under the MMPA. Similarly, the use of "detectable" or "measurable" in the NEPA significance criteria is not necessarily intended to indicate whether an effect is "insignificant" or "adverse" for purposes of ESA Section 7 consultation.

Table 3.15-2 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 3.15-3 Criteria Used to Characterize Impact Level Definitions for Marine Mammals

Criteria	Description	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 potential exceedances of underwater noise that meet Level B harassment (behavioral or temporary threshold shift [TTS]) thresholds. • Temporary disruption of critical activities (e.g., breeding, 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 potential exceedances of underwater noise that meet Level A harassment (permanent threshold shift [PTS]) thresholds and non-auditory injury thresholds for explosions. • One or more death or injury of an individual from a non-listed stock or population segment that does not result in population-level impacts. • 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 with high likelihood of exceeding 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 an individual from a species stock or population at risk. • 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 (WTGs and their foundations, OSSs and their foundations, scour protection for foundations, inter-array 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 (less than once per year) over the specified duration of the Project. **Frequent**: Effect occurs repeatedly (monthly to yearly) over the specified duration of the Project. **Continuous**: Effect occurs continuously (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.

3.15.3 Impacts of the No Action Alternative 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 activities and ongoing offshore wind activities as 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 F.

3.15.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, BOEM would not approve Dominion Energy's COP, and impacts from IPFs during construction, operation, and maintenance directly associated with the CVOW Project would not occur. The baseline conditions for marine mammals described in Section 3.15.1, *Description of the Affected Environment for Marine Mammals*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Hence, not approving the COP would have no additional incremental effect on marine mammals. Similarly, under the No Action Alternative, NMFS would not issue the requested incidental take authorization, which would also result in no additional incremental impact on marine mammals and their habitat.

Ongoing non-offshore wind activities that may affect marine mammals include, but are not limited to, submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, munitions training), marine transportation, research initiatives, and installation of new structures (such as artificial reefs) on the U.S. OCS. From these activities, marine mammals present in these areas are currently subject to a variety of ongoing human-generated IPFs. IPFs may result in a range of impact risks, from mortality to minor disturbance, and typically fall across a scale of risk depending on the activities and susceptibility of the species to impacts. Known contributors to mortality risk include collisions with vessels (ship strikes), entanglement with fishing gear, fisheries bycatch, and ingestion of marine debris and hazardous substances. Other IPFs not directly associated with mortality include underwater noise disturbance of marine and coastal environments and the disturbance of benthic habitats. Impacts associated with climate change have the potential to reduce long-term foraging and reproductive success, increase individual mortality and disease occurrence, and affect the distribution and abundance of prey resources due to changing water temperatures, ocean currents, and increased acidity (as outlined in BOEM 2019). Climate-related impacts, as well as vessel strike and fisheries interactions, could have population-level implications for some at-risk species. Many marine mammal distributions cover large spatial distances and rely on specific environmental conditions or resources during specific times of the year or life stages. These factors individually and in combination are susceptible to climate change and can influence individual survivorship and fecundity over broad geographical and temporal scales. IPFs with the potential to impact marine mammals within the geographic analysis area are briefly discussed in the sections that follow.

Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and have been identified as one of the primary causes of death for NARWs and humpback whales during the current and ongoing UMEs for both species (NMFS 2023b, 2023c). For NARW specifically, there have been a total of 12 mortalities, 2 serious injuries, and 2 sublethal injuries documented since the UME was declared in 2017 that have been attributed to vessel strikes (NMFS 2023c). Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world (Schoeman et al. 2020). Vessel speed and size are important factors for determining the probability and severity of vessel strikes. 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). Vanderlaan and Taggart (2007) reported that the probability of whale mortality increased with vessel speed, with the greatest increases occurring between 8.6 and 15 knots (16 and 28 kilometers per hour), and that the probability of death declined by 50 percent at speeds less than 11.8 knots (22 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 NARWs. Seasonal Management Areas require vessels 65 feet (19.8 meters) or larger to maintain speeds of 10 knots (18.5 kilometers per hour) or less and to avoid Seasonal Management Areas when possible. A proposed rule (87 FR 46921) would amend the existing rule to include vessels 35 feet (10.6 meters) and expand the Seasonal Management Areas. Additional voluntary 10-knot (18.5-kilometer-per-hour) speed restrictions are implemented for areas with aggregating NARWs outside of established Seasonal Management Areas in the form of Dynamic Management Areas and Slow Zones.

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; Reeves et al. 2013; Thomas et al. 2016). Entanglement in fishing gear is listed as a threat to humpback whales, NARWs, blue whales, fin whales, sei whales, common bottlenose dolphins, gray seals, and harbor seals (Hayes et al. 2020, 2021, 2022, 2023; NMFS 2023a). 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/NMFS entanglement/stranding database (Hayes et al. 2021, 2022). Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species' recovery (Knowlton et al. 2012; NMFS 2023c). NMFS estimates that over 85 percent of individuals have been entangled in fishing gear at least once (NMFS 2023g) and 60 percent of individuals show evidence of multiple fishing gear entanglements, with rates increasing over the past 30 years (King et al. 2021; Knowlton et al. 2012). Since the UME was declared for NARW in 2017, 76 of the 115 total mortalities, serious injuries, and sublethal injuries documented have been attributed to entanglements (NMFS 2023c). Marine mammals can also ingest or become entangled in marine debris (e.g., ropes, plastic) that is lost (i.e., ghost gear) from fishing vessels and other offshore activities. In the Atlantic, bycatch occurs in various gillnet and trawl fisheries off the Mid-Atlantic Coast, with hotspots driven by marine mammal density and fishing intensity (Benaka et al. 2019; Lewison et al. 2014). Small cetaceans and seals are at most risk of being caught as bycatch in various commercial, recreational, and subsistence fisheries due to their small body size, which allows them to be taken up in fishing gear. Additionally, bottom trawling and benthic disruption have the potential to result in impacts on prey availability and distribution.

In the marine mammal geographic analysis area, underwater noise from anthropogenic sources is expected to include offshore marine construction activities (including pile driving) related to wind and non-wind related development; vessel traffic from wind, commercial, military, research, and recreational sources; seismic surveys conducted on and outside the OCS; and military sonar and training activities. 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. 2021b). All noise sources that are audible by a given species have the potential to cause behavioral effects, and some sources of sufficient amplitudes may also cause a loss of hearing acuity when a mammal is exposed closer to the sound source or for extended durations. However, the long-term effects of multiple, contributory anthropogenic underwater noise stressors on marine mammals across their large geographical range are difficult to determine and relatively unknown. Further, the specific temporal and spatial aspects of contributing sources and the actual enumeration of noise-generating anthropogenic activities in the marine mammal geographic analysis is variable and highly generalized such that specific contributing noise stressors on specific populations are relatively difficult to quantify at the scales in which noise may be received by marine mammal populations. Therefore, marine mammals may be subjected to multiple anthropogenic noise stressors throughout their lifetimes that could disrupt critical life stages (e.g., feeding, breeding, calving) throughout their ranges, which could lead to detectable and measurable impacts on the individual.

The following ongoing offshore wind activities within the geographic analysis area would contribute to impacts on marine mammals:

- Continued O&M of the Block Island 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 and eventual O&M 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 Block Island and CVOW-Pilot projects and ongoing construction and eventual O&M of the Vineyard Wind 1 and South Fork projects would affect marine mammals through the primary IPFs of vessel traffic, noise, and presence of structures, which are described in detail in Section 3.15.3.2. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, cable emplacement and maintenance, port utilization, and lighting that are described in detail in Section 3.15.3.2 for planned offshore wind activities.

3.15.3.2 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 that may affect marine mammals include new submarine cables and pipelines, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, munitions training), marine transportation, biological and oceanographic research initiatives, and installation of new structures (such as artificial reefs) on the U.S. Continental Shelf (see Appendix F, Section F.2 for a description of ongoing and planned activities). These activities could result in displacement and injury to or mortality of individual marine mammals.

BOEM expects the combination of ongoing activities and reasonably foreseeable (planned) activities other than offshore wind to result in moderate impacts on marine mammal species, primarily driven by vessel traffic and ship strike risk, entanglement with fishing gear, anthropogenic (i.e., human introduced) noise, and climate change; these IPFs will likely result in impacts that are detectable and measurable, though populations are expected to sufficiently recover for species with annual mortality and serious injury below their respective potential biological removal value. For the NARW, given their current stock status, and estimated potential biological removal of 0.7, ongoing threats such as vessel strike and fishing gear entanglement can elevate collective impacts from ongoing activities and reasonably foreseeable activities other than offshore wind to major levels because a measurable impact is anticipated that could have population-level effects and compromise the viability of the species.

The IPFs deemed to have impacts on marine mammals are summarized herein for planned offshore wind activities on marine mammals during construction, O&M, and decommissioning of projects without the Proposed Action. This section provides a general description of these mechanisms, recognizing that the extent and significance of potential effects of planned offshore wind projects on conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed. Where appropriate, potential effects resulting from planned activities are generally characterized by comparison to effects resulting from approved projects that have been evaluated and are likely to be similar in nature. Planned activities with federal funding or approval would be subject to independent NEPA analyses and regulatory approvals. The environmental effects of other offshore wind energy development activities would be fully considered before BOEM makes a decision on the respective COP.

BOEM expects that planned offshore wind activities may affect marine mammals through the following IPFs.

Accidental releases: 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.

Polychlorinated biphenyls (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., Pierce et al. 2008; Jepson et al. 2016; Hall et al. 2018; Murphy et al. 2018); however, the population-level effects of these and other contaminants are unknown.

Planned offshore wind activities on the OCS could result in the accidental release of trash or contaminants associated primarily as related to vessel activity during Project construction, O&M, and decommissioning (see Section 3.21, *Water Quality*, for quantities and details). The inadvertent releases would contribute to the existing hazard posed by chronic marine pollution and debris. Entanglement in or ingestion of marine debris is a significant source of human-caused mortality in marine mammals. For example, ingested debris was documented in up to 22 percent of beached marine mammal carcasses. Autopsies identified blockage of the digestive tract, injury, and malnutrition caused by ingested debris as the likely cause of mortality (Baulch and Perry 2014). Approximately 50 percent of marine mammal species worldwide have been documented ingesting marine litter (Werner et al. 2016). However, it is difficult to link physiological effects on individuals to population-level impacts (Browne et al. 2015).

Vessels associated with planned offshore activities could generate exhaust and could be a source of potential accidental spills of petroleum-based toxics. Marine mammals that occur in the analysis area could be exposed to these contaminants. Inhalation of fumes from oil spills can result in mortality or sublethal effects on individual fitness, including adrenal effects, hematological effects, liver effects, lung disease, poor body condition, skin lesions, and several other health 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). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species. However, the likely number of additional 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. Although these effects are acknowledged, the likelihood of adverse population-level impacts on marine mammals from accidental releases of debris or contaminants from future activities on the OCS is low.

Current regulations and requirements imposed on federally approved activities prohibit vessels from dumping potentially harmful debris, require measures to avoid and minimize spills of toxic materials, and provide mechanisms for spill reporting and response. Based on these factors, accidental releases and discharges from ongoing and planned federally approved activities on the OCS are not expected to appreciably contribute to adverse marine mammal impacts.

Electromagnetic fields: In the planned activities scenario (excluding the Proposed Action), up to 5,499 miles (8,850 kilometers) of new offshore export cable, and 5,427 miles (8,734 kilometers) of new inter-array cable would be added in the marine mammal geographic analysis area, producing EMF in the immediate vicinity of each cable during operations (Appendix F, Table F2-1). Studies documented electric or magnetic sensitivity up to 0.05 microTesla for Earth's magnetic field for fin whale, humpback whale, sperm whale, bottlenose dolphin, common dolphin, long-fin pilot whale, Atlantic white-sided dolphin, striped dolphin (*Stenella coeruleoalba*), Atlantic spotted dolphin (*S. frontalis*), Risso's dolphin, and harbor porpoise (Normandeau et al. 2011). However, evidence used to make the determinations was only observed behaviorally/physiologically for bottlenose dolphins, and the remaining species were concluded based on theory or anatomical details. This analysis indicates that marine mammals may be sensitive to minor changes in EMFs (Walker et al. 2003).

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 offshore renewable energy projects. 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), and fiber-optic communications cables with optical repeaters would not produce EMF effects. Transmission cables using HVAC emit 10 times less magnetic field than HVDC (Taormina et al. 2018). Under the No Action Alternative, export cables would be added in other BOEM offshore wind leases and are presumed to include at least one identified cable route, which will produce EMF in the immediate vicinity of each cable during operations.

There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs, including a temporary change in swim direction following exposure to EMFs (Gill et al. 2005). These effects are more likely with exposure to HVDC cables versus HVAC cables (Normandeau et al. 2011). Submarine power cables, which produce EMFs in the immediate vicinity of each cable during operations, would be installed with appropriate shielding and burial depth to reduce potential EMFs at the surface. Submarine cables typically maintain a minimum separation of at least 330 feet (101 meters) to avoid inadvertent damage to existing infrastructure during installation. This separation distance ensures that there are no additive EMF effects from adjacent cables. Additionally, exposure to submarine cable EMFs would be limited to extremely small portions of the areas used by migrating marine mammals. Therefore, EMF exposure from ongoing and planned offshore wind projects is anticipated to be low, and impacts such as changes in swimming direction and altered migration routes would not be biologically notable.

New cable emplacement/maintenance: Planned offshore wind projects could disturb over 177,718[3] acres (71,919 hectares) of seabed while installing associated undersea cables, causing an increase in suspended sediment (Appendix F, Table F2-2). Typical activities associated with cable installation that have variable potential to increase suspended sediment in the water column include jet trenching, cable ploughs, and dredging operations, including use of a trailing hopper suction dredge. Local site conditions, including seabed type and local currents and wave conditions, can also affect the volume of seabed sediment disturbed and brought into suspension (BERR 2008). Those effects would be similar in nature to those observed during construction of the Block Island Wind Farm (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. These disturbances, therefore, would be localized in extent and limited in magnitude and duration. Data describing behavioral responses of marine mammals to localized turbidity plumes are limited, but available information suggests that most species would be insensitive to the associated changes in visibility. For example, visual impairment does not appear to negatively affect the ability of gray and harbor seals to forage and move effectively (McConnell et al. 1999; Newby et al. 1970; Todd et al. 2015). Behavioral responses and impacts related to increased turbidity are expected to be temporary and short term for ongoing and planned offshore wind projects.

Research on the total suspended solids (TSS), sensitivity of other marine mammal species such as dolphins and large whales is generally lacking. However, these species have developed echolocation for communicating, foraging, and navigating by evolving in an environment with variable and predominantly low visibility (Tyack and Miller 2002). This suggests that temporary reduction in visibility would not drastically impair behavior. Even if marine mammals were to alter their behavior in response to elevated TSS (e.g., by avoiding the disturbance and/or interrupting foraging), any potential exposures would be localized in extent, limited in magnitude, and short term, and therefore unlikely to result in biologically notable effects. Implementation of standard mitigation measures, such as minimum separation distances, would further reduce effects on marine mammals. Although marine mammal entrainment during cable emplacement activities is not expected, these mitigation measures would further reduce the potential risk to marine mammals. Therefore, the anticipated effects of seabed disturbance from ongoing and planned

[3] Kitty Hawk South has three export cables (57 miles [92 kilometers] to Virginia, 299 miles [322 kilometers] to North Carolina, and an additional 96 miles [154 kilometers] of inshore export cable to North Carolina) for a total of 352.9 miles (568 kilometers), and corridor widths between 1,520 miles (2,446 kilometers) (to Virginia) and 1,000 miles (1,609 kilometers) (to North Carolina) to allow for optimal routing of the cables.

offshore wind projects on marine mammals are likely to result in short-term, localized consequences to individuals that are detectable and measurable but do not lead to population-level effects.

Noise: Marine mammals rely on acoustics for communication, foraging, mating, predator avoidance, and navigation (Madsen et al. 2006; Weilgart 2007). A detailed discussion of marine mammal hearing anatomy is provided in Appendix J, *Overview of Acoustic Modeling Report*, Section J.2.6.1. Offshore wind activities may negatively affect marine mammals if the sound frequencies produced overlap with the functional hearing range of the animal exposed (NSF and USGS 2011). To account for differences in hearing among species, Southall et al. (2007) grouped marine mammals into five generalized hearing groups (low-frequency cetaceans [LFC], mid-frequency cetaceans [MFC], high-frequency cetaceans [HFC], phocid pinnipeds in water [PPW], and otariid pinnipeds in water [OW]) which have been adopted by NMFS for the purposes of assessing the potential for hearing impairment from underwater noise. No species from the OW hearing group (i.e., eared seals) are expected to occur in the Project area, and these species are not discussed further. A summary of estimated hearing ranges for marine mammal hearing groups from NMFS (2018) is provided in Table 3.15-4.

Noise exposure can cause responses ranging from low-level behavioral effects like temporary avoidance, moderate behavioral effects like interference with communication, foraging, mating, predator avoidance, and navigation (Madsen et al. 2006; Weilgart 2007; Southall et al. 2019) to auditory fatigue (TTS) or auditory injury (PTS) (Southall et al. 2019). The potential for noise to affect marine mammals will depend on the noise source type; spectral and propagation properties of the noise; the noise level to which an animal is exposed; the duration of the exposure; and the context (e.g., life stage, activity, ambient conditions, previous exposures) of the animal at time of exposure. Sources of anthropogenic noise can generally be categorized in two ways: impulsive noise, which is characterized by an instantaneous and rapid increase in sound pressure over a short period of time, and non-impulsive noise, which does not have the characteristic rapid rise in sound pressure seen in impulsive sources. Noise can also be characterized as intermittent or continuous depending on how often noise is generated over time. Both types of noise may be produced by activities related to planned offshore wind projects. Acoustic thresholds, which represent the minimal sound level at which the onset of a particular effect may occur, are available for both impulsive and non-impulsive noise and each marine mammal hearing group from NMFS (2018), as provided in Table 3.15-5. Animals are less likely to respond to sound levels when distant from a source, even when those levels elicit responses at closer ranges; therefore, both proximity and received levels are important factors when evaluating animal responses (Dunlop et al. 2017).

Impact and vibratory pile driving: Noise from foundation pile installation generates noise at intensities that may meet or exceed marine mammal acoustic thresholds for some species. The physical qualities of pile-driving noise are described in Appendix J, *Overview of Acoustic Modeling Report*. The effects would vary in extent and intensity based on the scale and design of each project, the schedule of project activities, and proximity of projects. If projects have overlapping construction schedules within a given BOEM wind energy area and pile-driving activities occur concurrently, an individual marine mammal could be exposed to the sounds from more than one pile-driving event within a given time period, or be exposed to pile-driving sounds over larger geographic areas. Concurrent pile-driving scenarios would increase the spatial extent of noise that is introduced into the marine environment at any given time, but would decrease the total number of days that any given project area within the geographic analysis area is ensonified. Results from Southall et al. (2021a) showed that concurrent construction of multiple windfarms, if scheduled to avoid critical periods when marine mammals (e.g., NARWs) are present in higher densities, minimizes the overall risk to the species'. For staggered construction schedules within a wind energy area, individual marine mammals could be exposed to pile-driving noise on different days within the same year. This would increase the total number of exposure days, but would likely occur intermittently over an animal's range. Given the migratory movements and seasonal abundances of marine mammals throughout the geographic analysis area, it is likely that some individuals would be exposed to multiple days of construction noise within the same year.

Table 3.15-4 Estimated Hearing Ranges for Marine Mammal Hearing Groups

Marine Mammal Hearing Group	Estimated Hearing Range	Representative Species
Low-frequency cetaceans	7 hertz to 35 kilohertz	Baleen whales (e.g., fin whale [*Balaenoptera physalus*], sei whale [*B. borealis*], NARW [*Eubalaena glaciali*], minke whale [*B. acutorostrata*], humpback whale [*Megaptera novaeangliae*])
Mid-frequency cetaceans	150 hertz to 160 kilohertz	Dolphins (e.g., Atlantic spotted dolphin [*Stenella frontalis*], Atlantic white-sided dolphin [*Lagenorhynchus acutus*], common dolphin [*Delphinus delphis*], Risso's dolphin [*Grampus griseus*], common bottlenose dolphin [*Tursiops truncates*], and long-finned pilot whale [*Globicephala melas*]) and sperm whales (*Physeter macrocephalus*)
High-frequency cetaceans	275 hertz to 160 kilohertz	True porpoises (e.g., harbor porpoise [*Phocoena phocoena*])
Phocid pinnipeds in water	50 hertz to 86 kilohertz	True seals (e.g., harbor seal [*Phoca vitulina*], gray seal [*Halichoerus grypus*])

Source: NMFS 2018.

Table 3.15-5 Acoustic Thresholds for Marine Mammal Hearing Groups for Impulsive and Non-Impulsive Anthropogenic Noise Sources

Marine Mammal Hearing Group	Impulsive Noise Sources		Non-Impulsive Noise Sources	
	PTS	Behavioral Disturbance	PTS	Behavioral Disturbance
Low-frequency cetaceans	$L_{E,24hr}$: 183 dB re 1 μPa^2 s $L_{p,pk}$: 219 dB re 1 μPa	L_P: 160 dB re 1 μPa	$L_{E,24hr}$: 199 dB re 1 μPa^2 s	Intermittent Sources: L_P 160 dB re 1 μPa Continuous Sources: L_P 120 dB re 1 μPa
Mid-frequency cetaceans	$L_{E,24hr}$: 185 dB re 1 μPa^2 s $L_{p,pk}$: 230 dB re 1 μPa		$L_{E,24hr}$: 198 dB re 1 μPa^2 s	
High-frequency cetaceans	$L_{E,24hr}$: 155 dB re 1 μPa^2 s $L_{p,pk}$: 202 dB re 1 μPa		$L_{E,24hr}$: 173 dB re 1 μPa^2 s	
Phocid pinnipeds in water	$L_{E,24hr}$: 185 dB re 1 μPa^2 s $L_{p,pk}$: 218 dB re 1 μPa		$L_{E,24hr}$: 201 dB re 1 μPa^2 s	

Source: NMFS 2018.
μPa = micropascal; dB = decibel; $L_{p,pk}$ = peak sound pressure level; $L_{E,24hr}$ = sound exposure level over 24 hours; L_P = root-mean-square sound pressure level; PTS = permanent threshold shift.

Pile-driving activities from planned and ongoing offshore wind development projects have the potential to affect all marine mammal hearing groups within a certain radius around each project site. Depending on the hearing sensitivity of the species, the type of pile driving (e.g., impact or vibratory), and noise mitigation measures applied in the project, exceedance of PTS thresholds are expected to occur on the scale of 1 to 2 kilometers, whereas exceedance of TTS thresholds and behavioral effects may occur several to tens of kilometers from the center of pile-driving activity. However, based on the mobility of most marine mammals, it is unlikely that consistent exposure of individuals to above-threshold noise levels would occur over large blocks of space and time. Masking for low-frequency cetaceans that could affect communication space and increase stress is more likely to occur over larger spatial and temporal scales. There is some evidence from acoustic deterrent data (e.g., Schakner and Blumstein 2013), that certain marine mammal species (MFC, HFC, and pinnipeds) will avoid some types of acoustic cues and thus may not be exposed to underwater sound for sufficient duration to cause PTS or TTS. In addition, when effective noise mitigation measures are applied (e.g., bubble curtains, mitigation zones), pile driving acoustic effects are reduced.

The most likely effect of pile-driving activity on marine mammals is behavioral short-term avoidance or displacement from the pile-driving site. This has been well-documented for harbor porpoises, an HFC species of high concern in European waters. A 2011 study of harbor porpoise acoustic activity in the North Sea at the Horns Rev II wind farm revealed that porpoise vocal activity was reduced as far as 11.1 miles (17.8 kilometers) from the construction site during pile driving. At the closest measured distance of 1.6 miles (2.5 kilometers), vocal activity completely ceased at the start of pile driving, did not recommence for up to 1 hour after pile driving ended, and remained below average levels for 24 to 72 hours (Brandt et al. 2011). 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 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. Displacement within the pile-driving monitored area was seen up to 7.5 miles (12 kilometers) away (Benhemma-Le Gall et al. 2021). Using passive acoustic monitoring (PAM) data from multiple projects across the North Sea, Brandt et al. (2016) determined, compared to the 25- to 48-hour pre-piling baseline period, porpoise detections during construction declined by about 25 percent at SEL_{24h} between 145 and 150 dB re 1 μPa^2 s and 90 percent at SEL_{24h} above 170 dB re 1 μPa^2 s. The results revealed a 68 percent decline in detections within 3 miles (5 kilometers) of the noise source during construction, 33 percent decline 3 to 6 miles (5 to 10 kilometers) away, 26 percent decline 6 to 9 miles (10 to 15 kilometers) away, and a decline of less than 20 percent 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-mile (0- to 5-kilometer) range, suggesting no long-term displacement of the animals. Little to no habituation was found as, over the course of installation, porpoises stayed away from pile-driving activities. 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).

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 similarly low, received SEL_{24h} from the two approaches (129 dB re 1 μPa^2 s [vibratory] and 133 dB re 1 μPa^2 s [impact], both at 2,664 feet [812 meters] from the pile). There were no statistically significant responses attributable to either type of pile-driving activity in the presence of species or duration of detections, except the duration of bottlenose dolphin acoustic encounters decreased by an average of approximately 4 minutes at sites within the Cromarty Firth during impact pile driving in comparison to areas outside the Cromarty Firth. 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. In addition to avoidance behavior, several 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 another playback study, trained 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 secession of echolocation activity, suggesting the animals became distracted from the task by the vibratory pile-driving sound.

Other species studied include Indo-Pacific hump-backed dolphins (MFC species), for which no overt behavioral changes besides increased swim speed was observed during impact pile driving (Würsig et al. 2000), and harbor seals (PPW species), which 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, but returned within 2 hours after the cessation of pile-driving activities (Russell et al. 2016). There are no studies that have directly examined the behavioral responses of LFC to pile driving, so studies using other impulsive sound sources such as seismic airguns serve as the best available proxies. With seismic airguns, the distance at which responses occur depends on many factors, including the volume of the airgun (and consequently source level), as well as the hearing sensitivity, behavioral state, and even life stage of the animal (Southall et al. 2021b). In a 1986 study, researchers observed the responses of feeding gray whales to a 100-cubic-inch (1,640 cubic centimeter) 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 SPL 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 (McCauley et al. 1998; Johnson 2002; Richardson et al. 1986) and as far away as 12.4 miles (20 kilometers) (Richardson et al. 1999). Bowhead whales have exhibited other behavioral changes, including reduced surface intervals and dive durations, at received SPL between 125 and 133 dB re 1 μPa (Malme et al. 1988). A more recent study by Dunlop et al. (2017) compared the migratory behavior of humpback whales exposed to a 3,130-cubic-inch (51,291-cubic-centimeter) airgun array with those that were not. There was no gross change in behavior observed (including respiration rates), although 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 that suggested behavioral change was most likely to occur within 2.5 miles (4 kilometers) of the ship at SEL_{24h} over 135 dB re 1 μPa^2 s (Dunlop et al. 2017).

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 kilohertz, LFC and PPW are more likely to experience acoustic masking from pile driving than MFC or HFC. 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 [Scheifele et al. 2004]; killer whales [Holt et al. 2009]), or shifting dominant frequencies (Lesage et al. 1999; Parks et al. 2007). When masking cannot be avoided, increased noise levels could affect the ability to locate and communicate with other individuals. However, given that pile driving is a relatively short-term event, on the order of several hours, and occurs intermittently with some quiet periods between individual pile installations, it is unlikely that complete masking would occur. While some small quiet periods between pile strikes could be available for communication, the complexity of the pile sound propagation and the potential for kurtosis of impulse sounds farther from the pile cannot assure communication effectiveness between strikes.

Overall, it is reasonable to assume that there would be greater impacts on LFC than other species groups, given the lower frequency component of pile-driving noise, even though direct research on pile-driving noise on LFC is limited. There is some evidence suggesting LFC may avoid or change their behavior when exposed to introduced sounds (Sprogis et al. 2020; Dunlop et al. 2017; Malme et al. 1986; Nowacek et al. 2004; Gailey et al. 2016); however, there is no direct evidence to date of avoidance of pile-driving activities. The primary frequency range used by LFC for listening to their environment and communicating with others overlaps with the dominant frequency of pile-driving noise. Additionally, as LFC have specific feeding and breeding grounds (unlike other species who can perform these life functions over broader spatial scales), disturbance by anthropogenic noise occurring in one of these key areas may have a greater effect on these species compared to pile driving outside of key habitats or time periods. Impacts would be reduced with implementation of project-specific avoidance, mitigation, and monitoring measures. For example, noise abatement devices, such as double-bubble curtains, can be used to reduce the overall acoustic energy that is introduced and decrease the geographic extent of noise-related impacts. The implementation of shutdown zones and seasonal restrictions based on species presence in an area can reduce the intensity and likelihood of effects to minor levels, by only allowing activity when animals are not present. However, the seasonal restrictions are largely driven by the presence of NARW, given their critically endangered status, so other species would only benefit if their presence in any given project area is similar to that of NARW. Many of these are requirements as conditions of compliance with the ESA, MMPA, and other federal regulations. These measures would reduce the potential for PTS and TTS effects from pile driving on all marine mammals. Considering the number and extent of projects planned in the geographic analysis area along with ongoing projects, mitigation would not be expected to eliminate the risk of behavioral impacts on marine mammals during pile-driving activities. However, the likely behavioral disturbances are not expected to have permanent population-level impacts for any marine mammal species.

Geophysical and geotechnical surveys: For the purposes of planned and ongoing offshore wind projects, geophysical and geotechnical surveys use active acoustic sources to evaluate the feasibility of turbine installation and to identify potential hazards. Recently, BOEM and USGS characterized underwater sounds produced by high-resolution geophysical 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 are unlikely to result in substantial behavioral disturbance of marine mammals, even without mitigation (Ruppel et al. 2022). This finding is supported empirically by Kates Varghese et al. (2020) who found no change in beaked whale foraging behavior during two deepwater mapping surveys using a 12-kilohertz 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-kilohertz EK-60 echosounder, while Cholewiak et al. (2017) found a decrease in beaked whale echolocation click detections during use of an EK-60 echosounder, and 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 echosounder. For some of the higher-amplitude sources such as some boomers and the highest-power sparkers, behavioral disturbance is possible, but unlikely with mitigation measures such as clearance and exclusion zones, the use of protected species observers (PSOs), and equipment shutdown protocols required by BOEM. 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. Impacts from ongoing and planned offshore wind projects, therefore, would be limited to short-term behavioral disturbances with no population-level impacts expected.

Unexploded ordnance detonations: Munitions and explosives of concern (MECs), including unexploded ordnances (UXOs), on the seabed may be encountered in offshore wind lease areas or along export cable routes. Of the offshore wind project MMPA applications submitted to date, Ocean Wind 1 (OCS-A 0498), Revolution Wind (OCS-A 0486), Sunrise Wind (OCS-A 0487), and New England Wind (OCS-A 0534) off the coast of New Jersey, Massachusetts, and Rhode Island have proposed up to 10, 13, 3, and 10 MEC detonations, respectively; while Atlantic Shores South Offshore Wind (OCS-A 0499), off the coast of New Jersey is not proposing any MEC detonations.

If found, the primary action for MECs is to leave them alone and in place as long as they pose no risk. Other options include having the MEC moved out of the immediate intersection ("lift-and-shift"), removal of the explosive components (if feasible and safe to do so), or removed by controlled explosive (high-order) detonation using a donor charge or through low-order deflagration. These alternative strategies are typically considered prior to explosive detonation, and only one detonation per day is typically permitted. The method that has a potential effect on marine mammals is explosive detonation. Underwater explosions create shock waves characterized by extreme changes in pressure. Shock waves are supersonic, so they travel faster than the speed of sound and can cause injury and mortality to a marine mammal, depending on how close an animal is to the blast. The physical range at which injury or mortality could occur will vary based on the amount of explosive material in the MEC, size of the animal, and the location of the animal in the water column relative to the explosive. Injuries may include hemorrhage or damage to the lungs, liver, brain, or ears, as well as auditory impairment such as PTS and TTS (Ketten 2004). Smaller animals are generally at a higher risk of blast injuries.

Blast injuries have been documented in close association with explosive detonations, including after 42 British ground mines (MK 1-7) were cleared in the Baltic Sea in 2019 (Siebert et al. 2022). Within a week of the mine detonations and in the 2 months following, 24 harbor porpoises were found dead in the general area, 8 of which had clear signs of blast injury as the primary cause of death, (i.e., dislocated ear bones, bleeding in the acoustic fat and melon), and several more had blast injuries and other signs of potential mortal stressors (e.g., found as bycatch, blunt force trauma). As the precise timing of the injuries was not known, it is not clear whether the observed injuries were due to this blast event or an unrelated event. In 2011, an underwater detonation (3.97 kilogram) at the Silver Strand Training Complex in San Diego, California, resulted in blast injury and death to at least three long-beaked common dolphins that had entered the 2,100-foot (640-meter) mitigation zone minutes before the detonation (Danil and St. Ledger 2011).

To predict the potential impacts of MECs on marine species, several models have been developed. Goertner (1982) developed a model for physical injuries to cetaceans at a range of depths, and a modified version of this model is used by NMFS for predicting injury impacts on marine mammals (NMFS 2023h). Hannay and Zykov (2022) modeled the distance to the NMFS thresholds (see Appendix J, *Overview of Acoustic Modeling Report,* for further detail) for five species groups (low-, mid-, and high-frequency cetaceans; phocid pinnipeds; otariid pinnipeds/sea turtles) exposed to MEC detonations of various charge masses at four sites in the Revolution Wind Project area. While exposure ranges will vary among lease areas based on environmental conditions and other factors, their results provide an example of predicted exposure ranges in U.S. waters. The largest auditory effect ranges were predicted for high-frequency cetaceans exposed to a 1,000-pound (454 kilogram) detonation (the largest charge mass modeled) at 10 miles (16 kilometers) (L_{pk}) and 7 miles (11.3 kilometers) (SEL) for PTS, and 12.6 miles (20.2 kilometers) for TTS (SEL; the behavioral threshold for a single detonation) (Hannay and Zykov 2022). The distances to auditory injury were always greater than the predicted ranges for non-auditory injury associated with the blast impulse. It is worth noting that when MECs are detonated they do not always fully detonate, meaning the explosion may not be as large as predicted by the charge mass. The modeling studies presented previously are based on the assumption that the charge fully detonates.

Behavioral effects are possible out to farther ranges, but because the explosion is ephemeral, behavioral effects are expected to be short term, challenging to observe, and of less concern compared to potential injury and mortality effects; they are therefore not typically evaluated in the same way other sound sources are evaluated or regulated for behavioral effects ranges. Todd et al. (1996) observed humpback whales near underwater explosions and did not note any overt behavioral changes (e.g., changing course, abrupt dive behavior) within 1.14 miles (1.83 kilometers) from the blast, at received peak pressures of 123 dB re 1 µPa. They saw no overall trend in humpback whale movements during the course of the month when intermittent blasting was taking place.

The number, charge mass, and location of MECs that may need controlled detonation for other projects are relatively unknown until a site assessment is performed. Therefore, it is difficult to predict the potential likelihood and frequency of effects of MEC detonation from other projects in the geographic area. However, while the likelihood of encountering this stressor is unknown, the effects are well documented. At close ranges, MEC detonations can be injurious or lethal. Mitigative measures for handling MECs are likely to be required to decrease the chance that a marine mammal will be severely injured or killed from an explosion. For example, seasonal and time of day restrictions can be put in place to avoid times when marine mammals may be present, noise mitigation devices can be applied to reduce noise propagation from the detonation, and visual and passive acoustic monitoring of clearance zones can be used to make sure the detonation does not occur until there are no animals detected. In addition, lower-order detonation methods, such as deflagration, are in development and could substantially decrease the energy released into the environment, therefore decreasing the effect ranges (Robinson et al. 2020). With mitigative measures in place, the intensity of this IPF is expected to be reduced from severe to moderate. MEC detonation impacts are expected to be similar across all marine mammal groups, with severe non-auditory impacts more likely for smaller animals. However, the likelihood of MEC detonation associated with planned offshore wind projects is unknown. Although the number of expected explosive MEC detonations associated with planned and ongoing offshore wind projects is unknown, the likelihood is expected to be low given the preferred non-detonation options available and mitigation measures that could be implemented (e.g., clearance zones, bubble curtains, other noise attenuation devices).

Aircraft: Other planned offshore wind activities may employ helicopters and fixed-wing aircraft for transporting construction and maintenance crew, or monitoring during construction activities, which emit sound that could affect marine mammals. In general, marine mammal behavioral responses to aircraft have most commonly been observed at altitudes of less than 492 feet (150 meters) from the aircraft (Patenaude et al. 2002; Smultea et al. 2008). Aircraft operations have resulted in temporary behavioral responses, including short surface durations in bowhead and beluga whales (Patenaude et al. 2002) and transient sperm whales (Richter et al. 2006), abrupt dives in sperm whales (Smultea et al. 2008), and percussive behaviors like breaching and tail slapping (Patenaude et al. 2002). 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). BOEM requires all aircraft operations to comply with current approach regulations for NARWs or unidentified large whales (50 CFR 222.32). These include the prohibition of aircraft from approaching within 1,500 feet (457 meters), which would minimize the potential responses of marine mammals to aircraft noise. In addition, based on the physics of sound propagation across different media (e.g., air and water), an animal must be directly below an aircraft (within a 13° cone) to hear the sound from the aircraft. With the implementation of BMPs, no biologically notable adverse effects are expected for marine mammals from aircraft operations related to ongoing and planned offshore wind projects.

Vessels: Noise from large commercial ships, as well as smaller fishing and recreational vessels, is likely to be present and persistent in the geographical area from ongoing and planned offshore wind projects. The physical qualities of vessel noise are described in Appendix J, *Overview of Acoustic Modeling Report*. Note that the specific effects of dynamic positioning noise on marine mammals have not been studied but are expected to be similar to that of transiting vessels.

Comprehensive reviews of the literature (Richardson et al. 1995; Erbe et al. 2019) 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 species. Observed behavioral responses across all marine mammal hearing groups include changes in dive patterns (Finley et al. 1990), disrupted resting behavior (Mikkelsen et al. 2019), increased swim speeds (Finley et al. 1990; Sprogis et al. 2020; Williams et al. 2022), and changes in respiration patterns (Nowacek et al. 2006; Hastie 2006; Sprogis et al. 2020). Changes to foraging behavior, which can have a direct effect on an animal's fitness, have also been observed in porpoises (Wisniewska et al. 2018) and killer whales (Holt et al. 2021) in response to vessel noise. Rolland et al. (2012) showed that fecal cortisol levels, indicative of a stress response, in NARWs decreased following the September 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. Other effects of vessel noise in the literature include changes in acoustic behaviors such as altered call frequencies (Lesage et al. 1999; Castellote et al. 2012), changes in the number of calls produced (Finley et al. 1990; Buckstaff et al. 2006; Azzara et al. 2013; Guerra et al. 2014; Tsujii et al. 2018), and changes in call duration or amplitude (Holt et al. 2009; Castellote et al. 2012); and acoustic masking, which has been analyzed by several studies (Clark et al. 2009; Erbe et al. 2016; Putland et al. 2018). Additionally, studies have attempted to understand the energetic cost of a change in vocal behavior. Holt et al. (2015) found that metabolic rates in bottlenose dolphins increased by 20–50 percent in comparison to resting metabolic rates, and though this study was not tied directly to exposure to vessel noise, it provides insight into the potential energetic cost of this type of behavioral change documented in other works (i.e., increases in vocal effort such as louder, longer, or increased number of calls). Williams et al. (2017) modeled the energetic cost of high-speed escape responses in dolphins and found that the cost per swimming stroke was doubled during such a flight response. Applying vessel activity estimates developed by BOEM (2019b), vessel activity could peak in 2025, with as many as 207 vessels involved in the construction of expected future wind energy projects. However, this increase must be considered relative to the baseline level of vessel traffic in the geographic analysis area (Appendix F, Table F1-14). The increased vessel traffic related to ongoing and planned offshore wind projects would be expected to result in localized, intermittent impacts on marine mammals that would be limited to behavioral disturbances, and no population-level impacts are expected.

Site preparation: Site preparation activities may include mechanical and/or hydraulic dredging to prepare an area for foundation installation, as well as boulder and/or sandwave clearance. Underwater noise generated by site preparation activities depends on the specific type of equipment used; however, it would likely be comparable to dredges and barges used for traditional waterways deepening and widening.

Todd et al. (2015) provide an extensive review of the impacts of dredging on marine mammals. Given the low source levels and transitory nature of dredging sources, exceedance of PTS thresholds is not likely, but TTS and behavioral thresholds could be exceeded at very close distances (Todd et al. 2015). For example, using measurements of the highest source level from multiple dredging vessel operations, Heinis et al. (2013) modeled harbor porpoise and seal exposure to a dredging operation. They found that TTS levels were not exceeded for harbor porpoise at any distance, and only exceeded for seals at distances within 295 feet (90 meters) of the dredging vessel. Empirical studies suggest that some high-frequency cetaceans may avoid dredging activities. For example, Diederichs et al. (2010) found short-term avoidance of dredging activities by harbor porpoises near breeding and calving areas in the North Sea. Pirotta et al. (2013) found that, despite a documented tolerance of high vessel density, as well as high availability of food, bottlenose dolphins spent less time in the area during periods of dredging. The study also showed that with increasing intensity in the activity, bottlenose dolphins avoided the area for longer durations (with one instance being as long as 5 weeks) (Pirotta et al. 2013). Some studies, primarily on seals and sea lions, found no observable response (Blackwell et al. 2004; Environment 2008; Gilmartin 2002), while several other studies showed temporary to long-term avoidance behavior for bowhead, gray, humpback, and minke whales (Anderwald et al. 2013; Borggaard et al. 1999; Richardson et al. 1990; Todd et al. 2015; Tyack 2008). For example, gray and humpback whales seem to avoid certain areas—even key breeding habitats—when dredging was occurring (Borggaard et al. 1999; Tyack 2008). These studies suggest that dredging does not produce sounds sufficient to cause PTS, but at close ranges the sounds have the potential to cause behavioral disturbance to, or temporary hearing impairment in, marine mammals.

While behavioral responses may occur from site preparation activities, they are expected to be short term and of low intensity due to ongoing and planned offshore wind projects. Masking and behavioral reactions from dredging may be more likely for baleen whales and pinnipeds due to the low-frequency spectrum over which the sounds occur and the overlap with their best hearing sensitivity.

Cable laying and trenching: Preparing a lease area for turbine installation and cable laying may require jetting, plowing, or removal of soft sediments, as well as the excavation of rock and other material through various dredging methods. 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. The physical qualities of these sound sources are described in Appendix J, *Overview of Acoustic Modeling Report*. Given the low source levels and transitory nature of these sources, exceedance of PTS levels is not likely for harbor porpoise and seals, according to measurements and subsequent modeling by Heinis et al. (2013). Of the few studies that have examined behavioral responses from cable-laying and trenching noise, most have involved other industrial activities, making it difficult to attribute responses specifically to dredging noise. Some found no observable response (Hoffman 2012), while others showed avoidance behavior (Richardson et al. 1990; Pirotta et al. 2013). Impacts on all marine mammals are expected to be of the lowest level of intensity due to the low sound levels and localized nature of the sound source. Impacts such as brief behavioral effects or acoustic masking over small spatial scales may occur for LFC species due to the low-frequency nature of these sound sources and the number of ongoing and planned offshore wind projects in the geographic analysis area, but these would be of low intensity, short term, and localized to the immediate area around the cable installation activity.

Drilling: Drilling may be required at the site of WTG foundations in the unlikely event that pile refusal occurs prior to meeting the target embedment depth for the piles. Research suggests that the sensitivity of marine mammals to drilling noise varies between and within species and is likely context dependent (Richardson et al. 1990). For example, ringed seals and harbor porpoises may be relatively tolerant to drilling activities (Moulton et al. 2003; Todd et al. 2009). In fact, Todd et al. (2020) measured drilling noise from jack-up platforms and concluded that harbor porpoises can only detect drilling noise out to a distance of approximately 230 feet (70 meters) from the source at the study site and concluded that the noise is unlikely to interfere with or mask echolocation clicks. In terms of behavioral disturbance, drilling activities may exceed the continuous noise threshold of 120 dB re 1 μPa tens of kilometers from the source (Appendix J, *Overview of Acoustic Modeling Report*) and given the low-frequency nature of drilling sounds, baleen whales may be more vulnerable to disturbance. The majority of studies on baleen whale behavioral responses to drilling noise have been conducted on arctic species in the context of oil and gas extraction, and these studies currently serve as the best available proxies. Bowhead whales have been reported to avoid a radius of approximately 6.2 miles (10 kilometers) around an operating drillship, with some individuals avoiding the site up to 12.4 miles (20 kilometers) away (Richardson et al. 1995). Richardson et al. (1990) performed playback experiments of drilling and dredging noises and observed bowhead whale responses. Behavioral reactions were observed for most of the animals, such as orienting away from the sound, cessation of feeding, and altered surfacing, respiration, and diving cycles (Richardson et al. 1990). Roughly half of the bowhead whales responded to the drilling noise playback at a received level of 115 dB re 1 μPa (20–1,000 Hz band) (Richardson et al. 1990). Blackwell et al. (2017) reported that bowhead whale calling rates were correlated with increasing levels of drilling noise, where calling rates initially increased, peaked, and then decreased. While such behavioral responses may result from offshore drilling associated with ongoing and planned offshore wind projects, they are expected to be short term and intermittent.

WTG operations: The operation of turbines during ongoing and planned offshore windfarms may result in long-term, low-level, continuous sound in the offshore environment. The physical qualities of turbine operational noise are described in Appendix J, *Overview of Acoustic Modeling Report*. Based on the currently available sound field data for turbines smaller than 6.2 MW (Tougaard et al. 2020) and comparisons to acoustic impact thresholds (NMFS 2018), underwater sound from offshore wind turbine operations is not likely to cause PTS or TTS in marine mammals but could cause behavioral and masking effects at close distances. Tougaard et al. (2020) aggregated the existing sound field measurements from 17 operating wind farms and modeled the received sound levels as a function of recording distance, wind speed, and turbine size. Based on their model, the mean of all the data normalized to a measurement made at 328 feet (100 meters), for a 1 MW WTG operating at a wind speed of 33 feet (10 meters) per second was a received SPL of 109 dB re 1 μPa. Based on the model, the noise from a single, 1 MW turbine dropped below ambient conditions within 1,312 feet (400 meters) of the foundation or a few kilometers for an array of 81 turbines. For high ambient noise conditions, the distance at which the turbine can be heard above ambient noise was even less. The available data also showed an increase in noise levels with increasing WTG power and wind speed (Tougaard et al. 2020). Stöber and Thomsen (2021) reviewed published literature and also identified an increase in underwater source levels (up to 177 dB re 1 μPa) with increasing power size with a nominal 10 MW WTG. They also estimate a sound decrease of roughly 10 dB from WTG using gear boxes compared to WTG using direct drive technology, which is now the standard installation configuration. More recently, Betke and Bellmann (2023) conducted standardized underwater sound measurements from 25 German offshore wind farms that included turbines up to 8 MW. The trend analysis in the Betke and Bellmann (2023) study showed that there was no statistical increase in radiated noise with increasing turbine power size. Results from field measurements showed primary frequency ranges between 50 and 200 Hz consistently across all wind farms regardless of turbine type. The average SPL for monopile foundations measured 121.5 dB re 1 μPa at 328 feet (100 meters) from the foundation. This measurement was 0.5 dB higher for other foundation types. Average SPL for foundations with gear box drives was 122.3 dB re 1 μPa at 328 feet (100 meters) from the foundation; foundations with gearless (direct) drive were 2.3 dB lower.

There are many natural sources of underwater sound that vary over space and time and would affect an animal's ability to hear WTG operational noise over ambient conditions. Lucke et al. (2007) explored the potential for acoustic masking from operational noise by conducting hearing tests on trained harbor porpoises (HFC species) while they were exposed to sounds resembling operational wind turbines (i.e., <1 kHz). They saw masking effects at SPLs of 128 dB re 1 μPa at frequencies of 700, 1,000, and 2,000 Hz, but found no masking at SPLs of 115 dB re 1 μPa. Based on propagation loss in a shallow water environment, the sound would attenuate to 115 dB re 1 μPa within 66 feet (20 meters) of the operating WTG (Lucke et al. 2007), suggesting the range for masking for HFC is very small. Though there are few empirical studies looking at the effect of operational WTG noise on wild marine mammals, the available studies show a range in responses such as increased acoustic presence in the wind farms (Russell et al. 2016; Scheidat et al. 2011) to decreased abundances of harbor porpoises in the wind farm compared to pre-construction periods, though no change in acoustic behavior was detected for those individuals that were present (Tougaard et al. 2009). In these field monitoring studies, it is not always clear if the behavioral responses have anything to do with operational noise, or merely the presences 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. Due to their low sound levels, behavioral and masking effects associated with turbine operational noise from ongoing and planned offshore wind projects are not expected to have significant impacts on individual survival, population viability, distribution, or behavior, and are not expected to occur outside a very small radius around a given turbine.

Summary of noise impacts: Underwater noise impacts on marine mammals from planned and ongoing offshore wind activities are anticipated to occur. Noise generated from planned and ongoing offshore wind activities include impulsive (e.g., impact pile driving, MEC detonations, some HRG surveys) and non-impulsive sources (e.g., vibratory pile diving, some HRG surveys, vessels, aircraft, cable laying or trenching, site preparation activities, turbine operations). Of those activities, only pile driving and MEC detonations are anticipated to cause PTS/injury-level effects in marine mammals. Vibratory pile driving of WTG and OSS foundations is not expected to result in PTS due to the short duration of the activity and the necessary time exposure that would be required to meet or exceed acoustic thresholds, if conducted continuously for long time periods. MEC detonation may also cause mortality, slight lung injury, and gastrointestinal tract injury at close range; however, there is a low likelihood of detonations and these would be spatially explicit events with no overlap in the produced sound fields so the risk of mortal and non-auditory injuries occurring is minimal. All noise sources that are audible by a given species have the potential to cause behavioral responses ranging from very low to more severe. All projects are expected to include applicant-proposed measures (e.g., exclusion zones, protected species observers) that would minimize underwater noise impacts on marine mammals. The effects of implementing underwater noise impact minimization measures would likely be similar to those described for the Proposed Action in Section 3.15.5, *Impacts of the Proposed Action on Marine Mammals*.

The intensity of this IPF is considered severe for MEC detonations, as mortality thresholds would be exceeded; medium for impact pile driving, as PTS thresholds would be exceeded; and low for all other activities, as TTS and behavioral thresholds would be exceeded. The predicted effect would be permanent in the case of some PTS effects and mortality and slight lung injury resulting from MEC detonations and short term with respect to TTS, behavioral effects, and masking. The geographic extent is considered localized for PTS effects and extensive for behavioral disturbance effects, as noise could exceed behavioral thresholds several tens of kilometers away depending on the activity. The frequency of the activity causing the effect is considered infrequent for impact pile driving, vibratory pile driving, MEC detonations, aircraft, cable-laying and trenching, and dredging noise; frequent for HRG survey noise; and continuous for WTG operation noise. With the application of mitigation measures similar to those outlined in Appendix H, *Mitigation and Monitoring,* for MEC detonations, the likelihood of mortality and non-auditory injury of a marine mammal from MEC detonations is considered low. Based on the source levels available in the literature and using the underwater noise modeling completed for the Proposed Action as a proxy for planned offshore wind activities, some PTS, TTS, behavioral disturbance, and masking effects on LFC, MFC, HFC, and phocid pinnipeds in water are considered likely with respect to this IPF, but would vary by species and population.

Port utilization: The development of an offshore wind industry in the marine mammal geographic analysis area may incentivize the expansion or improvement of regional ports to support planned projects. Three main activities surrounding port utilization could affect marine mammals: port expansion/construction, increased vessel traffic, and increased dredging. The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek. The Atlantic Shores South Offshore Wind project would construct an O&M facility in Atlantic City, New Jersey, on a shoreside parcel that was formerly used for vessel docking and other port activities. At larger ports such as Charleston and Norfolk, offshore wind-related activities would make up a small portion of the total activities at the port; therefore, offshore wind activities are likely to have a negligible impact on marine mammals through increased port utilization at these ports. However, for smaller ports within the geographic analysis area, such as Paulsboro and Hope Creek, port expansion may be necessary to accommodate the increased activity, resulting in more significant increases to vessel traffic, dredging, and shoreline construction. The USACE has proposed maintenance dredging of portions of the Newark Bay, New Jersey, federal navigation channel, including the removal of material from the Port Elizabeth Channel (USACE 2021). Additionally, in 2017, the USACE Charleston District awarded contracts as part of the Charleston Harbor Deepening Project, which will create a 52-foot (15.8-meter) depth at the entrance channel to Charleston Harbor in South Carolina. Port improvements could lead to an increase in vessel traffic and underwater noise from pile driving and dredging during construction, O&M, and conceptual decommissioning of planned and ongoing offshore wind projects. The realized impacts on marine mammals in the geographic analysis area from these activities include potential increased vessel interaction, exposure to noise, and localized turbidity plumes from dredging. See the *noise*, *traffic*, and *new cable emplacement/maintenance* IPFs for discussion of impacts on marine mammals from underwater noise, vessel strike, and elevated turbidity that would also be associated with port utilization and expansion. Any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on marine mammals.

Gear utilization (biological/fisheries monitoring surveys): Planned and ongoing offshore wind projects are likely to include plans that monitor biological resources in and near associated project areas throughout various stages of development. These could include trawl and trap surveys, as well as other methods of sampling the biota in the area. Theoretically, any line in the water column, including line resting on or floating above the seafloor set in areas where whales occur, could entangle a marine mammal (Hamilton et al. 2019; Johnson et al. 2005). Entanglements may involve the head, flippers, fluke, or multiple body parts; effects range from no apparent injury to death. Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW and may be a limiting factor in the species recovery (Hayes et al. 2023; Knowlton et al. 2012). NOAA Fisheries estimates that over 85 percent of individuals have been entangled in fishing gear at least once (Hayes et al. 2023) and 60 percent of individuals show evidence of multiple fishing gear entanglements, with rates increasing over the past 30 years (King et al. 2021; Knowlton et al. 2012). Of documented NARW entanglements in which gear was recovered, 80 percent was attributed to non-mobile fishing gear (i.e., lobster and gillnet gear) (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). Entanglement may also be responsible for high mortality rates in other large whale species, including fin whales (Hayes et al. 2022; Henry et al. 2020; Read et al. 2006). Additionally, there are considerable data on the potential for entanglement of humpback whales. 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 (see *Vessel traffic* IPF), entanglement of humpback whales could be limiting the recovery of the population (Hayes et al. 2020). Pinnipeds, including harbor seals and gray seals, are also at risk for entanglements (Hayes et al. 2022).

There are no documented cases of marine mammal entanglement associated with biological monitoring for the Block Island, CVOW Pilot project, and Vineyard Wind 1 wind farms. 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 (South Fork Wind 2021). While impacts from gear utilization associated with biological resource 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.

In summary, the presence of monitoring gear associated with ongoing and planned offshore wind projects could affect marine mammals by entrapment or entanglement; however, developers have included marine mammal mitigation and monitoring procedures in COPs submitted to date designed to avoid entanglement or entrapment in any biological survey plans. Therefore, it is expected that monitoring plans will have sufficient mitigation procedures in place to avoid entanglement and entrapment, and no impacts would occur. Should future developers not develop plans that avoid entanglement and entrapment, such an outcome could lead to injury, serious injury, or mortality of a marine mammal.

Presence of structures: Over 3,287 structures (WTGs and OSSs) could be constructed in the geographic analysis area (Appendix F, Table F-3) for planned offshore wind projects. The presence of structures would result in artificial reef and hydrodynamic effects that influence primary and secondary productivity and the distribution and abundance of fish and invertebrate community structure within and in proximity to project footprints. Depending on proximity and extent, hydrodynamic and reef effects from planned activities could influence the availability of prey and forage resources for marine mammals. Project-specific effects would vary, 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.

The long-term presence of WTG structures from ongoing and planned offshore wind projects could displace marine mammals from preferred habitats or alter movement patterns, potentially resulting in exposure to commercial and recreational fishing activity. 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. 2016). Other studies have documented apparent increases in marine mammal density around wind energy facilities. Russel et al. (2014) found clear evidence that seals were attracted to a European wind farm, apparently drawn to the abundant concentrations of prey created by the artificial reef effect. However, attraction to the windfarm area due to the increased presence of prey could result in exposure to additional or other risks. For example, gray and harbor seals are susceptible to entrapment in gillnet fisheries, as well as trawl fisheries to a lesser degree (Orphanides 2020; Moreno et al. 2020; Precoda and Orphanides 2022; Lyssikatos 2015). If commercial trawling were to occur near wind farms, increased interactions and resulting mortality of gray and harbor seals could occur.

The presence of vertical structures in the water column could cause a variety of hydrodynamic effects. 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). A reduction in wind-driven mixing is mainly caused by the extraction of kinetic wind energy by turbine operations, which reduces wind stress at the air-sea interface and can lead to changes in horizontal and vertical water column mixing patterns (Miles et al. 2021). In addition, 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 and are mainly driven by interactions at the air-sea surface interface, there is also the potential for tidal current wakes out to a kilometer from a monopile (Li et al. 2014). Direct observations of the influence of a monopile extending to at least 984 feet (300 meters), however, was indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to 3,280 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, and sensitivity of the analysis.

The presence of vertical structures in the water column could also cause a variety of long-term hydrodynamic effects, which could impact marine mammal prey species. Atmospheric wakes, characterized by reduced downstream mean wind speed and turbulence along with wind speed deficit, are documented with the presence of vertical structures. The magnitude of atmospheric wakes can change relative to instantaneous velocity anomalies. In general, lower impacts of atmospheric wakes are observed in areas of low wind speeds. Several hydrodynamic processes have been identified to exhibit changes from vertical structures:

- Advection and Ekman transport are directly correlated with shear wind stress at the sea surface boundary. Vertical profiles from Christiansen et al. (2022) exhibit reduced mixing rates over the entire water column. As for the horizontal velocity, the deficits in mixing are more pronounced in deep waters than in well-mixed, shallow waters, which is likely favored by the influence of the bottom mixed layer in shallow depths. In both cases, the strongest deficits occur near the pycnocline depth.
- Additional mixing downstream has been documented from Kármán vortices and turbulent wakes due to the pile structures of wind turbines (Carpenter et al. 2016; Grashorn and Stanev 2016; Schultze et al. 2020).
- Up-dwelling and down-dwelling dipoles under contact of constant wind directions affecting average surface elevation of waters have been documented as the result of offshore wind farms (Brostörm 2008; Paskyabi and Fer 2012; Ludewig 2015). Mean surface variability is between 1 and 10 percent.
- With sufficient salinity stratification, vertical flow of colder/saltier water to the surface occurs in lower sea surface level dipoles, and warmer/less saline water travels to deeper waters in elevated sea surface heights (Ludewig 2015; Christiansen et al. 2022). This observation also suggested impacts on seasonal stratification, as documented in Christiansen et al. (2022). However, the magnitude of salinity and temperature changes with respect to vertical structures is small compared to the long-term and interannual variability of temperature and salinity.

These potential hydrodynamic effects from the presence of vertical structures in the water column therefore affect nutrient cycling and could influence the distribution and abundance of fish and planktonic prey resources (van Berkel et al. 2020). Turbulence resulting from vertical structures in the water column could lead to localized changes in circulation and stratification patterns, with potential implications for primary and secondary productivity and fish distribution. Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. 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. However, the scale of vertical mixing is infrastructure specific. Strong thermoclines act as a barrier to vertical mixing and transport. In extreme scenarios, as seen near islands, enhanced mixing could prevent stratification; however, at regional scales, water columns typically re-stratify by natural buoyancy forcing (Dorrell et al. 2022). Changes in cold pool dynamics resulting from future activities, should they occur, could conceivably result in changes in habitat suitability and fish community structure, but the extent and significance of these potential effects are unknown. Daewel et al. (2022) modeled the effects of offshore wind farm projects in the North Sea on primary productivity and found that there were areas with both increased and decreased productivity within and around the wind farms. There was a decrease in productivity in the center of large wind farm clusters but an increase around these clusters in the shallow, near-coastal areas of the inner German Bight and Dogger Bank (Daewel et al. 2022). A change in the spatial distribution of primary productivity could have notable impacts on marine mammal prey. However, the authors noted that when integrated over a larger area, the local decreases and increases averaged to a nominal (0.2 percent) change.

The extraction of kinetic wind energy by turbine operations and reduction in wind stress at the air-sea interface can lead to changes in horizontal and vertical water column mixing patterns (Miles et al. 2021). Localized turbulence and upwelling effects around the monopiles are likely to transport nutrients into the surface layer, potentially increasing primary and secondary productivity. That increased productivity could be partially offset by the formation of abundant colonies of filter feeders on the monopile foundations. While the net impacts of these interactions are difficult to predict, they are not likely to result in more than localized effects on the abundance of zooplankton. Turbulent mixing would be increased locally within the flow divergence and in the wake, which would enhance local dispersion and dissipation of flow energy. However, because the monopiles would be spaced approximately 1 nautical mile (1.9 kilometers) apart, there would be less than 1 percent areal blockage, and the net effect over the spatial scale of the projects would be negligible. When considered relative to the broader oceanographic factors that determine primary and secondary productivity in the region, localized impacts on zooplankton abundance and distribution are not likely to measurably affect the availability of prey resources for marine mammals.

In summary, the waters surrounding offshore wind farms are characterized by strong seasonal stratification, which is expected to limit measurable hydrodynamic effects to within 600 to 1,300 feet (183 to 396 meters) down current of each monopile. Therefore, the effects from individual turbines could be limited to areas within or close to wind farm footprints. However, Christiansen et al. (2022) demonstrated that wind wakes and their effects on surrounding hydrodynamic patterns likely extend tens of kilometers outside the border of wind developments. Hydrodynamic effects, therefore, may not be localized to areas within or close to wind farm footprints if multiple adjacent wind farms are built out.

Long-term habitat alterations during windfarm operations through the placement of WTG and OSS foundations, scour protection, and cable protection could lead to potential changes in foraging habitat for some marine mammal species. Though the installation of wind farm infrastructure is expected to result in the loss of soft-bottom habitat, it would also result in the conversion of open-water habitat to hard, vertical habitat, which can, through a series of successional changes, aggregate prey species, including forage fish (Causon and Gill 2018; Taormina et al. 2018). This so-called “reef effect” could attract marine mammals seeking foraging opportunities within the wind farms. Seals, for example, have been documented foraging around wind farm structures in Europe (Russell et al. 2016). Due to the increase in prey availability, the reef effect may be considered a beneficial impact for fish-eating odontocetes and pinnipeds, though no noticeable impact on mysticetes or sperm whales is anticipated. However, there is currently no example of an operational, large-scale offshore renewable energy project within the geographic analysis area for marine mammals, so effects on marine mammals due to the reef effect remain largely uncertain.

The widespread development of offshore renewable energy facilities may facilitate climate change adaptation for certain marine mammal prey and forage species. Hayes et al. (2022) 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 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), though it is unknown how marine mammals may ultimately respond to this.

In contrast, broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020). This possible effect is primarily relevant to NARWs and other baleen whales, as their planktonic prey (calanoid copepods and krill) are driven primarily by hydrodynamic processes that can redistribute nutrients and create patchiness of prey both spatially and temporally. As aggregations of plankton, which provide a dense food source for NARWs to efficiently feed on, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities. For example, the 98-foot (30-meter) isobath along the western edge of Nantucket Shoals generally corresponds with the well-mixed tidal front that supports dense planktonic prey aggregations and, therefore, represents important feeding habitat for the NARW (Hayes 2022; O'Brien et al. 2022; Quintana-Rizzo et al. 2021).

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 uncertain, its significance unknown, and likely varies by species and location. Given this, BOEM has asked the National Academies of Sciences, Engineering, and Medicine to further evaluate this issue, with particular emphasis on assessing potential impacts on NARW prey availability; this study is currently ongoing at the time of publication of this Final EIS.

The presence of structures could lead to an increased risk of interaction with fishing gear, potentially resulting in entanglement leading to injury or death. Offshore structures and the anticipated reef effect could lead to increased recreational fishing within the lease areas and result in moderate exposure and high-intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death (Moore and van der Hoop 2012). The reef effect may result in drawing in recreational fishing effort from inshore areas, and overall interaction between marine mammals and fisheries could increase if marine mammals are also drawn to the lease areas due to increased prey abundance. Additionally, commercial and recreational fishing vessels may be displaced outside of lease areas. Bottom tending mobile gear is more likely to be displaced to areas outside of the lease areas than fixed gear. Future offshore wind projects would be more likely to displace larger fishing vessels with small mesh bottom-trawl gear and mid-water trawl gear, compared to smaller fishing vessels with similar gear types that may be easier to maneuver. In addition, some potential exists for a shift in gear types from fixed to mobile, or from mobile to fixed gear, due to displacement from the lease areas. The potential impact on marine mammals from these changes is uncertain. However, if a shift from mobile gear to fixed gear occurs due to inability of the fishermen to maneuver mobile gear, there would be a potential increase in the number of vertical lines, resulting in an increased risk of marine mammal interactions with fishing gear. These fisheries interactions may result in demographic impacts on marine mammal species.

Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW and may be a limiting factor in the species recovery (Knowlton et al. 2012). Current estimates indicate that 83 percent of NARWs show evidence of at least one past entanglement and 60 percent show evidence of multiple fishing gear entanglements, with rates increasing over the past 30 years (King et al. 2021; Knowlton et al. 2012). Of documented NARW entanglements in which gear was recovered, 80 percent was attributed to non-mobile fishing gear (i.e., lobster, gillnet) (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; Hayes et al. 2023).

Entanglement may also be responsible for high mortality rates in other large whale species, most notably humpback, minke, and fin whales (Henry et al. 2020; Read et al. 2006).

Abandoned or lost fishing gear, including that associated with pre- and post-construction fisheries monitoring surveys, may get tangled with foundations. Although this would result in a reduction in entanglement risk from free-floating abandoned gear, debris tangled with WTG foundations will still pose an entanglement risk to marine mammals in the vicinity of windfarm foundations. These potential long-term and intermittent impacts would persist until decommissioning is complete and structures are removed.

Some level of displacement of marine mammals out of the lease areas into areas with a higher potential for interactions with ships or fishing gear during construction of future offshore wind development may occur. Additionally, some marine mammals may avoid the lease areas during all stages (construction, operations, and decommissioning) of the future offshore wind development. Potential spatial displacement into areas with higher risk of interactions with fishing and commercial vessels (see *Traffic* IPF below) may also contribute to impacts on marine mammals.

Impacts from the presence of structures from ongoing and planned offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds; although impacts on individuals would be detectable and measurable, they would not lead to population-level effects for most species, except for NARW. Due to the heightened risk for entanglement in fishing gear and their estimated potential biological removal of 0.7, impacts on NARWs from the presence of structures are considered major. Impacts on MFC, HFC, and PPW may result in slight beneficial effects due to increases in aggregations of prey species.

Light: The addition of over 3,287 new offshore structures associated with planned and ongoing offshore wind projects in the geographic analysis area with long-term hazard and aviation lighting, as well as lighting associated with construction vessels, would increase artificial lighting. Vessel-related lighting impacts would be localized and temporary; this could attract potential prey species to construction zones, potentially aggregating some marine mammal species (primarily odontocetes), exposing them to greater harm from other IPFs associated with construction, including an increased risk of collision with vessels. Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities on marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented.

Vessel traffic: Increased vessel traffic presents a potential increase in collision-related risks to marine mammals. 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-watching vessels, research vessels, and even jet-skis (Dolman et al. 2006). 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 vessels 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.

Vessel speed and size are important factors for determining the probability and severity of vessel strikes. The size and bulk of the large vessels inhibit the ability for crew to detect and react to marine mammals along the vessel's transit route. Vessel strikes have been preliminarily determined as a leading cause of death for humpback whales during the current UME (NMFS 2023c). Two vessel types that carry AIS transponders were 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). 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 on collision data collected by Vanderlaan and Taggart (2007) and Pace and Silber (2005), 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 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 (16 and 28 kilometers per hour), and that the probability of death declined by 50 percent at speeds less than 11.8 knots (22 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 vessel operators to maintain speeds of 10 knots (18.5 kilometers per hour) or less and to avoid Seasonal Management Areas when possible. In 2017, vessel strikes were thought to be a leading cause of a UME for NARW (NMFS 2023d). From 2017 to 2023, a total of 12 fatal NARW vessel strikes have occurred, with an additional 4 resulting in serious and sublethal injuries (NMFS 2023b). 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 (NOAA 2020). NARW vessel strike mortalities decreased from 10 prior to the implementation of Seasonal Management Areas to 3, 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) and NMFS (2020) 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 NARWs may be present outside of established Seasonal Management Areas; therefore, temporary voluntary Dynamic Management Areas are established when a group of three or more NARWs are sighted nearby. 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 and cooperation has been modest and not at the same levels as achieved with Seasonal Management Areas; however, cooperation does increase during active Dynamic Management Area periods (NOAA 2020).

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. 2009; 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 traffic in the vicinity of a representative offshore project area from March 2019 to February 2020 was composed of cargo/carriers (22.4 percent), fishing vessels (19.6 percent), pleasure craft (19.1 percent), tugs (11.4 percent), other/undefined (11.1 percent), cruise ships/large ships (10.5 percent), and tanker/oil tanker (5.8 percent) (DNV 2021). Vessels more than 262 feet (80 meters) in length, and therefore those more likely to cause lethal or severe injury to large whales (Laist et al. 2001), in this area account for up to 38.7 percent of vessel traffic.

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/delphinids 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). However, the behavioral choice by small delphinids to bowride does expose them to the potential for vessel strike and has occurred seasonally in Florida (Wells and Scott 1997) as vessel traffic increases with recreational vessels. 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). Of the 3,633 stranded harbor seals in the Salish Sea (Canada/United States) from 2002 to 2019, 28 exhibited injuries consistent with propeller strike (Olson et al. 2021). There are very few documented cases of seal mortalities as a result of a vessel strikes in the literature (Richardson et al. 1995). 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 the 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 whales, blue whales, fin whales, sei whales, sperm whales, and, to a lesser extent, minke whales due to their smaller size (Hayes et al. 2020, 2021, 2022, 2023).

Although the duration of increased vessel traffic for ongoing and planned 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. Offshore wind vessels would be required to abide by mitigation measures designed to avoid vessel strike, including the use of trained observers, speed restrictions, and minimum separation zones, which would reduce, but not fully eliminate, strike risk to all marine mammals.

Climate change: Global climate change is an ongoing risk to marine mammals. However, the associated impact mechanisms are complex, not fully understood, and difficult to predict with certainty. Several sub-IPFs related to climate change have the potential to impact marine mammals, including increased storm severity and frequency; increased erosion and sediment deposition; ocean acidification; and altered habitat, ecology, and migration patterns. Climate change could potentially affect the incidence or prevalence of infection, the frequency or magnitude of epizootics, and/or the severity or presence of clinical disease in infected individuals (Burge et al. 2014). Over time climate change and coastal development would alter existing habitats, rendering some areas unsuitable for certain species and more suitable for others. For example, the NARW appears to be migrating differently and feeding in different areas in response to changes in prey densities related to climate change (Reygondeau and Beaugrand 2011; Meyer-Gutbrod et al. 2015). These long-term, high consequence impacts could include increased energetic costs associated with altered migration routes, reduction of suitable breeding and/or foraging habitat, and reduced individual fitness, particularly juveniles. However, ongoing and planned offshore wind development would not be expected to contribute to climate change impacts on marine mammals, and could result in a beneficial effect for marine mammals due to the decreased use of non-renewable energy sources that contribute to global climate change. See Section 3.4, *Air Quality*, for more details on the expected contribution of offshore wind development to climate change.

3.15.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, not approving the COP would have no additional incremental effect on marine mammals. Marine mammals would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continued impacts on marine mammals, primarily through pile-driving and construction noise, vessel noise, presence of structures, vessel traffic, commercial and recreational fisheries gear interactions, and climate change. BOEM anticipates that the impacts of ongoing non-offshore wind and offshore wind activities would be **major** for NARW due to the current stock status for which serious injury or loss of an individual from vessel strike or entanglement, and the continued stressor of climate change reducing the health and resilience of the population, would result in population-level impacts that threaten the viability of the species. For all other mysticetes, odontocetes, and pinnipeds the impacts of ongoing, non-offshore wind and offshore wind activities would be **moderate**. The adverse impacts that could result in **moderate** effects on other mysticetes include vessel strike, entanglement, and PTS resulting from exposure to anthropogenic noise (e.g., pile driving), which are of high intensity and long term but not expected to result in population consequences. The adverse impacts that could result in moderate effects on odontoncetes and pinnipeds are mainly pile-driving noise resulting in PTS for some species of odontocetes and the risk of entanglement. In all cases, impacts would be detectable and measurable, with no population-level effects expected for these species, except for NARW. Additionally, the presence of structures could result in **minor beneficial** impacts on some marine mammal species (e.g., pinnipeds and delphinids), which may be offset by the potential risks associated with entanglement from fishing gear.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and marine mammals would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on marine mammals due to increased offshore construction, presence of structures, and vessel traffic.

BOEM anticipates that the impacts associated with ongoing and planned non-offshore wind and offshore wind activities in the geographic analysis area would result in impacts from individual IPFs that would range from **negligible** to **moderate** on mysticetes (except NARW), odontocetes, and pinnipeds, and **negligible** to **major** on NARW. Moderate and major impacts would be primarily due to pile-driving and construction noise, increased vessel traffic, and fisheries gear interactions. **Moderate** impacts are expected for mysticete (except NARW), odontocete, and pinniped species as detectable and measurable impacts would occur of medium intensity and occur over a longer period of time and broader geographic region, but would not be expected to have any long-term effects on the populations. For NARW, given the declining population status and impacts from ongoing and planned future vessel traffic and fisheries gear interactions, impacts on NARWs resulting from all IPFs combined are expected to be **major** because serious injury or loss of an individual would result in population-level impacts that threaten the viability of the species if a vessel strike or entanglement were to occur. While vessel activity will increase due to the planned offshore wind projects included in the Cumulative Impacts scenario (planned and ongoing projects) compared to the No Action Alternative (ongoing projects), the planning, monitoring, mitigation, and enforcement of vessel activity, including speed restrictions, will minimize the effects from increased vessel numbers or transits compared to non-offshore wind activities. Additional vessel speed rules may be implemented that could result in a lowered risk from ongoing activities under the No Action Alternative (87 FR 46921); however, until those are in place and efficacy of enforcement is established, this assessment has assumed current conditions in the analysis of impacts. Additionally, the presence of structures could result in **minor beneficial** impacts on some marine mammal species (e.g., pinnipeds and delphinids), which may be offset by the potential risks associated with entanglement from fishing gear.

3.15.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on marine mammals.

- Total number, size, and location of WTGs.
- Total number, size, and location of offshore substations.
- The installation method of the WTG and offshore substations, including the total days of pile driving and time of year during which construction occurs.
- Total number, size, and location of inter-array and offshore export cables.
- Number and types of vessels and ports utilized.
- Vessels and gear utilized to sample environmental parameters in the project area through HRG surveys, fisheries, and biological monitoring.

Variability of the proposed Project design exists as outlined in Appendix E. The following summarizes potential variances in impacts.

- **Total number, size, and location of WTGs, OSSs, and inter-array and offshore export cables:** The level of hazard is proportional to the number of offshore structures and cables installed; fewer structures/cables would present less hazard to marine mammals.
- **Total number, size, and location of WTGs as it relates to hardened structure**: These factors may cause both beneficial and adverse impacts on marine mammals through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement.
- **Number and types of vessels and ports utilized:** The level of hazard is proportional to the number, size, and speed of vessels primarily during transit to and from ports of operation; fewer vessels travelling at slower speeds would present less hazards to marine mammals.
- **Season and duration of construction activities:** Marine mammals are present year-round, with species-variable seasonality. For example, NARWs are more likely to be present in the Offshore Project area during winter and spring but can occur year-round. Implementation of a mitigation or monitoring measure could have a measurable reduction in the potential effect of an IPF.

3.15.5 Impacts of the Proposed Action on Marine Mammals

The following discussions summarize the potential incremental impacts of the Proposed Action on marine mammals when compared to the No Action Alternative during the various phases of the Project. The analysis considered an incremental impact as one occurring as a result of the Proposed Action alone, without addition of baseline or other ongoing offshore wind and non-offshore wind activities. Routine activities would include construction, O&M, and decommissioning of the Proposed Action, as described in Chapter 2, *Alternatives*. Additionally, BOEM prepared a BA for the potential effects on NMFS federally listed species, which found that the Proposed Action may adversely affect marine mammals (BOEM 2023a, 2023b).

Accidental releases: Accidental releases of fuel, fluids, hazardous materials, trash, and debris may increase as a result of the Proposed Action. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present and during the proposed refueling of primary construction vessels at sea. BOEM prohibits the discharge or disposal of solid debris into offshore waters during any activity associated with construction and operation of offshore energy facilities (30 CFR 250.300). The USCG also prohibits dumping of trash or debris capable of posing entanglement or ingestion risk (International Convention for the Prevention of Pollution from Ships, Annex V, Public Law 100–200 [101 Stat. 1458]). The Proposed Action would comply with the federal requirements for the prevention and control of oil and fuel spills and would implement proposed best management practices for waste management and mitigation as well as marine debris awareness training for Project personnel, reducing the likelihood of an accidental release. Dominion Energy would have an Oil Spill Response Plan (COP, Appendix Q; Dominion Energy 2023) in place that would decrease potential impacts in the unlikely event of a spill. Informational training on proper storage and disposal practices to reduce the likelihood of accidental discharges would further reduce the likelihood of an accidental spill from occurring. The incremental impacts of the Proposed Action from accidental releases of hazardous materials and trash/debris would, therefore, not increase the risk beyond that described under Alternative A. In the unlikely event of an accidental oil spill, impacts would be sublethal due to quick dispersion, evaporation, and weathering, all of which would limit the amount and duration of exposure of marine mammals to hydrocarbons. The combined regulatory requirements and best management practices would effectively avoid accidental debris releases and avoid and minimize the impacts from accidental spills such that adverse effects on marine mammals are unlikely to occur. Therefore, there is no anticipated effect on marine mammals, and impacts on mysticetes (including the NARW), odontocetes, and pinnipeds from accidental releases and discharges would be negligible, with no perceptible population-level consequences.

Electromagnetic fields: Normandeau et al. (2011) reviewed the potential effects of EMFs from offshore wind energy projects on marine mammals and other species. They concluded that marine mammals are unlikely to detect magnetic field intensities below 50 milligauss, suggesting that these species would be insensitive to EMF effects from Project electrical cables. Project-related EMFs would be below this threshold and, therefore, indistinguishable from natural variability in the analysis area, except in a few locations where the cable lies on the bed surface (COP, Appendix AA, Table 1; Dominion Energy 2023). The areas with potentially detectable EMFs, if any, would be small, extending only a few feet from the cable. Both offshore export and inter-array cable arrays are high-voltage AC, which would be buried at a depth of approximately 3.3 to 16.5 feet (1 to 5 meters) and installed with appropriate cable shielding and scour protection (where needed). These factors would effectively limit marine mammal exposure EMF originating from the Proposed Action's HVAC cables. These factors indicate that the likelihood of marine mammals encountering detectable EMF is low, and any exposure would be below levels associated with measurable biological effects. Therefore, EMF effects on mysticetes (including the NARW), odontocetes, and pinnipeds would be at the lowest level of detection and negligible, with no perceptible population-level consequences.

New cable emplacement/maintenance: As described in Chapter 2, the inter-array and offshore export cables would be installed using cable burial methods such as jet plow, jet trenching, hydroplow (simultaneous lay and burial), mechanical plowing (simultaneous lay and burial), or other technologies available at the time of installation (or a combination of methods). The preferred installation method would use a jet trencher, while chain cutting, trench forming, pre-trenching, and mechanical plowing are not currently anticipated. Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance, pre-grapnel runs, and MEC identification surveys. Dominion Energy does not anticipate the need for boulder or sand wave removal, based on analysis of previous G&G survey data, which did not identify any boulders larger than 1.6 feet (0.5 meter). A pre-grapnel run may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the siting corridor.

Construction of the Project components would physically disturb the water column and seabed. Final cable installation methods would be determined by the final engineering design process that is informed by detailed geotechnical data, risk assessments, and coordination with regulatory agencies and stakeholders; however, cable emplacement for the inter-array and export cable, regardless of the installation method chosen, is estimated to temporarily disturb up to 2,988.8 acres (1,209.5 hectares) and 3,358.51 acres (1,359.14 hectares) during construction for each cable type, respectively, and the cable protection used for the offshore export cable would comprise a permanent footprint of 1.19 acres (0.48 hectare) over the operational life of the Project (COP, Table 4.2-17; Dominion Energy 2023).

The main effect of seabed disturbances during cable emplacement/maintenance for marine mammals would be the effects of benthic prey species within the Project area (described in Section 3.15.1 and EIS Appendix B). However, significant displacement of prey species during construction and O&M of the Project cables is not expected (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*) so new cable emplacement would not be expected to affect marine mammal foraging. There is no risk of entrainment by trailing hopper suction dredges because the Proposed Action does not project using this dredge equipment. The risk for vessel strike exists, although the risk is anticipated to be inherently small due to the slow-moving speeds during cable-laying activities. Additional vessel strike risk is detailed under the *Vessel traffic* IPF. Mitigation measures, as detailed in COP, Table 4.2-48 (Dominion Energy 2023) and Appendix H of this EIS, such as the use of PSOs to monitor for the presence of marine mammal species in the vicinity of Project operations, minimum separation distances, and vessel strike avoidance measures, would further reduce the potential impact on mysticetes (including the NARW), odontocetes, and pinnipeds that may be in the vicinity of dredging or cable-laying vessels.

BOEM anticipates that short-term and localized seafloor disturbances and increases in turbidity from inter-array cable installation would result in undetectable, negligible impacts on mysticetes (including the NARW), odontocetes, and pinnipeds, with no perceptible population-level consequences. Suspended sediment concentrations during the proposed cable-laying activities would be within the range of natural variability for this location, and above-ambient suspended sediment concentrations would be expected to settle relatively quickly (i.e., within a few hours). Individual marine mammals, if present, would be expected to successfully forage in nearby areas not affected by increased sedimentation, and only non-measurable negligible impacts, if any, on mysticetes (including the NARW), odontocetes, and pinnipeds would be expected given the localized and temporary nature of the potential impacts.

Noise: Activities associated with the Proposed Action that could cause underwater noise effects on marine mammals are impact pile driving (for the installation of WTGs and OSSs; installation and removal of goal posts), vibratory pile driving (for the installation of WTGs and OSS; installation and removal of cofferdams at landfall sites), HRG surveys, vessel traffic, and cable-laying activities. MEC detonation is not anticipated and, therefore, is not considered further (Tetra Tech 2022a). While all of these noise sources occur during construction, only WTG operation, HRG surveys, vessel traffic, and cable laying or trenching for cable repairs, if necessary, would occur during operation. Decommissioning activities related to noise would likely be similar to or less than those outlined for construction activities (with the exception of vibratory and impact pile driving for foundations).

Impact and vibratory pile driving: The Project PDE includes both impact and vibratory pile driving as an option for installation of the WTG monopile foundations and OSS jacket foundations, as well as vibratory pile driving, which would be used to install the cofferdams and impact pile driving of the goal post piles for nearshore cable landfall activities (COP, Appendix Z; Dominion Energy 2023). All these activities have potential to produce noise above recommended marine mammal acoustic thresholds (Table 3.15-5). Underwater acoustic modeling was conducted for the Project (COP, Appendix Z; Dominion Energy 2023) for impact and vibratory pile driving activities, and the results are summarized in Table 3.15-6. For the purposes of this assessment, the deep modeling location using the maximum hammer energy is provided for each scenario to show the maximum potential risk of impacts from the proposed pile-driving activities

Table 3.15-6 Summary of Underwater Acoustic Modeling Conducted at the Deep Location for the Coastal Virginia Offshore Wind Commercial Project Construction and Operations Plan[1]

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold ($L_{p,pk}$)				Distance to PTS Threshold ($L_{E,24hr}$)				Distance to Behavioral Threshold (L_P)
		LFC	MFC	HFC	PPW	LFC	MFC	HFC	PPW	All Hearing Groups
Standard Driving[2] Installation – Impact Pile Driving	10	132	29	663	141	4,396	170	2,139	1,267	6,182
Standard Driving Installation – Vibratory Pile Driving	10	--	--	--	--	141	0	85	0	8,866
Hard-to-Drive[3] Installation – Impact Pile Driving	10	132	29	663	141	4,980	187	2,304	1,358	6,182
Hard-to-Drive Installation – Vibratory Pile Driving	10	--	--	--	--	113	0	120	31	8,866
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	10	132	29	663	158	5,663	226	2,884	1,756	6,182
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	10	--	--	--	--	158	0	120	31	8,866
OSS Piled Jacket – Impact Pile Driving	10	0	0	197	0	2,680	48	1,435	1,283	2,172
OSS Piled Jacket – Vibratory Pile Driving	10	--	--	--	--	75	0	68	0	3,601
Cofferdam Installation – Vibratory Pile Driving	0	--	--	--	--	108	0	0	0	3,097
Goal Post Pile Installation – Impact Pile Driving	0	2	0	31	3	591	21	704	316	1,450

-- = not applicable; $L_{p,pk}$ = peak sound pressure level in units of dB referenced to 1 micropascal;; $L_{E,24hr}$ = sound exposure level over 24 hours in units of dB referenced to 1 micropascal squared second; L_P = root-mean-square sound pressure level in units of dB referenced to 1 micropascal; PPW = phocid pinniped in water PTS = permanent threshold shift.

[1] Distances to the TTS auditory thresholds for marine mammals were not included in the underwater acoustic modeling for the Proposed Action.

[2] One monopile foundation is installed in a 24-hour period using a vibratory pile driving for a duration of 60 minutes followed by 85 minutes of impact pile driving.

[3] One monopile foundation is installed in a 24-hour period using a “hard-to-drive” schedule where additional time is required to reach the target penetration requiring up to 30 minutes of vibratory pile driving followed by 99 minutes of impact pile driving.

(Table 3.15-6). Additional details about all the modeled scenarios can be found in Appendix J, *Overview of Acoustic Modeling Report*, as well as the acoustic modeling report prepared for this Project (COP, Appendix Z; Dominion Energy 2023). The levels of noise attenuation applied to each scenario are based on the exposure modeling conducted for Dominion Energy's LOA application (Tetra Tech 2022a, 2022b) for the Proposed Action. The Proposed Action includes using near-to-pile noise mitigation systems that, while not specified at this time, include a Hydro Sound Damper, the Noise Mitigation Sleeve, or the AdBm Noise Mitigation System; far-from-pile noise mitigation systems, such as a double big bubble curtain; or a combination of near-to and far-from pile mitigation systems to achieve, at minimum, acoustic isopleth ranges that meet the modeled scenario assuming 10 dB noise mitigation.

Noise produced by both impact and vibratory pile driving during installation of WTG and OSS foundations is the noise IPF with the greatest predicted measurable acoustic impact on marine mammals. As summarized in Table 3.15-6, ranges to the PTS thresholds for impact pile driving may extend up to 3.5 miles (5.6 kilometers) for LFC; 0.1 mile (0.2 kilometer) for MFC; and 1.8 miles (2.9 kilometers) for HFC; and 1.1 miles (1.8 kilometers) PPW. Ranges to the PTS thresholds for vibratory pile driving of the WTGs were generally much smaller than those for impact pile driving, extending up to 518 feet (158 meters) for LFC, 0 feet (0 meters) for MFC, 393 feet (120 meters) for HFC, and 102 feet (31 meters) for PPW (Table 3.15-6). Behavioral disturbances may also occur during installation of the WTGs and OSSs, as ranges to the behavioral thresholds may extend up to 3.7 miles (6 kilometers) for impact pile driving and up to 6.3 miles (10.1 kilometers) for vibratory pile driving (Table 3.15-6).

The Project would implement soft-start procedures during impact pile driving of the WTG and OSS foundations as soft-start is not feasible for vibratory pile-driving operations, as well as marine mammal monitoring, which would minimize the potential for impacts on all marine mammals. Additionally, PAM will occur during all foundation installation activities, and sound field verification (SFV) measurements will be performed on a subset of foundation installation locations to monitor the underwater sound produced during pile driving (vibratory and impact) activities for both the monopile and jacket foundations. The Lessee must submit an SFV Plan to BOEM, BSEE, NMFS Office of Protected Resources, and NMFS Greater Atlantic Regional Office (GARFO) at least 180 days before foundation pile driving is planned to begin. BOEM, BSEE, NMFS Office of Protected Resources, and NMFS GARFO will review the plan and will provide comments within 45 days of receipt of the plan. NMFS provides comments to BOEM, BSEE, and the Lessee, which will include a determination as to whether the plan is consistent with the requirements outlined in the MMPA ITA, Biological Opinion, and the Incidental Take Statement. If the plan is determined to be inconsistent with these requirements, the Lessee must resubmit a modified plan that addresses the identified issues at least 15 days before the start of the associated activity; at that time, BOEM, BSEE, and NMFS will discuss a timeline for review and approval of the modified plan. Under the terms of the NMFS Biological Opinion, the Lessee must obtain BOEM, BSEE, NMFS Office of Protected Resources, and NMFS GARFO's concurrence with this plan prior to the start of pile-driving activities. The plan must describe (e.g., using engineering and driving analysis, site surveys, bathymetric and geological information, modeling analysis) how the Lessee will ensure that the first three monopile and pin pile installation sites selected for SFV are representative of the rest of the monopile and pin pile installation sites. In the case that these sites are not determined to be representative of all other monopile and pin pile installation sites, the Lessee must include information on how additional sites will be selected for SFV. The plan must also include methodology for collecting, analyzing, and preparing SFV data for submission to BOEM, BSEE, and NMFS. The Lessee's plan must describe how the effectiveness of the sound attenuation methodology will be evaluated based on the results. The Lessee must also provide, as soon as they are available, but no later than 48 hours after each installation, the initial results of the SFV measurements to BOEM, BSEE, and NMFS GARFO in an interim report after each monopile for the first three piles and pin pile installation for all three full jacket foundations (using four pin piles each). If any interim SFV report submitted for any of the first three monopiles indicates the sound fields exceed the modeled distances to any protected species injury or behavioral harassment/disturbance thresholds (as modeled assuming 10 dB attenuation), the Lessee must carry out SFV for the next three monopiles and provide a SFV report to BOEM, BSEE, and NMFS within 48 hours after each foundation is installed. If any interim SFV report submitted for the first three monopiles and all three jacket foundation indicates the sound fields exceed the modeled distances to any protected species injury or behavioral harassment/disturbance thresholds (as modeled assuming 10 dB attenuation), the Lessee must prepare a plan outlining a combination of enhanced PAM and visual observation to cover the extended clearance and shutdown zones. After the first three monopiles and all three full jacket foundations (i.e., 12 pin piles), BOEM, BSEE, or NMFS may require the Lessee to carry out additional SFV on monopile foundations and provide additional interim SFV reports to BOEM, BSEE, and NMFS if the measured sound fields continue to exceed the modeled results. These requirements are in addition to the requirement for the Lessee to implement additional sound attenuation measures and/or adjustments to clearance and shutdown zones if sound fields exceed the modeled distances to any protected species injury or behavioral harassment/disturbance thresholds (as modeled assuming 10 dB attenuation).

Based on the ranges to the thresholds estimated with 10 dB noise attenuation, there is some risk of PTS occurring for all hearing groups except MFC as this hearing group is the only one with impact pile-driving ranges to the PTS threshold estimated at <0.6 mile (<1 kilometer). This is further validated by the exposure modeling in the LOA application, which showed no PTS exposures for any MFC species (Tetra Tech 2022b). However, the use of pre-start clearance protocols and shutdowns would help reduce the likelihood that individuals from other hearing groups would be present within the ensonified areas for sufficient duration and at sufficient intensity for PTS to be realized. Additional measures for NARW would be implemented to eliminate the risk of PTS, specifically the following (Tetra Tech 2022a):

- Foundation installation will only occur between May and October, in order to avoid the winter and spring seasons when NARW presence is greatest.
- Pre-start clearance monitoring and shutdowns during foundation installation will occur at any distance from the source if a NARW is detected visually or acoustically.
- PSOs will visually monitor from the foundation construction vessel, and a minimum of two PSO monitoring vessels will be required to fully monitor the maximum 3.7-mile (6-kilometer) PTS range estimated for LFC (Table 3.15-6).
- A real-time PAM system will be designed and deployed to supplement visual monitoring such that NARW detection capabilities extend to a minimum of 3 miles (5 kilometers) from all foundation installation activities.
- Nighttime pile driving has not been proposed nor is it planned by Dominion Energy at present and would only be allowed upon the receipt and approval of an Alternative Monitoring Plan. Therefore, no foundation installation activities will occur during nighttime except under specified safety and engineering conditions defined in Appendix H, and all PSOs will be equipped with night vision equipment and infrared technology should monitoring be required during nighttime or low visibility conditions.
- A minimum visibility range[4] will be maintained during all foundation installations, and no piling will commence if this visibility range is not met.
- A soft-start procedure will be implemented.

[4]The minimum visibility range will be further determined through further consultation with the agencies within the final issued LOA and may vary depending on results of the SFV.

For all other species, the Project will implement group-specific clearance and zones that will be monitored for at least 60 minutes prior to the start of pile driving to ensure no marine mammals are present when pile driving begins (Tetra Tech 2022a). The respective clearance and shutdown zones were determined based on the different pile-driving scenarios (i.e., one pile installed per day, two piles installed per day) and are summarized in Table 3.15-7.

Table 3.15-7 Summary of Clearance and Shutdown Zones for Impact Pile Driving of the Foundations under the Proposed Action

Species Group	Clearance Zone (meters)		Shutdown Zone (meters)	
	One Pile per Day	Two Piles per Day	One Pile per Day	Two Piles per Day
NARW	At any distance	At any distance	At any distance	At any distance
All other mysticetes and sperm whales	5,100	6,500	1,750	1,750
Harbor porpoise	750	750	750	750
Dolphins and pilot whales	500	500	500	500
Seals	500	500	500	500

Piling would cease when practicable as determined by the lead engineer on duty (Tetra Tech 2022a) until the animal had been observed moving away. However, as discussed in Section 3.15.3.2, *Cumulative Impacts of the No Action Alternative,* potential behavioral disturbances that do occur are likely to be short term given the intermittent nature of the proposed pile-driving activities (<4 hours per pile and up to a maximum of two piles per day over an approximate 2-year construction period; Tetra Tech 2022a) and will dissipate once the pile-driving activities have ceased. Therefore, it is expected that with the mitigation included under the Proposed Action, no population-level impacts are expected to occur for any species if PTS were to occur.

Behavioral and masking effects are more difficult to mitigate, and with the threshold ranges extending to a maximum of 3.8 miles (6,182 meters) for the installation of one standard and one hard-to-drive pile, behavioral disturbances are considered likely during impact pile driving, and a maximum of 5.5 miles (8,866 meters) during vibratory pile driving of one standard and one hard-to-drive pile. As described in Section 3.15.3.2, the most common behavioral effect of both impact and vibratory pile driving on marine mammals is temporary avoidance or displacement from the pile-driving site (Dahne et al. 2013; Brandt et al. 2016; Benhemma-Le Gall et al. 2021). Other effects may include adverse impacts on foraging ability resulting from the increased background noise near the pile-driving site, which could decrease odontocete target detection abilities and decrease their catch rate success (Branstetter et al. 2018; Kastelein et al. 2019). However, studies to date are only available for MFC, HFC, and PPW species, and knowledge of pile-driving effects on LFC species is primarily based on their responses to other impulsive sources such as airguns as proxies (Section 3.15.3.2). Behavioral responses in LFC include avoidance of the sound source, cessation of feeding behaviors, and changes in dive behavior (Malme et al. 1986, 1989; Richardson et al. 1986; Johnson 2002; McCauley et al. 1998). However, Dunlop et al. (2017) also indicate that behavioral responses were more likely to occur within 2.5 miles (4 kilometers) of the source, and beyond that the severity of the behavioral changes is likely to decrease.

Overall, based on both the modeled ranges and the exposure assessment provided in the LOA application (Tetra Tech 2022a, 2022b), there is risk of PTS for all LFC except NARW given the above-noted mitigation that will be implemented under the Proposed Action, as well as for all HFC and PPW species during installation of the WTG and OSS foundations (Tetra Tech 2022a, 2022b). However, due to the low threshold ranges (Table 3.15-6) and results of the exposure modeling (Tetra Tech 2022a) no PTS is likely to occur for any MFC species. The modeled exposure numbers and requested take from Tetra Tech (2022a, 2022b) are summarized in Appendix J, *Overview of Acoustic Modeling Report*. Behavioral disturbances could occur for all marine mammal species during foundation installation, but these would be expected to be short term, and individuals affected would likely return to pre-construction behaviors once pile driving has ceased. Therefore, noise produced during installation of the WTG and OSS foundations may result in moderate impacts on LFC (except the NARW), HFC, and PPW as the potential impacts would be detectable and measurable, but the populations would sufficiently recover once pile driving has ceased; with minor impacts on MFC and the NARW due to the low risk of PTS occurring. However, if a NARW were to experience PTS despite the mitigation measures implemented, then the impact on that species would be major as population-level effects could be realized.

Vibratory pile driving during installation of the cofferdams is not expected to result in any auditory injury as thresholds are not exceeded beyond 354 feet (108 meters) from the source for LFC species, and not exceeded at any distance for the remaining hearing groups (Table 3.15-6). There is a risk of behavioral disturbances based on the modeled threshold distance of 1.9 miles (3 kilometers) for all marine mammals; however, the short duration of vibratory pile-driving activities at the nearshore location of the cofferdam installation would limit marine mammal exposure. Up to nine temporary cofferdams, if needed, would be installed via vibratory pile driving approximately 1,000 to 1,800 feet (305 to 549 meters) offshore (COP, Section 3.4.2; Appendix Z, Section Z.5.2; Dominion Energy 2023), limiting the number and species of marine mammals potentially present during operations. This is further evidenced by the exposure modeling in the LOA application (Tetra Tech 2022b), which showed exposures above the behavioral disturbance threshold for only a few dolphin species and seals. Additionally, the behavioral threshold for vibratory pile driving is a sound pressure level (L_P) of 120 dB referenced to 1 micropascal, which represents the lowest L_P to which a marine mammal may respond. However, behavioral responses are situationally dependent, and the type and level of disturbance will vary based on several factors such as species, development phase, and an individual's previous exposure to noise (Ellison et al. 2012; Southall et al. 2021b). Furthermore, if a behavioral response were to occur, it would not necessarily be biologically notable or result in population-level impacts. Due to the duration and location of vibratory pile driving, it is unlikely any notable adverse behavioral disturbances would occur. Impacts on all mysticetes (including the NARW), odontocetes, and pinnipeds would barely be measurable and would, therefore, be negligible, with no perceptible population-level consequences.

Impact pile driving during installation of the goal post piles used to support trenchless installation of the export cable is also not expected to result in PTS for any species based on the modeled ranges (1,939 feet [591 meters] for LFC; 69 feet [21 meters] for MFC; 2,310 feet [704 meters] for HFC; and 1,037 feet [316 meters] for PPS), but there is potential for behavioral disturbances for which ranges that meet or exceed this threshold may extend to 0.9 mile (1,450 meters) (Table 3.15-6). However, compared to impact pile driving for the WTG and OSS foundations, noise levels produced during installation of the goal post piles would be substantially lower and this activity would occur over a relatively shorter period (24 days) so any behavioral effects would be temporary and would not affect an individual's ability to successfully obtain food to maintain their health, make seasonal migrations, or participate in breeding or calving. Additionally, the Project would shut down pile-driving activities at any distance a NARW is visually or acoustically detected; at 0.6 mile (1,000 meters) for all other LFC, sperm whales, and pilot whales; and at 328 feet (100 meters) for all other marine mammal species (Tetra Tech 2022a), which would fully encompass the modeled PTS ranges and would effectively reduce the risk of exposure to noise above the behavioral disturbance threshold for any species. This is further evidenced by the exposure modeling in the LOA application, which predicted exposures above the behavioral disturbance threshold for only a few dolphin species and seals (Tetra Tech 2022b). Due to the duration and modeled threshold ranges (Table 3.15-6), behavioral disturbances would be limited to a few individuals and would have no perceptible consequences to those individuals or the populations, and impacts on all mysticetes (including the NARW), odontocetes, and pinnipeds are therefore expected to be negligible.

HRG surveys: The LOA application estimated that PTS threshold distances from HRG survey equipment were 0.3 foot (0.1 meter) during operation of a sparker system and 19.4 feet (5.9 meters) during operation of a boomer system for LFC; 0 feet (0 meters) for a sparker system and 0.7 foot (0.2 meter) for a boomer system for MFC; 4.9 feet (1.5 meters) for a sparker system and 177.8 feet (54.2 meters) for a boomer system for HFC; and 0.3 foot (0.1 meter) for a sparker system and 11.5 feet (3.5 meters) for a boomer system for PPW (Tetra Tech 2022a). Behavioral disturbance threshold showed larger estimated distances, up to 328 feet (100 meters) for the sparker system and 72 feet (21.9 meters) for the boomer system for all marine mammals. Given these small ranges, PTS is not expected to occur for any species, and any behavioral disturbances that may occur would be temporary and limited to brief changes in swim direction and/or speed. However, as discussed in Section 3.15.3.2, recent empirical studies showed most HRG sources are unlikely to result in behavioral disturbances for marine mammals, and no changes in foraging or mating behavior, which could affect the continued viability of a given population, would occur. Additionally, the Proposed Action includes implementation of a 1,640-foot (500-meter) clearance and shutdown zone for NARW and all other ESA-listed marine mammals, and a 328-foot (100-meter) clearance and shutdown zone for all other marine mammal species, which would further reduce the risk of behavioral disturbances occurring during the Project HRG surveys (Appendix H, *Mitigation and Monitoring*). Therefore, potential impacts on all mysticetes (including the NARW), odontocetes, and pinnipeds are expected to be negligible as any disturbances would be at the lowest level of detection, barely measurable, and result in no perceptible population-level consequences.

Vessels: Both larger and smaller vessels may be used throughout Project construction, and smaller vessels are expected to make routine trips to the Lease Area for routine maintenance (COP, Sections 3.4.1.5 and 3.5.3; Dominion Energy 2023). Project vessel noise has the potential to exceed the behavioral threshold for marine mammals; however, these disturbances would be localized and would not affect biologically important behaviors such as foraging or mating. Larger construction vessels would be used during other construction activities such as pile driving, and it is more likely marine mammals will respond to that noise rather than noise from the vessels. BOEM anticipates that underwater noise generated by larger vessels used for Project activities would overlap the hearing range of several mysticetes (e.g., LFC) including the blue, fin, humpback, sei, minke, and NARW, and would be audible to these species. However, the noise levels generated by Project vessels would be below the PTS thresholds of all marine mammal species; therefore, vessel noise from Project activities is not expected to result in PTS-level effects. As discussed in Section 3.15.3.2, Project vessels and associated noise impacts could result in a range of behavioral responses, including the onset of avoidance behavior (e.g., heading away or increasing range from the source); changes in acoustic behavior (brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential), and diving and subsurface interval behavior (increased interval between surfacing bouts); and no detectable response and brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential (Southall et al. 2021b). However, these effects would be expected to dissipate once the vessel or individual has left the area, and no long-term or population-level impacts are expected. Additionally, all Project vessels would implement mitigation to prevent potential vessel strikes (Appendix H), which would also prevent any marine mammal from getting close enough to transiting vessels to be exposed to above-threshold noise levels. BOEM therefore anticipates impacts on mysticetes (including the NARW), odontocetes, and pinnipeds from Project vessel noise to be minor as effects would be detectable, though short term, localized, and not expected to lead to population-level effects.

Cable laying: The most likely cable burial methods being considered as part of the Proposed Action are jet plow, jet trenching, hydroplow (simultaneous lay and burial), and mechanical plowing (simultaneous lay and burial) (COP, Section 3.4, Dominion Energy 2023). These cable burial methods are expected to produce low-frequency noise at relatively low sound levels compared to pile driving, as discussed in Section 3.15.3.2. Potential impacts would be limited to behavioral disturbances that are short term and localized around the immediate area surrounding the cable installation activities; prolonged behavioral disturbances that would result in population-level impacts are unlikely to occur given the characteristics of the noise (Section 3.15.3.2) and the duration of this activity (Chapter 2). Acoustic masking of LFC species is also not expected to result during cable installation for this Project given the number of vessels and equipment that would be required under the Proposed Action relative to the planned offshore wind development projects assessed in Section 3.15.3.2. Impacts from Project cable installation noise would therefore be barely measurable and negligible for all mysticetes (including the NARW), odontocetes, and pinnipeds, with no perceptible population-level consequences.

Operational WTGs: Operational noise from WTGs, while detectable, is not expected to result in any long-term or biologically notable impacts on marine mammals. As discussed in Section 3.15.3.2, noise produced by WTGs is within the hearing range for marine mammals, particularly for LFC species as WTG noise is predominantly in the lower frequencies (<200 Hz) (Tougaard et al. 2020; Stöber and Thomsen 2021). Therefore, operations of the WTGs would result in long-term, low-level, continuous noise in the Project area, which could result in behavioral disturbances and auditory masking at close distances (Lucke et al. 2007; Tougaard et al. 2009, 2020; Thomsen and Stöber 2022). More recently, Betke and Bellmann (2023) conducted standardized underwater sound measurements from 25 German offshore wind farms that included turbines up to 8 MW. The trend analysis in the Betke and Bellmann (2023) study showed that there was no statistical increase in radiated noise with increasing turbine power size. Results from field measurements showed primary frequency ranges between 50 and 200 Hz consistently across all wind farms regardless of turbine type. The average SPL for monopile foundations measured 121.5 dB re 1 µPa at 328 feet (100 meters) from the foundation. This measurement was 0.5 dB higher for other foundation types. Average SPL for foundations with gear box drives was 122.3 dB re 1 µPa at 328 feet (100 meters) from the foundation; foundations with gearless (direct) drive were 2.3 dB lower.

The overall number of WTGs (up to 202 under the Proposed Action) may result in a higher source level relative to previously measured WTGs. However, the potential for impact is not likely to occur outside a relatively small radius surrounding the Project foundations, and the audibility of the WTGs may be further limited by the ambient noise conditions of the Project area (e.g., Jansen and de Jong 2014). Although WTG noise may exceed ambient sound levels present within the Proposed Action area, it is not expected to exceed noise produced by vessel traffic out to 0.6 mile (1 kilometer) (Tougaard et al. 2020). Impacts on all mysticetes (including the NARW), odontocetes, and pinnipeds would therefore be similar to those described for vessel noise under Section 3.15.3.2, *Cumulative Impacts of the No Action Alternative*, which would be detectable, localized, long term, and minor, with no population-level consequences.

Port utilization: The primary port that will be utilized under the Proposed Action during construction would be the Port of Portsmouth, Virginia. The onshore O&M facility is anticipated to be based in Hampton Roads–Lynnhaven, Virginia. The Proposed Action would generate trips by support vessels, such as crew transports vessels, hotel vessels, tugs, and miscellaneous vessels (COP, Appendix S, Section 18.1; Dominion Energy 2023), resulting in an increase in vessel traffic in the region and potentially contributing to the need for expansion or increased maintenance of port facilities within the marine mammal geographic analysis area. However, no specific project proposals were developed as part of the Proposed Action; therefore, impacts resulting from potential port expansion or increased maintenance of port facilities cannot be evaluated in this EIS. Expansion could result in adverse effects on coastal and estuarine habitats from shoreline noise during construction and disturbance or loss of habitat for prey species. Increased maintenance such as dredging could expose marine mammals to increased levels of underwater noise and increase turbidity, affecting individual marine mammals or their prey. Increased port expansion and port maintenance would likely be intermittent but long term. Increased vessel traffic associated with the specified ports is covered in the *Vessel traffic* IPF section. Any future port maintenance or expansion projects would be subject to additional NEPA analysis.

Gear utilization: The presence of gear used for fisheries and benthic monitoring surveys under the Proposed Action could affect marine mammals by entrapment or entanglement. The anchoring lines and buoys used to secure the pots/traps, such as those that would be used for the black sea bass and whelk surveys under the Proposed Action, may pose an entanglement risk to marine mammals. However, these risks would be reduced through implementation of mitigation procedures included in monitoring plans. Equipment used in the fisheries monitoring surveys would use both weak-link and weak-rope technologies that are consistent with the changes outlined in the Atlantic Large Whale Take Reduction Plan (NOAA 2021). However, given the relatively limited extent and duration of these surveys and the application of monitoring and mitigation measures (e.g., soak time limits, gear marking, and recovery of lost gear requirements; Appendix H), entanglement as a result of the Proposed Action is not likely to occur, and impacts, if any, would not lead to population-level effects. The impact of gear utilization as a result of the Proposed Action, therefore, is expected to be negligible and with no perceptible population-level consequences for mysticetes (including the NARW), odontocetes, and pinnipeds.

Presence of structures: The various types of impacts on marine mammals that could result from the presence of structures are described in detail in Section 3.15.3.1, *Impacts of the No Action Alternative*. The Proposed Action would add up to 205 new structures (up to 202 new WTGs and 3 OSSs) on the OCS. WTGs would be spaced in a 0.93 by 0.75 nautical mile (1.7 by 1.4 kilometer) offset grid pattern (east-west by northwest by southeast gridded layout). See COP, Section 3.3 (Dominion Energy 2023) for detailed information regarding the WTG structures. Based on documented lengths (Wynne and Schwartz 1999), the largest NARW (59 feet [18 meters]), fin whale (79 feet [24 meters]), sei whale (59 feet [18 meters]), and sperm whale (59 feet [18 meters]) would fit end to end between two foundations spaced at 1 nautical mile (1.9 kilometers) 100 times over. This simple assessment of spacing relative to animal size indicates that the physical presence of the monopile foundations is unlikely to pose a barrier to the movement of large marine mammals, and even less likely to impede the movement of smaller marine mammals. On this basis, BOEM concludes that the presence of the Project's WTG foundations would pose a negligible risk of impeding the movements of marine mammals. The presence of the monopile foundations over the life of the Project could affect marine mammal foraging and migratory movements, which could additionally result in the displacement of individuals. Additional impacts may occur if individuals are displaced into areas with higher risk of vessel and/or fisheries interactions.

The potential hydrodynamic effects identified in Section 3.15.3.1 from the presence of vertical structures in the water column could affect nutrient cycling and could influence the distribution and abundance of fish and planktonic prey resources (van Berkel et al. 2020; Golbazi et al. 2022; Raghukumar et al. 2022). Localized turbulence and upwelling effects around the monopiles are likely to transport nutrients into the surface layer, potentially increasing primary and secondary productivity. That increased productivity at a local scale could be partially offset by the formation of abundant colonies of filter feeders on the monopile foundations. While the net impacts of these interactions are difficult to predict, they are not likely to result in more than localized effects on the abundance of zooplankton. Turbulent mixing would be increased locally within the flow divergence and in the wake, which would enhance local dispersion and dissipation of flow energy. However, because the monopiles would be spaced in a 0.93 by 0.75 nautical mile (1.7 by 1.4 kilometer) offset grid pattern, there would be less than 1 percent areal blockage, and the net effect over the spatial scale of the Project would be negligible. When considered relative to the broader oceanographic factors that determine primary and secondary productivity in the region, localized impacts on zooplankton abundance and distribution are not likely to measurably affect the availability of prey resources for marine mammals. Habitat conditions would be expected to revert back to pre-Project conditions when the Project is decommissioned, or to a similar condition within the limits determined by climate change and other ongoing environmental trends.

Long-term reef and hydrodynamic effects of the Proposed Action could result in beneficial effects on fish-eating odontocetes and pinnipeds that benefit from increased prey abundance around the structures.

Conversely, minor adverse effects due to disruption in hydrodynamics from the Proposed Action could result in impacts on NARW and mysticetes that forage on plankton and forage fish. However, no long-term, population-level effects on any of these species, including NARW, would be expected to occur as the Project does not occur in any designated critical foraging habitat or biologically important feeding area identified for these species. Structures associated with the Project may provide some level of reef effect and may result in long-term, minor beneficial impacts on pinniped and small odontocete foraging and sheltering, but these benefits could be offset by the potential of entanglement in derelict fishing gear.

The presence of structures could also result in interaction with active or abandoned fishing gear or in a shift from mobile to fixed fishing methods that could increase entanglement risk to large whales. Periodic monitoring and reporting of marine debris around WTG foundations (Appendix H, Table H-2) provides BOEM with the ability to better assess these risks. While it is recognized that offshore wind facilities provide structure and, therefore, additional fishing opportunities, it is not anticipated that overall fishing effort in the geographic analysis area would increase. Furthermore, commercial and recreational fishing efforts and their impacts on protected species would be managed through state and federal regulations. Regarding the risk of marine mammal entanglement in marine debris that becomes caught on foundation structures, there is little evidence from existing artificial reef sites in the Atlantic Ocean where this is the likely outcome. The likelihood of an increased risk of entanglement beyond the environmental baseline is considered negligible. Thus, the incremental impact of additional structures is not expected to lead to population-level effects on marine mammal species.

In summary, long-term reef and hydrodynamic effects resulting from the Proposed Action could result in minor beneficial effects on fish-eating marine mammals such as odontocetes and pinnipeds that benefit from increased prey abundance around the structures. These effects could cause localized changes to prey distribution but do not suggest a notable change in prey availability. Long-term reef and hydrodynamic effects could result in non-measurable, negligible effects on mysticetes (including the NARW) that forage on plankton and forage fish, but no perceptible consequences for individuals or populations are expected. BOEM concludes that the physical presence of WTG and OSS foundations would pose a non-measurable, negligible risk of physical displacement by posing a barrier to movement for mysticetes (including the NARW), odontocetes, and pinnipeds, with no perceptible consequences for individuals or populations. Entanglement in debris caught on structures is unlikely to occur, and as a result, impacts due to entanglement are considered non-measurable and negligible, with no perceptible population-level consequences for mysticetes (including the NARW), odontocetes, and pinnipeds.

Lighting: The Proposed Action would introduce stationary artificial light sources in the form of navigation, safety, and work lighting. Orr et al. (2013) summarized available research on potential operational lighting effects from offshore wind energy facilities and developed design guidance for avoiding and minimizing lighting impacts on aquatic life, including marine mammals. BOEM concluded that the operational lighting effects on marine mammal distribution, behavior, and habitat use were negligible if recommended design and operating practices are implemented. Therefore, BOEM anticipates that operational lighting effects on mysticetes (including the NARW), odontocetes, and pinnipeds would be non-measurable and negligible, with no perceptible individual or population-level consequences.

Vessel traffic: Construction vessels pose a potential collision risk to marine mammals as detailed in Section 3.15.1. The vessels used for Project construction are described in COP, Section 3.4.1 and detailed in COP, Table 3.4-5 (Dominion Energy 2023). COP, Appendix S: *Navigation Safety Risk Assessment* provides an additional comprehensive analysis of ongoing vessel traffic and risks to navigation. The Project would only have a minor impact on baseline vessel traffic in the analysis area. The relative risk of vessel strikes associated with the Proposed Action is dependent upon the stage of development (i.e., construction, operations, or conceptual decommissioning), time of year, number of vessels, and speed of vessels during each stage. Construction vessels would either remain stationary when installing the monopiles/pin piles for jacket foundations and WTG/OSS equipment or move slowly (i.e., at less than 10 knots [18.5 kilometers per hour]) when travelling between foundation locations (Dominion Energy 2023).

Vessel trips would average 46 trips per day through the duration of construction activities (January 2023 through August 2027) between the primary construction vessel port in Portsmouth, Virginia, to the Lease Area. Daily estimated vessel trips would be dependent on the construction period and activity, and range from a minimum of 3 trips per day to a maximum of 95 trips per day. Project operations would involve roughly weekly crew transfer vessel transits, biweekly service operations vessel transits, and additional vessel activity for routine surveys and support, in total equating to approximately 253 annual vessel round trips originating from the Norfolk, Virginia, O&M facility (COP, Appendix N; Dominion Energy 2023). Planned mitigation measures, including vessel strike avoidance procedures, voluntary speed restrictions, PAM monitoring of the transit corridor, and use of PSOs, would effectively limit collision risk when travelling to and from area ports (Appendix H). The risk of vessel strike would be long term because vessel interactions with marine mammals could occur during construction, O&M, or decommissioning of the Project.

Vessel collisions are a key source of mortality and serious injury for many marine mammal species (Hayes et al. 2021, 2022, 2023; Laist et al. 2001; Rockwood et al. 2017; Schoeman et al. 2020), indicating the importance of protective measures to minimize risks to vulnerable species. If a vessel strike does occur, the impact on individual marine mammals could cause injuries ranging from minor to mortality; therefore, population-level impacts would range from negligible to major, depending on the species and severity of the strike. However, Dominion Energy has committed to a range of APMs to avoid vessel collisions with marine mammals (Appendix H, Table H-1). These APMs would minimize encounters that have a high risk of resulting in collision or injury by reducing both the encounter potential (e.g., trained visual observers, vessel separation distances, seasonal restrictions, avoidance of aggregations, strict adherence to NMFS Regional Viewing Guidelines for vessel strike avoidance) and severity potential (e.g., vessel speed reduction, vessel positioning parallel to animals). These APMs, plus additional strike avoidance measures (Appendix H, Table H-2), are considered effective at avoiding and minimizing collision risk. Therefore, with implementation of these known and highly effective measures, BOEM concludes that vessel strikes are unlikely to occur. As a result, there is no anticipated effect on marine mammals and collision effects due to the Proposed Action would, therefore, be negligible for mysticetes, odontocetes, and pinnipeds.

3.15.5.1 Cumulative Impacts of the Proposed Action

Accidental releases: In context of reasonably foreseeable environmental trends, combined impacts of accidental releases on marine mammals from ongoing and planned actions, including the Proposed Action, are expected to be temporary and highly localized due to the likely limited extent and duration of a release. The Proposed Action would contribute an undetectable increment to cumulative accidental release impacts, resulting in negligible impacts on all mysticetes (including the NARW), odontocetes, and pinnipeds that are barely measurable and with no perceptible population-level consequences.

Electromagnetic fields: In context of reasonably foreseeable environmental trends, the combined impacts of EMFs on marine mammals from ongoing and planned actions, including the Proposed Action, are expected to be long term but highly localized. The incremental impact contributed by the Proposed Action would result in a noticeable increase in EMFs in the geographic analysis area beyond that described under the No Action Alternative. However, the cumulative impacts from EMFs would likely still be negligible and at the lowest level of detection for all mysticetes (including the NARW), odontocetes, and pinnipeds, with no perceptible population-level consequences.

New cable emplacement/maintenance: In context of reasonably foreseeable environmental trends, the combined cable emplacement impacts on marine mammals from ongoing and planned actions, including the Proposed Action, are expected to be highly localized and temporary. The Proposed Action would contribute an undetectable increment to the cumulative cable emplacement impacts on mysticetes (including the NARW), odontocetes, and pinnipeds, which are expected to be barely detectable and negligible. Some non-measurable negligible impacts on mysticetes (including the NARW), odontocetes, and pinnipeds could occur if impacts occur in close temporal and spatial proximity, though these impacts would not be expected to be biologically notable and would be minimized due to the implementation of mitigation measures. No perceptible population-level consequences are expected.

Noise: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the cumulative noise impacts on the Atlantic OCS generated by other ongoing and planned activities including offshore wind. Construction-related noise impacts would occur within a limited time frame. However, long-term noise sources from operational turbines and vessels would persist. All effects on marine mammals from noise (e.g., some PTS, TTS, behavioral changes, masking) are anticipated to be the same as described in Section 3.15.3.2, *Cumulative Impacts of the No Action Alternative*. BOEM concludes that the cumulative effects of noise on mysticetes, odontocetes, and pinnipeds would be moderate because impacts on individuals would be detectable and measurable, though populations would maintain viability throughout their range. The NARW could be an exception to this determination because of its perilous population status. Hearing-related injury to even one individual that results in reduced reproductive fitness could contribute to the ongoing downward trend in population viability. Should such impacts occur, they could constitute a greater than moderate impact on this species. However, the APMs proposed for this Project should effectively avoid this level of impact.

Port utilization: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute incrementally to the combined impacts of port utilization from other ongoing and planned activities including offshore wind, which would likely be minor, as impacts on marine mammals would be detectable, but highly localized and intermittent; population-level impacts would not be expected for mysticetes (including the NARW), odontocetes, and pinnipeds. However, any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on marine mammals.

Gear utilization: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the cumulative impacts of gear utilization. As described above, entanglement or entrapment in gear under the Proposed Action is not anticipated to occur. If entanglement or entrapment did occur for other planned offshore wind projects (or from other ongoing non-offshore wind activities), it would likely result in major impacts on NARWs because population-level impacts that threaten the viability of the species could occur; moderate impacts on non-NARW mysticetes because population-level impacts may be realized, but the viability of each species throughout its range is not likely to be compromised; and negligible to minor impacts on odontocetes and pinnipeds because barely measurable to measurable impacts may occur, but no population-level effects would occur.

Presence of structures: The incremental impact contributed by the Proposed Action would result in a noticeable increase in the presence of structures in the geographic analysis area beyond what is described under the No Action Alternative. The cumulative effects of long-term habitat alteration and hydrodynamic impacts on marine mammals are unclear, could be beneficial or adverse, and could range from negligible to moderate adverse. Detectable and measurable impacts may be realized for mysticetes, odontocetes, and pinnipeds, but the viability of each species (except the NARW) is not likely to be compromised. Effects on specific species, including the NARW, would depend on several factors including the nature and distribution of changes in forage availability, resulting effects on individual survival and reproductive fitness, and the status and sensitivity of the affected population to these impacts. The potential hydrodynamic effects discussed in Section 3.15.3.2, *Cumulative Effects of the No Action Alternative*, may influence the availability of already limited prey resources for NARW. However, these hydrodynamic effects would be expected to be negligible for the Project as the primary feeding grounds for NARW are north around New England and Canada, so a limited amount of NARW feeding is likely to occur around the Project structures. Although the type and magnitude of effect from displacement and shifts in prey resources due to the presence of structures are largely unknown, the possibility of changes in distribution relative to commercial fishing activity and increased interaction with fishing gear poses the potential for increased risk of entanglement. Effects on each species would depend on the number of individual animals exposed to entanglement effects, the nature of the impact (i.e., injury or mortality), and the status and sensitivity of the affected population to these impacts. Should such changes occur, increased risk of entanglement would constitute a minor to moderate adverse effect on mysticetes (except the NARW), odontocetes, and pinnipeds, because this stressor is a documented source of injury and mortality, though population-level effects are not expected. In the case of NARW, the potential for increased exposure to entanglement could pose a significant risk as injury or mortality that removes even one juvenile or reproductive age individual from the population would constitute a major effect that compromises the viability of the species. It is important to stress that the likelihood of this level of effect is unclear because it is not known if the presence of structures would displace NARW and whether displacement would lead to increased fishing gear exposure. These potential long-term impacts would persist until decommissioning is complete and structures are removed. Minor beneficial impacts for some marine mammal species, including odontocetes and pinnipeds, is expected due to the large number of structures and associated reef effect. These benefits, though small and potentially unmeasurable, may be offset due to the risk of entanglement in derelict fishing gear.

Light: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined lighting impacts from other ongoing and planned activities including offshore wind, which would likely be negligible, localized, and long term for mysticetes (including the NARW), odontocetes, and pinnipeds, with no perceptible population-level consequences.

Vessel traffic: In context of reasonably foreseeable environmental trends, the combined vessel traffic impacts on marine mammals from ongoing and planned actions, including the Proposed Action could range from minor to major, depending on the number of individuals exposed and population status. The Proposed Action would contribute a detectable increment to the cumulative traffic (vessel strike) impacts. Collision-related effects would be minor for pinnipeds, odontocetes, and for non-listed mysticetes because impacts would be detectable and measurable, but would not lead to population-level effects. Given the population status and estimated potential biological removal of 0.7 for NARW, collision-related impacts are considered major for NARW because the removal of even one individual could compromise the viability of the species. Due to the population status of all other listed mysticetes, collision-related effects are considered moderate because population-level effects may be realized, but the viability of the species is not likely to be compromised.

3.15.5.2 Conclusions

Impacts of the Proposed Action. The incremental impact of the Proposed Action when compared to the No Action Alternative is summarized here. The analysis considered an incremental impact as an impact occurring because of the Proposed Action alone, without addition of baseline or other ongoing offshore wind and non-offshore wind activities. Noise produced by activities associated with the Proposed Action, primarily during construction (i.e., pile driving during installation of the WTG and OSS foundations), would disturb marine mammals and could result in permanent impacts (i.e., PTS). The APMs would minimize noise exposure and the potential for PTS being realized for NARWs would be avoided. Therefore, the incremental impact of the Proposed Action would be **minor** for NARWs given the likely outcome of noise exposure would be a deflection, but not abandonment of their migratory path. NARWs may experience effects at an individual level; however, no stock or population-level impacts are anticipated. The incremental impact of the Proposed Action would be **moderate** for all other mysticetes, harbor porpoise, and pinnipeds due to the potential for PTS to be realized for these species during construction. The incremental impact of the Proposed Action would be **minor** for all other odontocetes because no PTS is expected, but there is potential for behavioral disturbances due to noise produced during construction. More severe impacts on marine mammals, such as mortality or serious injury from vessel strikes and entanglement, are not anticipated to occur from the Proposed Action due to the APMs and additional measures that would be required as part of the environmental permitting processes, including vessel speed restrictions, required separation distances, vessel strike avoidance measures, use of a dedicated lookout (e.g., a protected species observer or trained crew member), and surveys for lost or discarded fishing gear around the WTG and OSS foundations (Appendix H). Beneficial impacts are expected to result from the presence of Project structures as related to the artificial reef effect for pinnipeds and small odontocetes, but these may be offset by the potential risks associated with entanglement from fishing gear.

When including the baseline status of marine mammals in the impact findings, the construction, installation, operation, and conceptual decommissioning of the Proposed Action would result in **negligible** to **major** impacts on the NARW, with major impacts resulting from vessel strike and entanglement risk due to the ongoing activities described in Section 3.15.3 and **negligible** to **moderate** impacts for all other mysticetes, odontocetes, and pinnipeds with moderate impacts resulting from vessel strike, entanglement risk, and PTS risk resulting from ongoing construction noise. Adverse effects for all other IPFs are expected to be negligible for mysticetes (including NARW), odontocetes, and pinnipeds. Greater than negligible adverse effects would be of medium intensity, of longer duration, and present throughout the entire marine mammal geographic analysis area but would not be expected to have any long-term effects on the populations, except for the NARW. Due to its current stock status, population-level impacts that threaten the viability of the species could be realized if a NARW vessel strike or entanglement were to occur. **Minor beneficial** impacts are expected to result from the presence of structures as related to the artificial reef effect for pinnipeds and small odontocetes, but may be offset by the potential risks associated with gear entanglement from fishing gear.

Cumulative impacts of the Proposed Action. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, impacts resulting from individual IPFs from ongoing and planned actions, including the Proposed Action, would range from **negligible** to **major** for the NARW, **negligible** to **moderate** for all other mysticetes (except the NARW), odontocetes, and pinnipeds, and could include **minor beneficial** impacts. Considering all of the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action, would result in overall **major** impacts on the NARW and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds in the geographic analysis area. The main drivers for this impact rating are pile driving and construction noise, risk of vessel strikes due to increased vessel traffic associated with the expanded planned action scenario, risks associated with gear entanglement from fishing gear, and ongoing climate change. **Moderate** impacts are expected for mysticetes (except the NARW), odontocetes, and pinnipeds species which could result in effects that are of medium intensity, of longer duration, and present throughout the entire marine mammal geographic analysis area but would not be expected to have any long-term effects on the populations, except for NARW. Based on the NARW's current status, impacts on NARWs resulting from all IPFs combined from ongoing and planned actions, including the Proposed Action, are expected to be **major** because serious injury or loss of an individual would result in population-level impacts that threaten the viability of the species if a vessel strike or entanglement were to occur. The presence of structures could result in **minor beneficial** impacts on pinnipeds and delphinids, but these may be offset by the potential risks associated with entanglement from fishing gear. The Proposed Action would contribute to the overall impact rating primarily through noise-related IPFs.

3.15.6 Impacts of Alternatives B and C on Marine Mammals

The following sections summarize the potential incremental impacts of Alternatives B and C individually on marine mammals when compared to the No Action Alternative during the various phases of the Project. The analysis considered an incremental impact as an impact occurring as a result of Alternatives

B or C alone, without addition of baseline or other ongoing offshore wind and non-offshore wind activities. Routine activities would include construction, O&M, and decommissioning of Alternatives B and C, as described in Chapter 2.

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, which is described in this section.

Impacts of Alternatives B and C. Impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of Alternatives B and C would be similar to those described under the Proposed Action, but associated IPFs would slightly decrease compared to the Proposed Action due to the reduction in the number and size of WTGs under Alternatives B and C. Alternative B would construct and operate 29 fewer WTGs than the Proposed Action, and Alternative C would construct and operate 33 fewer WTGs than the Proposed Action. Alternatives B and C would also avoid placement or development of infrastructure in the Fish Haven area, and Alternative C would further avoid complex habitats, including the sand ridge habitat area. However, while Alternatives B and C may be slightly less impactful than the Proposed Action, the impacts on marine mammals under these alternatives would not be appreciably different than those under the Proposed Action as the noise produced during impact pile driving would still pose a comparable level of risk for all marine mammal species, as described for the Proposed Action, just over a slightly shorter duration. Additionally, the number of vessels and equipment would be expected to be largely the same as described for the Proposed Action, and the overall levels of noise produced by the WTGs during operations would be expected to result in similar impacts to those described under the Proposed Action. The change in the number of WTGs installed and their locations would therefore not affect the potential impacts posed by any IPFs on all marine mammal species compared to what was described for the Proposed Action.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, Alternatives B and C may be slightly less impactful than the Proposed Action, the impacts on marine mammals under these alternatives would not be appreciably different than those under the Proposed Action. The main drivers for this impact rating are identical to those of all the action alternatives: pile driving, vessel and construction noise, increased vessel traffic associated with the expanded planned action scenario, entanglement risk associated with the presence of structures, and ongoing climate change.

3.15.6.1 Conclusions

Impacts of Alternatives B and C. The incremental impact of Alternatives B and C when compared to the No Action Alternative are summarized here. The analysis considered an incremental impact as an impact occurring as a result of Alternative B or Alternative C alone, without addition of baseline or other ongoing offshore wind and non-offshore wind activities. The incremental impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of Alternatives B and C would be the same as described under the Proposed Action as the reduction in the number of WTG proposed for these alternatives would not change the overall impact levels assessed for the Proposed Action. Noise produced by activities associated with the Proposed Action, primarily during construction (i.e., pile driving during installation of the WTG and OSS foundations), would disturb marine mammals and potentially result in permanent impacts (i.e., PTS). APMs would minimize noise exposure, and the potential for PTS being realized for NARWs would be avoided. Therefore, the incremental impact of Alternatives B and C would be **minor** for NARWs given the likely outcome of noise exposure would be a deflection, but not abandonment of their migratory path, and though they may experience effects at an individual level, no stock or population-level impacts are anticipated. The incremental impact of Alternatives B and C would be **moderate** for all other mysticetes, harbor porpoise, and pinnipeds due to the potential for PTS to be realized for these species during construction. The incremental impact of Alternatives B and C would be **minor** for all other odontocetes because no PTS is expected but there is potential for behavioral disturbances due to noise produced during construction. More severe impacts on marine mammals such as mortality or serious injury from vessel strikes and entanglement are not anticipated to occur from Alternatives B and C due to the APMs and additional measures that would be required as part of the environmental permitting processes, including vessel speed restrictions, required separation distances, vessel strike avoidance measures, use of a dedicated lookout (e.g., a protected species observer or trained crew member), and surveys for lost or discarded fishing gear around the WTG and OSS foundations (Appendix H). Beneficial impacts are expected to result from the presence of Project structures as related to the artificial reef effect for pinnipeds and small odontocetes, but these may be offset by the potential risks associated with gear entanglement from fishing gear

When including the baseline status of marine mammals in the impact findings, the construction, installation, operation, and conceptual decommissioning of Alternatives B and C would result in individual IPFs ranging from **negligible** to **major** impacts on NARW; and **negligible** to **moderate** impacts for all other mysticetes, odontocetes, and pinnipeds. **Major** impacts on NARW result primarily due to vessel strike and entanglement risk from the ongoing activities described in Section 3.15.3. **Moderate** impacts on other mysticetes, odontocetes, and pinnipeds result primarily due to vessel strike, entanglement risk, and the risk of PTS from ongoing construction activity noise. Adverse effects from all other IPFs are expected to be **negligible** for mysticetes (including NARWs), odontocetes and pinnipeds. Above negligible adverse effects would be of medium intensity, of longer duration, and present throughout the entire geographic analysis area but would not be expected to have any long-term effects on the populations, except for the NARW. Due to its current stock status, population-level impacts that threaten the viability of the species could be realized if a NARW vessel strike or entanglement were to occur. **Minor beneficial** impacts are expected to result from the presence of structures as related to the artificial reef effect for pinnipeds and small odontocetes, but may be offset by the potential risks associated with gear entanglement from fishing gear.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, impacts resulting from individual IPFs from ongoing and planned actions, including Alternatives B and C, would range from **negligible** to **major** for NARW, **negligible** to **moderate** for all other mysticetes (except NARW), odontocetes, and pinnipeds, and could include **minor beneficial** impacts. Considering all of the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including Alternatives B and C, would result in overall **major** impacts on the NARW and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds in the geographic analysis area. The main drivers for this impact rating are pile driving and construction noise, risk of vessel strikes due to increased vessel traffic associated with the expanded planned action scenario, risks associated with gear entanglement from fishing gear, and ongoing climate change. **Moderate** impacts are expected for mysticetes (except the NARW), odontocetes, and pinnipeds species, which could result in effects that are of medium intensity, of longer duration, and present throughout the entire marine mammal geographic analysis area but would not be expected to have any long-term effects on the populations, except for the NARW. Based on the NARW's current status, impacts on NARWs resulting from all IPFs combined from ongoing and planned actions, including Alternatives B and C, are expected to be **major** because serious injury or loss of an individual would result in population-level impacts that threaten the viability of the species if a vessel strike or entanglement were to occur. The presence of structures could result in **minor beneficial** impacts on pinnipeds and delphinids, but these may be offset by the potential risks associated with entanglement from fishing gear. Alternatives B and C would contribute to the overall impact rating primarily through noise-related IPFs.

3.15.7 Impacts of Alternative D on Marine Mammals

The following sections summarize the potential incremental impacts of Alternative D on marine mammals when compared to the No Action Alternative during the various phases of the Project. The analysis considered an incremental impact as an impact occurring as a result of Alternative D alone, without addition of baseline or other ongoing offshore wind and non-offshore wind activities. Routine activities would include construction, O&M, and decommissioning of Alternative D, as described in Chapter 2.

Impacts of Alternative D. Impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of Alternative D would be the same as described under the Proposed Action. Because Alternative D is specific to the Onshore Project component, individual IPFs discussed under the Proposed Action would not change. Therefore, the impacts on marine mammals under Alternative D would not be different from those for the Proposed Action.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, impacts resulting from individual IPFs resulting from ongoing and planned actions, including Alternative D, would not differ from cumulative impacts of the Proposed Action. The main drivers for this are identical to those of all the action alternatives: pile driving, vessel and construction noise, increased vessel traffic associated with the expanded planned action scenario, entanglement risk associated with the presence of structures, and ongoing climate change.

3.15.7.1 Conclusions

Impacts of Alternative D. The incremental impact of the Alternative D when compared to the No Action Alternative is summarized here. The analysis considered an incremental impact as an impact occurring as a result of Alternative D alone, without addition of baseline or other ongoing offshore wind and non-offshore wind activities. The incremental impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning of Alternative D would be the same as described under the Proposed Action as Alternative D is specific to the Onshore Project component and would, therefore, not result in a significant difference in potential impact levels for marine mammals compared to the Proposed Action. Noise produced by activities associated with Alternative D, primarily during construction (i.e., pile driving during installation of the WTG and OSS foundations), would disturb marine mammals and could potentially result in permanent impacts (i.e., PTS). APMs would minimize noise exposure and the potential for PTS being realized for NARWs would be avoided. Therefore, the incremental impact of Alternative D would be **minor** for NARWs given the likely outcome of noise exposure would be a deflection, but not abandonment of their migratory path, and though they may experience effects at an individual level, no stock or population-level impacts are anticipated. The incremental impact of Alternative D would be **moderate** for all other mysticetes, harbor porpoise, and pinnipeds due to the potential for PTS to be realized for these species during construction. The incremental impact of Alternative D would be **minor** for all other odontocetes because no PTS is expected, but there is potential for behavioral disturbances due to noise produced during construction. More severe impacts on marine mammals such as mortality or serious injury from vessel strikes and entanglement are not anticipated to occur from Alternative D due to the APMs and additional measures that would be required as part of the environmental permitting processes, including vessel speed restrictions, required separation distances, vessel strike avoidance measures, use of a dedicated lookout (e.g., a protected species observer or trained crew member), and surveys for lost or discarded fishing gear around the WTG and OSS foundations (Appendix H). Beneficial impacts are expected to result from the presence of Project structures as related to the artificial reef effect for pinnipeds and small odontocetes, but these may be offset by the potential risks associated with gear entanglement from fishing gear.

When including the baseline status of marine mammals in the impact findings, the construction, installation, operation, and conceptual decommissioning of Alternative D would result in individual IPFs ranging from **negligible** to **major** impacts on NARWs and **negligible** to **moderate** impacts for all other mysticetes, odontocetes, and pinnipeds. Major impacts on NARWs result primarily due to vessel strike and entanglement risk from the ongoing activities described in Section 3.15.3. Moderate impacts on other mysticetes, odontocetes, and pinnipeds result primarily due to vessel strike, entanglement risk, and the risk of PTS from ongoing construction noise. Adverse impacts from all other IPFs are expected to be negligible for mysticetes (including the NARW), odontocetes and pinnipeds. Above negligible adverse impacts are expected to result mainly from pile-driving noise, increased vessel traffic, and fishing gear entanglement. Populations are expected to recover fully from these individual IPFs for all species except for the NARW. Due to its current stock status, population-level impacts that threaten the viability of the species could be realized if a NARW vessel strike or entanglement were to occur. Beneficial impacts are expected to result from the presence of structures as related to the artificial reef effect for pinnipeds and small odontocetes, but may be offset by the potential risks associated with gear entanglement from fishing gear.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends and planned actions in the geographic analysis area, impacts from individual IPFs resulting from ongoing and planned actions, including Alternative D, would range from **negligible** to **major** for the NARW, **negligible** to **moderate** for all other mysticetes (except NARW), odontocetes, and pinnipeds, and could include **minor beneficial** impacts. Considering all of the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including Alternative D, would result in overall **moderate** to **major** impacts on NARWs and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds in the geographic analysis area. The main drivers for this impact rating are pile driving, vessel and construction noise, increased vessel traffic associated with the expanded planned action scenario, the conversion of soft bottom to hard structure habitat, and ongoing climate change. **Moderate** impacts are expected for most marine mammal species as detectable and measurable impacts could have population-level effects, but populations would be expected to sufficiently recover when IPF stressors are removed and remedial or mitigating actions are taken, except for the NARW. Due to the NARW's current stock status, impacts on NARWs resulting from all IPFs combined from ongoing and planned actions, including Alternative D, are expected to be **major** because a measurable impact is anticipated that could have population-level effects that compromise the viability of the species. The presence of structures could result in **minor beneficial** impacts on pinnipeds and delphinids, but these may be offset by the potential risks associated with entanglement from fishing gear. Alternative D would contribute to the overall impact rating primarily through noise-related IPFs.

3.15.8 Agency-Required Mitigation Measures

The mitigation measures listed in Table 3.15-8 are recommended for inclusion in the Preferred Alternative. These measures are also included in Appendix H, Table H-2. If one or more of the measures analyzed are adopted, the risk for some adverse impacts could be further reduced. There are no additional agency-required mitigation measures identified as relevant for marine mammals (Appendix H, Table H-3). Lessee authorization and permit conditions, including those associated with the NMFS Proposed Incidental Take Regulations and associated 5-year Letter of Authorization issued pursuant to the MMPA, are included in Appendix H, Table H-4.

Table 3.15-8 Measures Resulting from Consultations: Marine Mammals[1]

Measure	Description	Effect
BOEM-Proposed Mitigation and Monitoring Measures in the NMFS BA		
Vessel strike avoidance procedures	Applicant proposed measures plus: • As part of vessel strike avoidance, a training program will be implemented. The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event. • Vessel operators and crew must maintain a vigilant watch for marine mammals and sea turtles by slowing down or stopping their vessels to avoid striking these protected species. Vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures will include, but are not limited to, the following, except under extraordinary circumstances when complying with these measures would put the safety of the vessel or the crew at risk: o If underway, vessels must steer a course away from any sighted NARW at 10 knots (18.5 kilometers per hour) or less until the 1,640-foot (500-meter) minimum separation distance has been established. If a NARW is sighted in a vessel's path, or within 330 feet (100 meters) of an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. Engines will not be engaged until the NARW has moved outside of the vessel's path and beyond 330 feet (100 meters). If stationary, the vessel must not engage engines until the NARW has moved beyond 330 feet (100 meters); o All vessels will maintain a separation distance of 330 feet (100 meters) or greater of any sighted whales. If sighted, the vessel underway must reduce speed and shift the engine to neutral and must not engage the engines until the whale has moved outside the vessel's path and beyond 330 feet (100 meters). If a survey vessel is stationary, the vessel will not engage engines until the whale has moved out of the vessel's path and beyond 330 feet (100 meters); o Vessel operators will use all available sources of information of NARW presence, including daily monitoring of the Right Whale Sightings Advisory System, WhaleAlert app, and monitoring of USCG VHF Channel 16 to receive notifications of right whale detections, Seasonal Management Areas, Dynamic Management Areas, and Slow Zones to plan vessel routes to minimize the potential for co-occurrence with right whales.	Maintains safe operating distances to minimize vessel interactions with marine mammals. This measure would ensure effective monitoring by further clarifying the distance at which vessels would divert their path and the distance at which vessels would reduce speed and shift to neutral.

Measure	Description	Effect
LOA requirements	The measures required by the final MMPA LOA will be incorporated into COP approval, and BOEM, BSEE, or both will monitor compliance with these measures.	Compliance with LOA requirements would reduce risks for marine mammals under the Proposed Action.
BOEM Project Design Criteria (PDCs) and BMPs	BOEM will require Dominion Energy comply with all the PDCs and BMPs for protected species at https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf, that implement the integrated requirements for threatened and endangered species resulting from the June 29, 2021, programmatic consultation under the ESA, revised September 1, 2021. This requirement also applies to non-ESA-listed marine mammals that are found in that document. Consultation conditions occurring in State waters outside of BOEM jurisdiction may apply to co-action agencies issuing permits and authorizations under this consultation.	Compliance with PDCs and BMPs for protected species would minimize risk to marine mammals during site characterization and site assessment surveys.
Marine debris awareness training	Dominion Energy will ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris–related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities will continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are in fact trained. The training process 1ill include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and • Record keeping and the availability of records for inspection by DOI. By January 31 of each year, Dominion Energy will submit to DOI an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. Dominion Energy will send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).	Marine debris and trash awareness training would minimize the risk of marine mammal ingestion of or entanglement in marine debris.

Measure	Description	Effect
Data collection BA BMPs	BOEM will ensure that all PDC and BMPs 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 Dominion Energy project as applicable.	Compliance with PDCs and BMPs for protected species would minimize risk to marine mammals during site characterization and site assessment surveys during all Project phases.
BOEM COP PDCs and BMPs	Use standard underwater cables that have electrical shielding to control the intensity of EMFs.	This measure would decrease the area and intensity of EMF effects.
BOEM COP PDCs and BMPs	Lessees and grantees should evaluate marine mammal use of the Proposed Action area and should design the Project to minimize and mitigate the potential for mortality or disturbance. The amount and extent of ecological baseline data required should be determined on a project basis.	Compliance with this measure would avoid adverse effects by ensuring early planning.
BOEM COP PDCs and BMPs	Vessels related to project planning, construction, and operation should travel at reduced speeds when assemblages of cetaceans are observed. Vessels also should maintain a reasonable distance from whales, small cetaceans, and sea turtles, and these should be determined during site-specific consultations.	This measure would minimize the potential of vessel strikes for marine mammals from Project-related vessels.
BOEM COP PDCs and BMPs	Lessees and grantees should minimize potential vessel effects on marine mammals and sea turtles by having project-related vessels follow the NMFS Regional Viewing Guidelines while in transit. Operators should undergo training on applicable vessel guidelines.	This measure would minimize the potential of vessel strikes for marine mammals from Project-related vessels.
BOEM COP PDCs and BMPs	Lessees and grantees should take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	This measure would minimize the potential and severity of noise-related effects for marine mammals.
BOEM COP PDCs and BMPs	Lessees and grantees should avoid and minimize effects on marine species and habitats in the Proposed Action area by posting a qualified observer on site during construction activities. This observer should be approved by BOEM and NMFS.	This measure would increase accountability and ensure the effectiveness of mitigation and monitoring measures.
Periodic underwater surveys, reporting of monofilament and other fishing gear around WTG foundations	Dominion Energy must monitor indirect effects associated with charter and recreational fishing gear lost from expected increases in fishing around WTG foundations by surveying at least 10 of the WTGs located closest to shore in the Dominion Energy Lease Area (OCS-A 0483) annually. Survey design and effort may be modified with review and concurrence by DOI. Dominion Energy may conduct surveys by remotely operated vehicles, divers, or other means to determine the frequency and locations of marine debris.	This measure would establish requirement for monitoring and reporting of lost monofilament and other fishing gear around WTGs, which would reduce the risk of entanglement

Measure	Description	Effect
	Dominion Energy must report the results of the surveys to BOEM (at renewable_reporting@boem.gov) and BSEE (at marinedebris@bsee.gov) in an annual report, submitted by April 30, for the preceding calendar year. Annual reports must be submitted in Word format. Photographic and videographic materials must be provided on a portable drive in a lossless format such as TIFF or Motion JPEG 2000. Annual reports must include survey reports that contain: the survey date; contact information of the operator; the location and pile identification number; photographic, video documentation, or both of the survey and debris encountered; any animals sighted; and the disposition of any located debris (i.e., removed or left in place). Annual reports must also include claim data attributable to the Project from Dominion Energy corporate gear loss compensation policy and procedures. Required data and reports may be archived, analyzed, published, and disseminated by BOEM.	associated with the presence of structures.
PAM Plan	BOEM and USACE will ensure that Dominion Energy prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. This plan will be submitted to NMFS and BOEM for review and concurrence at least 120 days prior to the planned start of activities requiring PAM.	This measure would ensure the efficacy of PAM placement for appropriate monitoring.
Pile Driving Monitoring Plan	BOEM will ensure that Dominion Energy prepares and submits a Pile Driving Monitoring Plan to BOEM, BSEE, and NMFS for review and concurrence at least 90 days before start of pile driving. The plan will detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan will also describe how BOEM and Dominion Energy would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Dominion Energy will obtain NMFS' concurrence with this plan prior to starting any pile driving.	This measure would ensure adequate monitoring and mitigation is in place during pile driving, which would minimize the potential for Level A or Level B exposures to marine mammals during foundation installation.
PSO Coverage	BOEM and USACE will ensure that PSO coverage is sufficient to reliably detect marine mammals and sea turtles at the surface in the identified clearance and shutdown zones to execute any pile-driving delays or shutdown requirements during foundation installation. This will include a PSO/PAM team on the construction vessel and two additional PSO vessels each with a visual monitoring team. The following equipment and personnel will be on each associated vessel. ***Construction Vessel:*** • 2—visual PSOs on watch. • 2—reticle binoculars (7x or 10x) calibrated for observer height off the water.	This measure would ensure adequate monitoring of zones during foundation installation to reduce risk to marine mammals.

Measure	Description	Effect
	• 2—mounted "big eye" binoculars (25x or similar) if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1—PAM operator on duty. • 1—mounted thermal/infrared camera system. • 2—"big eye" binoculars (25x or similar) mounted 180° apart. • 1—monitoring station for real-time PAM system. • 2—handheld or wearable night vision devices with infrared spotlights. • 1—data collection software system. • 2—PSO-dedicated VHF radios. • 1—digital single-lens reflex camera equipped with a 300-millimeter lens. ***Each Additional PSO Vessel (2):*** • 2—visual PSOs on watch. • 2—reticle binoculars (7x or 10x) calibrated for observer height off the water. • 1—mounted "big eye" binoculars (25x or similar) if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1—mounted thermal/IR camera system. • 1—handheld or wearable night vision device with infrared spotlight. • 1—data collection software system. • 2—PSO-dedicated VHF radios. 1—digital single lens reflex camera equipped with a 300-mm lens. If, at any point prior to or during construction, the PSO coverage that is included as part of the Proposed Action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs, platforms, or both will be deployed. Determinations prior to construction will be based on review of the Pile Driving Monitoring Plan. Determinations during construction will be based on review of the weekly pile-driving reports and other information, as appropriate.	
Sound Field Verification Plan	BOEM will require Dominion Energy to develop an operational SFV Plan to determine the operational noises emitted from the Offshore Project area. The plan will be reviewed and approved by BOEM and NMFS. The plan will include measurement procedures and results reporting that meet ISO standard 18406:2017 (Underwater acoustics – Measurement of radiated underwater sound from percussive pile driving).	This measure would establish requirements for operational noise monitoring.
Sound field verification	Applicant proposed measures plus:	This measure would ensure adequate monitoring of

Measure	Description	Effect
	• BOEM and USACE will ensure that if the clearance, shutdown zones, or both are expanded due to the verification of sound fields from Project activities, PSO coverage is sufficient to reliably monitor the expanded clearance, shutdown zones, or both. Additional observers will be deployed on additional platforms for every 4,921 feet (1,500 meters) that a clearance or shutdown zone is expanded beyond the distances modeled prior to verification.	clearance zones in order to minimize noise-related effects on marine mammals.
Adaptive shutdown zones	BOEM and USACE may consider reductions in the shutdown zones for sei, fin, or sperm whales based on SFV of a minimum of three piles; however, BOEM/USACE would ensure that the shutdown zone for sei whales, fin whales, blue whales, and sperm whales is not reduced to less than 3,280 feet (1,000 meters), or 1,640 feet (500 meters) for sea turtles. No reductions in the clearance or shutdown zones for NARWs would be considered regardless of the results of SFV of a minimum of three piles.	This measure would ensure that shut down zones are sufficiently conservative in order to minimize noise-related effects on marine mammals.
Minimum visibility requirement	• In order to commence pile driving at foundations, PSOs must be able to visually monitor a 5,741-foot (1,750-meter) radius from their observation points for at least 60 minutes immediately prior to piling commencement. • In order to commence pile driving at trenchless installation sites, PSOs must be able to visually monitor a 3,280-foot (1,000-meter) radius from their observation points for at least 30 minutes immediately prior to piling commencement. • Acceptable visibility will be determined by the Lead PSO.	This measure would ensure adequate monitoring of zones, which would minimize noise-related effects on marine mammals.

Alternative Monitoring Plan (AMP) for Pile Driving	Dominion Energy must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevent visual monitoring of the full extent of the clearance and shutdown zones.
	• Dominion Energy must submit an AMP to BOEM and NMFS for review and approval at least 6 months prior to the planned start of pile driving. This plan may include deploying additional observers; alternative monitoring technologies such as night vision, thermal, and infrared; or use of PAM and must demonstrate the ability and effectiveness to maintain all clearance and shutdown zones during daytime as outlined below in Part 1 and nighttime as outlined in Part 2 to BOEM's and NMFS's satisfaction.
	• The AMP must include two stand-alone components:
	  o Part 1 – Daytime when lighting or weather (e.g., fog, rain, sea state) conditions prevent visual monitoring of the full extent of the clearance and shutdown zones; daytime being defined as 1 hour after civil sunrise to 1.5 hours before civil sunset.
	  o Part 2 – Nighttime inclusive of weather conditions (e.g., fog, rain, sea state); nighttime being defined as
		This measure would establish requirements for nighttime and low-visibility impact pile-driving approval, which would serve to decrease the potential for noise-related impacts to occur during those conditions.

<table>
<tr><th>Measure</th><th>Description</th><th>Effect</th></tr>
<tr><td></td><td>1.5 hours before civil sunset to 1 hour after civil sunrise.
• If a protected marine mammal or sea turtle is observed entering or found within the shutdown zones after impact pile driving has commenced, Dominion Energy will follow the shutdown procedures outlined in Table 1-7 of the NMFS Biological Assessment. Dominion Energy will notify BOEM and NMFS of any shutdown occurrence during piling-driving operations with 24 hours of the occurrence unless otherwise authorized by BOEM and NMFS.
• The AMP should include, but is not limited to, the following information:
o Identification of night vision devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable night vision devices, infrared spotlights), if proposed for use to detect protected marine mammal and sea turtle species.
o Demonstration (through empirical evidence) of the capability of the proposed monitoring methodology to detect marine mammals and sea turtles within the full extent of the established clearance and shutdown zones (i.e., species can be detected at the same distances and with similar confidence) with the same effectiveness as daytime visual monitoring (i.e., same detection probability). Only devices and methods demonstrated as being capable of detecting marine mammals and sea turtles to the maximum extent of the clearance and shutdown zones will be acceptable.
o Evidence and discussion of the efficacy (range and accuracy) of each device proposed for low visibility monitoring must include an assessment of the results of field studies (e.g., Thayer Mahan demonstration), as well as supporting documentation regarding the efficacy of all proposed alternative monitoring methods (e.g., best scientific data available).
o Reporting procedures, contacts and timeframes.
BOEM may request additional information, when appropriate, to assess the efficacy of the AMP.</td><td></td></tr>
<tr><td>Sampling gear</td><td>All sampling gear will be hauled at least once every 30 days, and all gear will be removed from the water and stored on land between survey seasons to minimize risk of entanglement.</td><td>The regular hauling of sampling gear would reduce risk of entanglement for marine mammals.</td></tr>
<tr><td>Gear identification</td><td>To facilitate identification of gear on any entangled animals, all trap/pot gear used in the surveys will be uniquely marked to distinguish it from other commercial or recreational gear. Using black and yellow striped duct tape, place a 3-foot-long mark within 2 fathoms of a buoy. In addition, using black and white paint or duct tape, place three additional marks on the top, middle and bottom of the line. These gear marking colors are proposed as they are not gear markings used in other fisheries and are, therefore, distinct. Any changes in marking</td><td>Gear identification would improve accountability in the case of gear loss and distinguish survey gear from other commercial or recreational gear.</td></tr>
</table>

Measure	Description	Effect
	would not be made without notification and approval from NMFS.	
Lost survey gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety will be undertaken to recover the gear. All lost gear will be reported to NMFS (mailto:nmfs.gar.incidental-take@noaa.gov) as soon as possible or within 24 hours of the documented time of missing or lost gear. This report will include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	This measure would promote the recovery of lost gear, which would reduce risk of entanglement for marine mammals.
Monthly/annual reporting	Applicant proposed measures plus: • BOEM will ensure that Dominion Energy implements the following reporting requirements necessary to document the amount or extent of take that occurs during all phases of the Proposed Action: ○ All reports will be sent to: nmfs.gar.incidental-take@noaa.gov. ○ During the construction phase and for the first year of operations, Dominion Energy will compile and submit monthly reports that include a summary of all Project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), and piles installed, and all observations of ESA-listed species. Monthly reports are due on the 15th of the month for the previous month. ○ Beginning in year two of operations, Dominion Energy will compile and submit annual reports that include a summary of all Project activities carried out in the previous year, including vessel transits (number, type of vessel, and route), repair and maintenance activities, survey activities, and all observations of ESA-listed species. These reports are due by April 1 of each year (i.e., the 2026 report is due by April 1, 2027). Upon mutual agreement of NMFS and BOEM, the frequency of reports can be changed.	Reporting requirements to document take would improve accountability for documenting marine mammal take associated with the Proposed Action.
Reasonable and Prudent Measures and Terms and Conditions from the NMFS Biological Opinion Issued September 18, 2023		
Pile Driving	Effects to ESA-listed species must be minimized during pile driving.	This measure would minimize exposures to ESA-listed species during pile driving.
Reporting Requirements	Effects to, or interactions with, ESA-listed Atlantic sturgeon, whales, and sea turtles must be documented during all phases of the proposed action, and all incidental take must be reported to NMFS GARFO.	Reporting requirements to document take would improve accountability for documenting marine mammal take associated with the Proposed Action.

Measure	Description	Effect
Review of Plans	Plans must be prepared that describe the implementation of activities or monitoring protocols for which the details were not available at the time this consultation was completed. All required plans must be submitted to NMFS GARFO with sufficient time for review, comment, and concurrence.	Plans and protocols would establish requirements for operations and monitoring.
On-site Observation and Inspection	BOEM and BSEE must exercise their authorities to assess and ensure compliance with the implementation of measures to avoid, minimize, monitor and report incidental take of ESA-listed species during activities described in this Opinion. On-site observation and inspection must be allowed to gather information on the implementation of measures, and the effectiveness of those measures, to minimize and monitor incidental take during activities described in this Opinion, including its Incidental Take Statement.	Assessing compliance and effectiveness of measures would reduce impacts to ESA-listed species.
Pile Driving	To implement the requirements of RPM 1 for ESA-listed whales, to the extent that the final MMPA ITA requires additional measures from those in the proposed ITA (which are incorporated into the proposed action) to minimize effects of pile driving on ESA-listed whales, CVOW-C must comply with those measures. To facilitate implementation of this requirement: a. BOEM must require, through an enforceable condition of their approval of CVOW-C's Construction and Operations Plan, that CVOW-C comply with any measures in the final MMPA ITA that are revised from, or in addition to, measures included in the proposed ITA, which already have been incorporated into the proposed action. b. NMFS OPR must ensure compliance with all mitigation measures as prescribed in the final ITA. We expect this will be carried out through NMFS OPR's review of plans and monitoring reports, including interim and final sound field verification (SFV) reports, submitted by CVOW-C over the life of the MMPA ITA and taking any responsive action within its statutory and regulatory authority it deems necessary to ensure compliance based on the foregoing review. c. The USACE must review the final MMPA ITA as issued by NMFS OPR and determine if an amendment or revision is necessary to the permit issued to CVOW-C by USACE to incorporate any new or revised measures for pile driving or related activities addressed in the USACE permit, to ensure compliance with any measures in the final MMPA ITA that are revised from, or in addition to, measures included in the proposed ITA, which have been incorporated into the proposed action; and, if necessary, exercise its regulatory authority to make appropriate amendments or revisions.	This measure would minimize effects on ESA-listed whales.
Sound Field Verification	To implement the requirements of RPM 1, the following related to SFV must be implemented by BOEM, BSEE, USACE, and/or CVOW-C. The purpose of SFV and the steps outlined here are to ensure that CVOW-C does not exceed the distances to the injury or behavioral harassment threshold (Level A and Level B harassment, respectively) for	This measure would ensure adequate monitoring and mitigation is in place during pile driving, which would minimize

Measure	Description	Effect
	ESA-listed marine mammals, the injury or behavioral harassment thresholds for sea turtles, or the injury or behavioral disturbance thresholds for Atlantic sturgeon that are identified in this opinion and that underpin the effects analysis, exposure analysis and our determination of the amount and extent of incidental take exempted in this ITS, including the determination that no incidental take is anticipated. The measures outlined here are based on the expectation that CVOW-C's initial pile driving methodology and sound attenuation measures will result in noise levels that do not exceed the identified distances (as modeled assuming 10 dB attenuation) but, if that is not the case, provide a step-wise approach for modifying operations and/or modifying or adding sound attenuation measures that can reasonably be expected to avoid exceeding those thresholds prior to the next pile being driven. a. Consistent with the measures incorporated into the proposed action, BOEM, BSEE, and USACE must require and CVOW-C must implement Sound Field Verification (SFV) on at least the first three monopiles installed (see also T&C 8.d. below) in accordance with the additional requirements specified here. If any of the SFV measurements from any of the piles indicate that the distance to any isopleth of concern is greater than those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), before the next pile is installed CVOW-C must implement the following measures as applicable: b. Identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances (e.g., if the pile was installed with a single bubble curtain and a near field sound attenuation device, add a second bubble curtain or if the pile was installed with a double bubble curtain without a near field sound attenuation device, add a nearfield noise attenuation device; adjust hammer operations; adjust noise attenuation system to improve performance); provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures on any subsequent piles that are installed (e.g., if threshold distances are exceeded on pile 1 then additional measures must be deployed before installing pile 2). NMFS GARFO will strive to provide concurrence as quickly as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving CVOW-C's proposal and request for concurrence. c. If any of the SFV measurements indicate that the distances to level A thresholds for ESA-listed whales	the potential for Level A or Level B exposures to marine mammals during foundation installation.

Measure	Description	Effect
	(peak or cumulative) or PTS peak or cumulative thresholds for sea turtles are greater than the modeled distances assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), the clearance and shutdown zones (see Table 47) for subsequent piles must be increased so that they are at least the size of the distances to those thresholds as indicated by SFV (e.g., if threshold distances are exceeded on pile 1 then the clearance and shutdown zones for pile 2 must be expanded). For every 1,500 m that a marine mammal clearance or shutdown zone is expanded, additional PSOs must be deployed from additional platforms/vessels to ensure adequate and complete monitoring of the expanded shutdown and/or clearance zone; CVOW-C must submit a proposed monitoring plan for NMFS GARFO's concurrence describing the proposed deployment of additional PSOs including the number of PSOs and location of all PSOs. In the event that the clearance or shutdown zone for sea turtles needs to be expanded, the proposed monitoring plan must also include a description of how additional PSOs will be deployed to ensure effective monitoring for sea turtles in the expanded zones. d. If, after implementation of 3.a.i, any subsequent SFV measurements indicate that the distances to any identified isopleth of concern are still greater than those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), CVOW-C must identify and propose for review and concurrence: additional modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed (e.g., if threshold distances are still exceeded on pile 2 the additional measures must be deployed for pile 3). NMFS GARFO will strive to provide concurrence as quickly as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving CVOW-C's proposal and request for concurrence. Clearance and shutdown zones must be expanded consistent with the requirements of 3.b.ii. e. Following installation of the pile with additional modified, and/or alternative noise attenuation measures or operational changes required by 3.a.iii, if SFV results indicate that any isopleths of concern are still larger than those modeled assuming 10 dB attenuation, before any additional piles can be installed, CVOW-C must and propose for review and concurrence: additional, modified,	

Measure	Description	Effect
	and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed. Following concurrence from NMFS GARFO, BOEM, BSEE, and USACE must require and CVOW-C must implement those measures and any expanded clearance and shutdown zone sizes (and any required additional PSOs) consistent with the requirements of 3.b.ii. Additionally, BOEM, BSEE, and USACE must require and CVOW-C must continue SFV for two additional piles with enhanced sound attenuation measures and submit the interim reports as required above (for a total of at least three piles with consistent noise attenuation measures). i. If no additional measures are identified for implementation, or if the SFV required by 3.a.iv indicates that the distance to any isopleths of concerns for any ESA-listed species are still larger than those modeled assuming 10 dB attenuation, NMFS GARFO will presume that reinitiation of consultation is necessary, consistent with 50 CFR §402.16(a)(2) and/or (a)(3). NMFS GARFO, NMFS OPR, BOEM, BSEE, and USACE will meet within three business days to discuss: the results of SFV monitoring, the severity of exceedance of distances to identified isopleths of concern, the species affected, modeling assumptions, and whether any triggers for reinitiation of consultation are met (50 CFR 402.16), including consideration of whether the SFV results constitute new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered in the consultation. ii. Following installation of the pile with additional alternative, or modified noise attenuation measures/operational changes required by 3.a.iii or 3.a.iv, if SFV results indicate that all isopleths of concern are within distances to isopleths of concern modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), SFV must be conducted on two additional piles (for a total of at least three piles with consistent noise attenuation measures). If the SFV results from all three of those piles are within the distances to isopleths of concern modeled assuming 10 dB attenuation, BOEM, BSEE, and USACE must require, and CVOW-C must continue to implement the approved additional, alternative, or modified sound attenuation measures/operational changes, BOEM, BSEE, USACE and/or CVOW-C can request concurrence from NMFS GARFO to the original clearance and shutdown zones (Table 48) or CVOW-C	

Measure	Description	Effect
	can continue with the expanded clearance and shutdown zones with additional PSOs. f. Consistent with the measures incorporated into the proposed action, BOEM, BSEE, and USACE must require, and CVOW must implement SFV on all piles associated with installation of all three OSS foundations with the additional requirements specified here (see also T&C 8.d. below). If any of the SFV measurements from the first OSS foundation installation indicate that the distance to any isopleth of concern is larger than those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), before the second OSS foundation is installed BOEM, BSEE, and USACE must ensure that CVOW must: i. Identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO and NMFS OPR supporting that determination; and, following concurrence from NMFS GARFO, deploy those additional measures for the second OSS foundation. BOEM, BSEE, and USACE supporting that determination and request concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional, modified, and/or alternative measures or modifications to operations for the second OSS foundation. ii. If any of the SFV measurements indicate that the distances to level A thresholds for ESA-listed whales or PTS peak or cumulative thresholds for sea turtles are larger than the modeled distances (assuming 10 dB attenuation, see Table 34, Table 37,and Table 40), the clearance and shutdown zones (see Table 48) for the second OSS foundation must be increased to be at least the size of the distances to those thresholds as indicated by SFV. For every 1,500 m that a marine mammal clearance or shutdown zone is expanded, additional PSOs must be deployed from additional platforms or vessels to ensure adequate and complete monitoring of the expanded shutdown and/or clearance zone; CVOW must submit a proposed monitoring plan for NMFS GARFO's concurrence describing the proposed deployment of additional PSOs including the number and location of all PSOs. In the event that the clearance or shutdown zone for sea turtles needs to be expanded, the proposed monitoring plan must also include a description of how additional PSOs will be deployed to ensure effective monitoring for sea turtles in the expanded zones. iii. If, after implementation of 3.b.i, any subsequent SFV measurements indicate that the distances to any	

Measure	Description	Effect
	identified isopleth of concern are still greater than those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), CVOW-C must identify and propose for review and concurrence: additional modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed (e.g., if threshold distances are still exceeded on OSS, 2 the additional measures must be deployed for OSS 3). NMFS GARFO will strive to provide concurrence as quickly as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving CVOW-C's proposal and request for concurrence. Clearance and shutdown zones must be expanded consistent with the requirements of 3.b.ii. iv. Following installation of the OSS with additional modified, and/or alternative noise attenuation measures or operational changes required by 3.b.iii, if SFV results indicate that any isopleths of concern are still greater than those modeled assuming 10 dB attenuation, before the third OSS can be installed, CVOW-C must and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's, BOEM, BSEE, and USACE must require and CVOW-C must implement those measures and any expanded clearance and shutdown zone sizes (and any required additional PSOs) consistent with the requirements of 3.b.ii. 1. If no additional measures are identified for implementation and NMFS concurs with that determination, NMFS GARFO will presume that reinitiation of consultation is necessary, consistent with 50 CFR §402.16(a)(2) and/or (a)(3). NMFS GARFO, NMFS OPR, BOEM, BSEE, and USACE will meet within three business days to discuss: the results of SFV monitoring, the severity of exceedance of distances to identified isopleths of concern, the species affected, modeling assumptions, and whether any triggers for reinitiation of consultation are met (50 CFR	

Measure	Description	Effect
	§402.16), including consideration of whether the SFV results constitute new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered in the consultation. v. Following installation of the second OSS with additional noise attenuation measures required by 3.b.iii, if SFV results indicate that all isopleths of concern are within distances those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), BOEM, BSEE, and USACE must require, and CVOW-C must continue to implement the approved additional, alternative, or modified sound attenuation measures/operational changes, BOEM, BSEE, USACE and/or CVOW-C can request concurrence from NMFS GARFO to the original clearance and shutdown zones (Table 48) or CVOW-C can continue with the expanded clearance and shutdown zones with additional PSOs. g. Abbreviated SFV Monitoring (consisting of a single acoustic recorder placed at an appropriate distance from the pile) must be performed on all foundation installations for which the complete SFV monitoring outlined in 3a and 3b is not carried out. Results must be included in the weekly reports. Any indications that distances to the identified Level A and Level B harassment thresholds for whales or distances to injury or behavioral disturbance distances for sea turtles or Atlantic sturgeon must be addressed by CVOW-C, including an explanation of factors that contributed to the exceedance and corrective actions that were taken to avoid exceedance on subsequent piles. BOEM, BSEE, USACE, and CVOW-C must meet with NMFS GARFO within two business days of CVOW-C's submission of a report that includes an exceedance to discuss if any additional action is necessary. h. CVOW-C must inspect and carry out appropriate maintenance on the noise attenuation system prior to every pile driving event and prepare and submit a Noise Attenuation System (NAS) inspection/performance report. For piles for which full SFV is carried out, this report must be submitted as soon as it is available, but no later than when the interim SFV report is submitted for the respective pile. Performance reports for all subsequent piles must be submitted with the weekly pile driving reports. All reports must be submitted by email to nmfs.gar.incidental-take@noaa.gov. i. Performance reports for each bubble curtain deployed must include water depth, current speed and direction, wind speed and direction, bubble curtain deployment/retrieval date and time, bubble curtain hose length, bubble curtain radius (distance from pile), diameter of holes and hole spacing, air supply	

Measure	Description	Effect
	hose length, compressor type (including rated Cubic Feet per Minute (CFM) and model number), number of operational compressors, performance data from each compressor (including Revolutions Per Minute (RPM), pressure, start times, and stop times), free air delivery (m^3/min), total hose air volume (m^3/(min m)), schematic of GPS waypoints during hose laying, maintenance procedures performed (pressure tests, inspections, flushing, re-drilling, and any other hose or system maintenance) before and after installation and timing of those tests, and the length of time the bubble curtain was on the seafloor prior to foundation installation. Additionally, the report must include any important observations regarding performance (before, during, and after pile installation), such as any observed weak areas of low pressure. The report may also include any relevant video and/or photographs of the bubble curtain(s) operating during all pile driving.	
Reporting Requirements	To implement the requirements of RPM 2, CVOW-C must file a report with NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and BSEE (via TIMSWeb and notification email to protectedspecies@bsee.gov) in the event that any ESA-listed species is observed within the identified shutdown zone during active pile driving. This report must be filed within 48 hours of the incident and include the following: duration of pile driving prior to the detection of the animal(s), location of PSOs and any factors that impaired visibility or detection ability, time of first and last detection of the animal(s), distance of animal(s) at first detection, closest point of approach of animal(s) to pile, behavioral observations of the animal(s), time the PSO called for shutdown, hammer log (number of strikes, hammer energy), time the pile driving began and stopped, and any measures implemented (e.g., reduced hammer energy) prior to shutdown. If shutdown was determined not to be feasible, the report must include an explanation for that determination and the measures that were implemented (e.g., reduced hammer energy).	This measure would ensure adequate monitoring of zones during foundation installation to reduce risk to marine mammals.
Reporting Requirements	To implement the requirements of RPM 2, BOEM, BSEE, USACE, and CVOW-C must implement the following reporting requirements necessary to document the amount or extent of incidental take that occurs during all phases of the proposed action: a. If a North Atlantic right whale is observed at any time by PSOs or project personnel, CVOW-C must ensure the sighting is immediately reported to NMFS. If immediate reporting is not possible, the report must be made within 24 hours of the sighting. i. The report must be made to the appropriate geographic reporting line: • If in the Northeast Region (ME to VA/NC border) call (866-755-6622).	Reporting requirements to document take would improve accountability for documenting ESA-listed species and marine mammal take associated with the Proposed Action

Measure	Description	Effect
	• If in the Southeast Region (NC to FL) call (877-WHALE-HELP or 877-942-5343). • If calling the hotline is not possible, reports can also be made to the U.S. Coast Guard via channel 16 or through the WhaleAlert app (http://www.whalealert.org/). The sighting report must include the time (note time format, e.g., UTC, EST), date, and location (latitude/longitude in decimal degrees) of the sighting, number of whales, animal description/certainty of sighting (provide photos/video if taken), lease area/project name, PSO/personnel name, PSO provider company (if applicable), and reporter's contact information. ii. If a North Atlantic right whale is detected at any time by PSOs/PAM Operators via PAM, CVOW-C must ensure the detection is reported as soon as possible and no longer than 24 hours after the detection to NMFS via the 24-hour North Atlantic right whale Detection Template (https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates). Calling the hotline is not necessary when reporting PAM detections via the template. iii. A summary report must be sent within 24 hours to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and NMFS OPR (PR.ITP.MonitoringReports@noaa.gov) with the above information and confirmation the sighting/detection was reported to the respective hotline, the vessel/platform from which the sighting/detection was made, activity the vessel/platform was engaged in at time of sighting/detection, project construction and/or survey activity ongoing at time of sighting/detection (e.g., pile driving, cable installation, HRG survey), distance from vessel/platform to animal at time of initial sighting/detection, closest point of approach of whale to vessel/platform, vessel speed, and any mitigation actions taken in response to the sighting. b. In the event of a suspected or confirmed vessel strike of any ESA-listed species (e.g., marine mammal, sea turtle, listed fish) by any vessel associated with the Project or other means by which project activities caused a non-auditory injury or death of a ESA-listed species, CVOW-C must immediately report the incident to NMFS. If in the Greater Atlantic Region (ME-VA), call the NMFS Greater Atlantic Stranding Hotline (866-755-6622) and if in the Southeast Region (NC-FL), call the NMFS Southeast Stranding Hotline (877-942-5343). As well as notify BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov). Separately, CVOW-C must immediately report the incident to NMFS GARFO (*nmfs.gar.incidental-take@noaa.gov*), and if in the	

Measure	Description	Effect
	Southeast region (NC-FL), also to NMFS SERO (*secmammalreports@noaa.gov*). The report must include: (A) Time, date, and location (coordinates) of the incident; (B) Species identification (if known) or description of the animal(s) involved (i.e., identifiable features including animal color, presence of dorsal fin, body shape and size); (C) Vessel strike reporter information (name, affiliation, email for person completing the report); (D) Vessel strike witness (if different than reporter) information (name, affiliation, phone number, platform for person witnessing the event); (E) Vessel name and/or MMSI number; (F) Vessel size and motor configuration (inboard, outboard, jet propulsion); (G) Vessel's speed leading up to and during the incident; (H) Vessel's course/heading and what operations were being conducted (if applicable); (I) Part of vessel that struck whale (if known); (J) Vessel damage notes; (K) Status of all sound sources in use; (L) If animal was seen before strike event; (M) behavior of animal before strike event; (N) Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike; (O) Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike; (P) Estimated (or actual, if known) size and length of animal that was struck; (Q) Description of the behavior of the marine mammal immediately preceding and following the strike; (R) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike; (S) Other animal details if known (e.g., length, sex, age class); (T) Behavior or estimated fate of the animal post-strike (*e.g.*, dead, injured but alive, injured and moving, external visible wounds (linear wounds, propeller wounds, non-cutting blunt-force trauma wounds), blood or tissue observed in the water, status unknown, disappeared); (U) To the extent practicable, photographs or video footage of the animal(s); and (V) Any additional notes the witness may have from the interaction. For any numerical values provided (i.e., location, animal length, vessel length), please provide if values are actual or estimated. Reports of Atlantic sturgeon take must include a statement as to whether a fin clip sample for genetic sampling was taken. Fin clip samples are required in all cases to document the DPS of origin; the only exception to this requirement is when additional handling of the sturgeon would result in an imminent risk of injury to the fish or the survey personnel handling the fish, we expect such incidents to be limited to capture and handling of sturgeon in extreme weather. Instructions for fin clips and associated metadata are available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic, under the "Sturgeon	

Measure	Description	Effect
	Genetics Sampling" heading. c. In the event that personnel involved in the Project discover a stranded, entangled, injured, or dead ESA-listed species (e.g., marine mammal, sea turtle, listed fish), CVOW-C must immediately report the observation to NMFS. If in the Greater Atlantic Region (ME-VA) call the NMFS Greater Atlantic Stranding Hotline (866-755-6622) and if in the Southeast Region (NC-FL) call the NMFS Southeast Stranding Hotline (877-942-5343). Separately, CVOW-C must report the incident, if in the Greater Atlantic region (ME to VA) to GARFO (nmfs.gar.incidental-take@noaa.gov) or if in the Southeast region (NC-FL) to NMFS SERO (secmammalreports@noaa.gov) as soon as feasible. As well as notify BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov). Note, the stranding hotline may request the report be sent to the local stranding network response team. Reports of listed fish should only be sent to nmfs.gar.incidental-take@noaa.gov. The report must include: (A) Contact information (name, phone number,), time, date, and location (coordinates) of the first discovery (and updated location information if known and applicable); (B) Species identification (if known) or description of the animal(s) involved; (C) Condition of the animal(s) (including carcass condition if the animal is dead); (D) Observed behaviors of the animal(s), if alive; (E) If available, photographs or video footage of the animal(s); and (F) General circumstances under which the animal was discovered. Staff responding to the hotline call will provide any instructions for handling or disposing of any injured or dead animals, which may include coordination of transport to shore, particularly for injured sea turtles d. CVOW-C must compile and submit weekly reports during pile driving that document the pile ID, type of pile, pile diameter, start and finish time of each pile driving event, hammer log (number of strikes, max hammer energy, duration of piling) per pile, any changes to noise attenuation systems and/or hammer schedule, details on the deployment of PSOs and PAM operators, including the start and stop time of associated observation periods by the PSOs and PAM Operators, and a record of all observations/detections of marine mammals and sea turtles, including time (UTC) of sighting/detection, species ID, behavior, distance (meters) from vessel to animal at time of sighting/detection (meters), animal distance (meters) from pile installation vessel, vessel/project activity at time of sighting/detection, platform/vessel name, and mitigation measures taken (if any) and reason. Sightings/detections during pile driving activities (clearance, active pile driving, post-pile driving) and all other (transit, opportunistic,) sightings/detection must be reported and identified as such. These weekly reports must be submitted to NMFS GARFO	

Measure	Description	Effect
	(nmfs.gar.incidental-take@noaa.gov), BOEM, and BSEE by CVOW-C or the PSO providers and can consist of QA/QC'd raw data. Weekly reports are due on Wednesday for the activities occurring the previous week (Sunday–Saturday, local time). e. Starting in the first month that in-water activities occur (e.g., cofferdam installation, fisheries surveys, and HRG activities), CVOW-C must compile and submit monthly reports that include a summary of all project activities carried out in the previous month, including dates and location of any fisheries surveys carried out, vessel transits (name, type of vessel, number of transits, vessel activity, and route (this includes transits from all ports, foreign and domestic), cable installation activities (including sea to shore transition), number of piles installed and pile IDs, and all sightings/detections of ESA-listed whales, sea turtles, and sturgeon, inclusive of any mitigation measures taken as a result of those observations. Sightings/detections must include species ID, time, date, initial detection distance, vessel/platform name, vessel activity, vessel speed, bearing to animal, project activity, and if any mitigation measures taken. These reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and are due on the 15th of the month for the previous month. f. CVOW-C must submit to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) an annual report describing all activities carried out to implement their Fisheries Research and Monitoring Plan. This report must include a summary of all activities conducted, the dates and locations of all fisheries surveys, summarized by month, number of vessel transits inclusive of port of origin and destination, and a summary table of any observations of ESA-listed species during these surveys. Each annual report is due by February 15 (i.e., the report for 2024 activities is due by February 15, 2025). g. BOEM, BSEE, and/or CVOW-C must submit full detection data, metadata, and location of recorders (or GPS tracks, if applicable) from all real-time hydrophones used for monitoring during construction within 90 calendar days after pile-driving has ended. Reporting must use the webform templates on the NMFS Passive Acoustic Reporting System website at https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates. BOEM, BSEE, and/or CVOW-C must submit the full acoustic recordings from all the real-time hydrophones to the National Centers for Environmental Information (NCEI) for archiving within 90 calendar days after pile-driving has ended and instruments have been pulled from the water. Archiving guidelines outlined here (https://www.ncei.noaa.gov/products/passive-acoustic-data#tab-3561) must be followed. Confirmation of both submittals must be sent to NMFS GARFO.	

Measure	Description	Effect
Review of Plans	To implement RPM 2, within 10 business days of BOEM, BSEE, and/or USACE obtaining updated information on project plans (i.e., as obtained through a relevant Facility Design Report (FDR)/Fabrication and Installation Report (FIR) or other submission), BOEM, BSEE, and/or USACE must provide NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) with the following information: number and size of foundations to be installed to support wind turbine generators and offshore substations, installation method for the sea to shore transition (e.g., casing pipe, cofferdam, no containment), the proposed construction schedule (i.e., months when pile driving is planned), and any available updates on anticipated vessel transit routes (e.g., any changes to the ports identified for use by project vessels) that will be used by project vessels. NMFS GARFO will review this information and request a meeting with BOEM, BSEE, and USACE if there is any indication that there are changes to the proposed action that would cause an effect to listed species or critical habitat that was not considered in this Opinion, including the amount or extent of predicted take, such that any potential trigger for reinitiation of consultation can be discussed with the relevant action agencies. days of BOEM's submission to NMFS, and NMFS' receipt of the requested information.	Review of updates to planned operations would avoid impacts, including take, to marine mammals, ESA-listed species, or critical habitat that were not previously considered.
Review of Plans	To implement RPM 3, the plans identified below must be submitted to NMFS GARFO at nmfs.gar.incidental-take@noaa.gov by BOEM, BSEE, and/or CVOW-C. Any of the identified plans can be combined such that a single submitted plan addresses multiple requirements provided that the plan clearly identifies which requirements it is addressing. For each plan, within 45 calendar days of receipt of the plan, NMFS GARFO will provide comments to BOEM, BSEE, and CVOW-C, including a determination as to whether the plan is consistent with the requirements outlined in this ITS and/or in Section 3 (Description of the Proposed Actions) of this Opinion. If the plan is determined to be inconsistent with these requirements, BOEM, BSEE and/or CVOW-C must resubmit a modified plan that addresses the identified issues within 30 days of the receipt of the comments, but at least 15 calendar days before the start of the associated activity. At that time, BOEM, BSEE and NMFS GARFO and OPR will discuss a timeline for review and approval of the modified plan. If further revisions are necessary, at all times, NMFS GARFO, BOEM, and BSEE will be provided at least three business days for review and, whenever possible, NMFS GARFO, BOEM, and BSEE will aim to provide responses within four business days. BOEM, BSEE and CVOW-C must receive NMFS GARFO's concurrence with these plans before the identified activity is carried out: a. Passive Acoustic Monitoring Plan for Pile Driving. BOEM, BSEE, and/or CVOW-C must submit this Plan to NMFS GARFO at least 180 calendar days before impact pile driving is planned. BOEM, BSEE, and CVOW-C must	Plans and protocols would establish requirements for operations and monitoring.

Measure	Description	Effect
	obtain NMFS GARFO's concurrence with this Plan prior to the start of any pile driving. The Plan must include a description of all proposed PAM equipment and hardware, the calibration data, bandwidth capability and sensitivity of hydrophones, and address how the proposed passive acoustic monitoring will follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs et al., 2021). The Plan must describe and include all procedures, documentation, and protocols including information (i.e., testing, reports, equipment specifications) to support that it will be able to detect vocalizing whales within the clearance and shutdown zones, including deployment locations, procedures, detection review methodology, and protocols; hydrophone detection ranges with and without foundation installation activities and data supporting those ranges; communication time between call and detection, and data transmission rates between PAM Operator and PSOs on the pile driving vessel; where PAM Operators will be stationed relative to hydrophones and PSOs on pile driving vessel calling for delay/shutdowns; and a full description of all proposed software, call detectors, and filters. The Plan must also incorporate the requirements relative to North Atlantic right whale reporting in 5.a. b. Marine Mammal and Sea Turtle Monitoring Plan – Pile Driving. BOEM, BSEE, and/or CVOW-C must submit this Plan to NMFS GARFO at least 180 calendar days before any pile driving for foundation installation is planned. BOEM, BSEE, and/or CVOW-C must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of any pile driving for foundation installation. The Plan(s) must include: a description of how all relevant mitigation and monitoring requirements contained in the incidental take statement will be implemented, a pile driving installation summary and sequence of events, a description of all training protocols for all project personnel (PSOs, PAM Operators, trained crew lookouts,), a description of all monitoring equipment and evidence (i.e., manufacturer's specifications, reports, testing) that it can be used to effectively monitor and detect ESA-listed marine mammals and sea turtles in the identified clearance and shutdown zones (i.e., field data demonstrating reliable and consistent ability to detect ESA-listed large whales and sea turtles at the relevant distances in the conditions planned for use), communications and reporting details, and PSO monitoring and mitigation protocols (including number and location of PSOs) for effective observation and documentation of sea turtles and ESA-listed marine mammals during all pile driving events. The Plan(s) must demonstrate sufficient PSO and PAM Operator staffing (in accordance with watch shifts), PSO and PAM Operator schedules, and contingency plans for instances if	

Measure	Description	Effect
	additional PSOs and PAM Operators are required. The Plan must detail all plans and procedures for sound attenuation, including procedures for adjusting the noise attenuation system(s) and available contingency noise attenuation measures/systems if distances to modeled isopleths of concern are exceeded during SFV. The plan must also describe how CVOW-C would determine the number of sea turtles exposed to noise above the 175 dB harassment threshold during impact pile driving of WTG and OSS foundations and how CVOW-C would determine the number of ESA-listed whales exposed to noise above the Level B harassment (behavioral disturbance) threshold during impact pile driving of WTG and OSS foundations. c. Reduced Visibility Monitoring Plan. BOEM, BSEE, and/or CVOW-C must submit this Plan to NMFS GARFO at least 180 calendar days before impact pile driving is planned to begin. BOEM, BSEE, and CVOW-C must obtain NMFS GARFO's concurrence with this Plan prior to the start of pile driving. This Plan must contain a thorough description of how CVOW-C will monitor pile driving activities during reduced visibility conditions (e.g., rain, fog) and at night (i.e., between 1.5 hours prior to civil sunset and 1 hour after civil sunrise), including proof of the efficacy of monitoring devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable night vision devices NVDs, spotlights) in detecting ESA-listed marine mammals and sea turtles over the full extent of the required clearance and shutdown zones, including demonstration that the full extent of the minimum visibility zones (2,000 m for WTG and OSS foundations, 1,000 m for goal posts) can be effectively and reliably monitored. The Plan must identify the efficacy of the technology at detecting marine mammals and sea turtles in the clearance and shutdowns under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting. The Plan must include a full description of the proposed technology, monitoring methodology, and data demonstrating to NMFS GARFO's satisfaction that marine mammals and sea turtles can reliably and effectively be detected within the clearance and shutdown zones for foundation piles before and during impact pile driving. Additionally, this Plan must contain a thorough description of how CVOW-C will monitor pile driving activities during daytime when unexpected changes to lighting or weather occur during pile driving that prevent visual monitoring of the full extent of the clearance and shutdown zones. d. Sound Field Verification Plan - WTG and OSS Installation. BOEM, BSEE, and/or CVOW-C must submit this Plan to NMFS GARFO at least 180 calendar days before pile driving for WTG and/or OSS foundations is planned to begin. BOEM, BSEE, and CVOW-C must obtain NMFS	

Measure	Description	Effect
	GARFO's concurrence with this Plan(s) prior to the start of these pile driving activities. To validate the estimated sound fields, SFV measurements will be conducted during pile driving of the first three monopiles and the three OSS foundations (inclusive of all four pin piles) installed over the course of the Project, with noise attenuation activated (inclusive of vibratory and impact driving). The Plan(s) must describe how the first three monopile installation sites and installation scenarios (i.e., hammer energy, number of strikes) are representative of the rest of the monopile installations and, therefore, why these monopile installations would be representative of the remaining monopile installations. If the monitored pile locations are different from the ones used for exposure modeling, justification must be provided for why these locations are representative of the modeling. In the case that these sites are not determined to be representative of all other monopile installation sites, CVOW-C must include information on how additional monopiles/sites would be selected for SFV. The Plan(s) must also include the piling schedule and sequence of events, communication and reporting protocols, methodology for collecting, analyzing, and preparing SFV data for submission to NMFS GARFO, including instrument deployment, locations of all hydrophones, including direction and distance from the pile, hydrophone sensitivity, recorder/measurement layout, and analysis methods, and a template of the interim report to be submitted. The Plan must also identify the number and location of hydrophones that will be reported in the SFV Interim Reports and any additional hydrophone locations that will be included in the final report(s). The Plan must describe how the effectiveness of the sound attenuation methodology will be evaluated based on the results. The Plan must address how CVOW-C will implement Terms and Conditions 3a and 3b (see above) which includes, but is not limited to identifying additional noise attenuation measures (e.g., add noise attenuation device, adjust hammer operations, adjust NMS) that will be applied to reduce sound levels if measured distances are greater than those modeled. The plan must describe how Abbreviated SFV Monitoring (consisting of a single acoustic recorder placed at an appropriate distance from the pile) required by Term and Condition 3.c. will be performed on all foundation installations for which the complete SFV monitoring outlined in 3a and 3b is not carried out. The plan must also outline the anticipated results that will be included in the weekly reports. The plan must also specify steps that will be taken should any exceedances occur. e. SFV Interim Reports - Pile Driving. BOEM, BSEE, and USACE must require and CVOW-C must provide, as soon as they are available but no later than 48 hours after the installation of each of the first three monopiles and after each of the three OSS foundations (inclusive of all four pin	

Measure	Description	Effect
	piles), the initial results of the SFV measurements to NMFS GARFO in an interim report. If technical or other issues prevent submission within 48 hours, CVOW-C must notify BOEM, BSEE, and NMFS GARFO within that 48-hour period with the reasons for delay and provide an anticipated schedule for submission of the report. These reports are required for each of the first three monopiles and each of the three OSS foundations installed, and any additional piles for which SFV is required. The interim report must include data from hydrophones identified for interim reporting in the SFV Plan and include a summary of pile installation activities (pile diameter, pile weight, pile length, water depth, sediment type, hammer type, total strikes, total installation time [start time, end time], duration of pile driving, max single strike energy, NAS deployments), pile location, recorder locations, modeled and measured distances to thresholds, received levels (rms, peak, and SEL) results from Conductivity, Temperature, and Depth (CTD) casts/sound velocity profiles, signal and kurtosis rise times, pile driving plots, activity logs, and weather conditions. Additionally, any important sound attenuation device malfunctions (suspected or definite), must be summarized and substantiated with data (e.g., photos, positions, environmental data, directions,) and observations. Such malfunctions include gaps in the bubble curtain, significant drifting of the bubble curtain, and any other issues which may indicate sub-optimal mitigation performance or are used by CVOW-C to explain performance issues. Requirements for actions to be taken based on the results of the SFV are identified in 3.a. above. f. The final results of SFV for monopile and pin pile installations must be submitted as soon as possible, but no later than within 90 days following completion of pile driving for which SFV was carried out. g. Vessel Strike Avoidance Plan. BOEM, BSEE, and/or CVOW-C must submit this plan to NMFS GARFO as soon as possible after issuance of this Opinion but no later than 180 days prior to the planned start of in-water construction activities (including cable installation). The Plan must provide details on all relevant mitigation and monitoring measures for listed species, vessel speeds and transit protocols from all planned ports, vessel-based observer protocols for transiting vessels, communication and reporting plans, proposed alternative monitoring equipment to maintain vessel strike avoidance zones in varying weather conditions, darkness, sea states, and in consideration of the use of artificial lighting. If CVOW-C plans to implement PAM in any transit corridor to allow vessel transit above 10 knots, the plan must describe how PAM, in combination with visual observations, will be conducted to ensure the transit corridor is clear of North Atlantic right whales. PAM information should follow what is required to be submitted for the PAM Plan in 8.a.	

Measure	Description	Effect
On-site Observation and Inspection	To implement the requirements of RPM 4, BOEM and BSEE must exercise their authorities to assess the implementation of measures to avoid, minimize, monitor, and report incidental take of ESA-listed species during activities described in this Opinion. BOEM and/or BSEE shall immediately exercise their respective authorities to take effective action to ensure prompt implementation and compliance if CVOW-C is not complying with: any avoidance, minimization, and monitoring measures incorporated into the proposed action or any term and condition(s) specified in this statement, as currently drafted or otherwise amended in agreement between the BOEM, BSEE, and NMFS; if BOEM and/or BSEE fail to do so, the protective coverage of Section 7(o)(2) may lapse.	Plans and protocols would establish requirements for operations and monitoring.
On-site Observation and Inspection	To implement the requirements of RPM 4, CVOW-C must consent to on-site observation and inspections by Federal agency personnel (including NOAA personnel) during activities described in the Biological Opinion, for the purposes of evaluating the effectiveness and implementation of measures designed to minimize or monitor incidental take.	On-site observations and inspections would ensure effectiveness and compliance with minimization and monitoring measures.

[1] Also Identified in Appendix H, Table H-2.

3.15.8.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.15-8 and Table H-2 in Appendix H are incorporated in the Preferred Alternative. There are no additional Agency-required mitigation measures identified as relevant for marine mammals (Appendix H, Table H-3). These measures, if adopted, would serve to reduce impacts on marine mammals and are broadly categorized as follows:

- **Vessel strike avoidance procedures:** Establishing and maintaining safe operating distances will minimize vessel interactions with marine mammals. This measure would further clarify the distance at which vessels would divert their path and the distance at which vessels would reduce speed and shift to neutral. Adoption of this measure would further clarify requirements for vessel strike avoidance under the Proposed Action but would not alter the impact determinations.
- **Letter of Authorization requirements:** Compliance with MMPA LOA requirements would reduce risks for marine mammals under the Proposed Action. However, this measure would not alter impact determinations for marine mammals.
- **BOEM PDCs and BMPs for data collection activities:** Compliance with BOEM's PDCs and BMPs for protected species would minimize risk to marine mammals during site characterization and site assessment surveys, including during Project construction and O&M. While adoption of this measure would decrease risk to marine mammals under the Proposed Action, it would not alter the impact determination.
- **BOEM COP PDCs and BMPs to minimize vessel interactions and EMF, noise, and habitat effects:** Compliance with PDCs to minimize vessel interactions would reduce the risk of vessel strike. Compliance with PDCs to minimize EMF, noise, and habitat effects would minimize the potential and severity of effects for marine mammals. While adoption of this measure would reduce risk to marine mammals under the Proposed Action, it would not alter the impact determinations.

- **Marine debris awareness training:** 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.
- **Passive Acoustic Monitoring Plan, Pile-Driving Monitoring Plan, adaptive shutdown zones, minimum visibility requirements, Alternative Monitoring Plan, protected species observer coverage, sound field verification, and shutdown zones:** The development of Passive Acoustic Monitoring and Alternative Monitoring Plans, adaptive shutdown zones, minimum visibility requirements, PSO coverage, and shutdown zones would minimize the potential for Level A or Level B exposures during impact pile driving. The development of a Pile-Driving Monitoring Plan and SFV would increase the accountability of underwater noise mitigation during pile driving. While adoption of these measures would decrease risk to marine mammals during impact pile driving or increase accountability during this construction activity under the Proposed Action, it would not alter the impact determination.
- **Operational Sound Field Verification Plan:** The development of an Operational Sound Field Verification Plan would allow BOEM to confirm that impacts of operating WTG noise 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.
- **Passive acoustic monitoring:** The use of passive acoustic monitoring to record ambient noise and document presence of marine mammals before, during, and after construction would 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.
- **Periodic underwater surveys, and reporting of monofilament and other fishing gear around WTG foundations:** 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 determinations.
- **Sampling gear, gear identification, lost survey gear, and survey training:** The regular hauling of sampling gear and survey staff training would reduce risk of entanglement in fisheries survey gear. Gear identification and lost survey gear would improve accountability in the case of gear loss. While adoption of these measures would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination.
- **Weekly, monthly, annual, and incidental take reporting:** Reporting requirements to document take would improve accountability for documenting marine mammal take associated with the Proposed Action, though it would not alter the impact determination.

3.16. Navigation and Vessel Traffic

This section discusses navigation and vessel traffic characteristics and potential impacts on the 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, as shown on Figure 3.16-1, includes coastal and marine waters within a 10-mile (16.1-kilometer) buffer of the Lease Area (OCS-A 0483) associated with the Project and OCS A0497, associated with the CVOW-Pilot Project, ensuring coverage of the nearby TSS lanes, the staging areas, and relevant routes, as well as an area within 2 nautical miles (3.7 kilometers) of the export cable corridors. Information presented in this section draws primarily upon the *Navigation Safety Risk Assessment* (NSRA)[1] (COP, Appendix S; Dominion Energy 2023) which was conducted per the guidelines in USCG Navigation and Vessel Inspection Circular (NVIC 01-19) (USCG 2019) and Commandant Instruction 16003.2B (USCG 2019).

3.16.1 Description of the Affected Environment for Navigation and Vessel Traffic

3.16.1.1 Regional Setting

Proposed Project facilities would be approximately 33 nautical miles (61 kilometers) east of the JEBLCFS–the major operating base for the Amphibious Forces in the U.S. Navy's Atlantic Fleet under a Commercial Lease for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0483). The nearest port relevant to shipping and navigation is the Port of Virginia, Virginia, located 41.5 nautical miles (77 kilometers) west of the Lease Area. NSRA Figures 5.11 through 5.13 show the location of the Project area and the waterways that leading to ports that may be used by the Project. NSRA Figures 6.13 through 6.22 present regional vessel traffic in the vicinity of the Project area (COP, Appendix S; Dominion Energy 2023).

There are several routing measures that regulate vessel traffic to help ships avoid navigational hazards in the vicinity of the Project area.[2] Vessel traffic in and out of Chesapeake Bay is regulated by the Chesapeake Bay TSS consisting of a Southern Approach and an Eastern Approach converging on a Precautionary Area (33 CFR 167.200). On the Southern Approach, the inbound and outbound traffic lanes are separated by a two-way deep-water route (DWR) for deep-draft vessels or naval aircraft carriers (COP, Appendix S; Dominion Energy 2023). The Lease Area is located partially within the Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway, proposed by the USCG *Atlantic Coast Port Access Route Study* (ACPARS) (Figure 4.4-43) (Dominion Energy 2023 citing USCG 2016). On June 19, 2020, USCG issued an Advance Notice of Proposed Rulemaking (85 *Federal Register* 37034-37040) (ANPRM) seeking comments regarding the possible establishment of additional shipping safety fairways

[1] The NSRA (COP Appendix S, Dominion Energy 2023) analyzed vessel traffic within a Marine Traffic Study Area, which is inclusive of the Project area, the remainder of the Lease Area plus a 10-nautical mile (18.5-kilometer) buffer, the offshore export cable corridor, and a 2-nautical mile (3.7-kilometer) buffer. The study area considers current traffic patterns, density, and vessel numbers, as well as anticipated changes in traffic from the Project within the areas between the ports, to and from the Offshore Project area, and inclusive of the Offshore Project area. Where this EIS references vessel data and risk analysis from the NSRA, they are specific to the geographic scope of the Marine Traffic Study Area.

[2] The term *routing measure* originates from the International Maritime Organization. The International Convention for the Safety of Life at Sea, Chapter V, recognized the International Maritime Organization as the only international body for establishing routing measures (https://www.imo.org/en/OurWorkSafety/Pages/ShipsRouteing.aspx). USCG submits and obtains approval for routing measures within U.S. navigable waters to the International Maritime Organization. Areas to Be Avoided, Inshore Traffic Zones, No Anchoring, Area, Precautionary Areas, and Traffic Separation Schemes are all routing measures (USCG 2020: Appendix B).

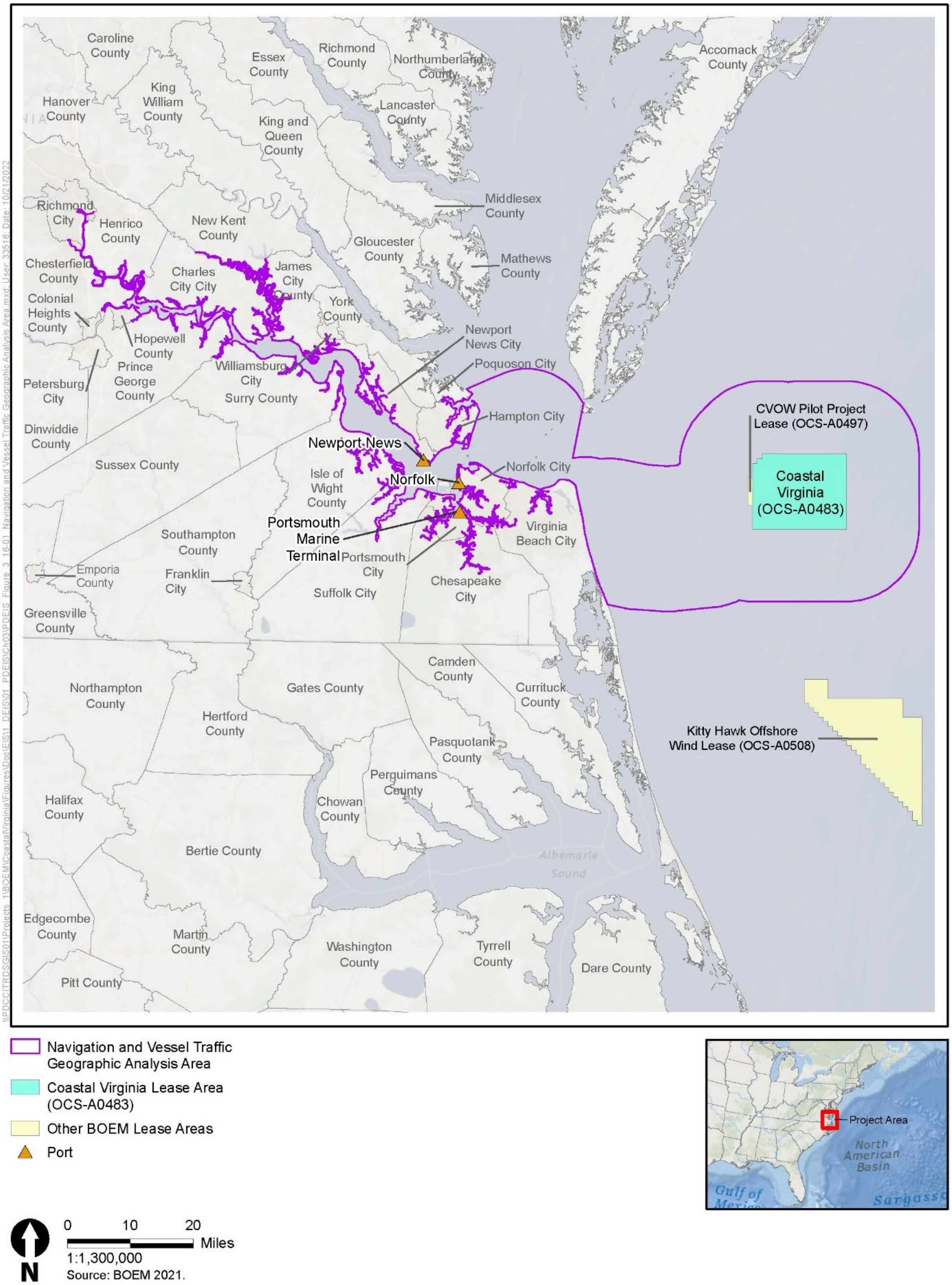


Figure 3.16-1 Navigation and Vessel Traffic Geographic Analysis Area

along the Atlantic Coast based on the navigation safety corridors identified in the *Atlantic Coast Port Access Route Study* (ACPARS) (USCG 2016). On September 9, 2022, USCG published the Consolidated Port Approaches Port Access Route Studies (CPAPARS) to announce the conclusion of the studies supplemental to the ACPARS. On March 10, 2023, USCG released an update to the CPAPARS (USCG 2023a). 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), dialogue with the maritime industry, and comments received on the ANPRM for establishing shipping safety fairways along the Atlantic Coastline. The report provides recommendations for a system of shipping safety fairways and routing measures along the Atlantic Coast, which would be included in any subsequent rulemaking proposal.

The potential fairway is about 200 nautical miles (322 kilometers) long, approximately 10 nautical miles (18.5 kilometers) wide; however, the width narrows to approximately 4 nautical miles (7.4 kilometers) wide adjacent to the Lease Area and includes the customary route taken by vessels transiting between the Port of Virginia; the Port of Baltimore, Maryland; the Port of Philadelphia, Pennsylvania; and the Port of Wilmington, Delaware (USCG 2020). The proposed Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway occupies a small portion of three of the northwesternmost Lease Area aliquots. The intersection of the Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway and the Lease Area is approximately 135 acres (0.5 square kilometer), which is approximately 0.1 percent of the Lease Area (COP, Section 4.4.7.1; Dominion Energy 2023). The offshore export cable corridor is located south of a Precautionary Area (COP, Appendix S, Section 5.1, Figure 5.1; Dominion Energy 2023).

Traffic patterns, traffic density, and statistics were developed from 1 year of Automatic Identification System (AIS) data collected during the entirety of 2019 (COP, Appendix S, Section 6.1; Dominion Energy 2023). Figure 6.8 in the NSRA shows vessel traffic in the vicinity of the Project area based on Automatic Identification System (AIS) data and nearby routing measures (traffic separation zones, precautionary areas); data from NOAA Vessel Monitoring System (VMS) data recorded during 2015 and 2016; the Northeast Ocean Data Portal (Dominion Energy 2023). This data and information were analyzed in the NSRA for the Proposed Action. The highest density area was in the approach to Chesapeake Bay, where large volumes of commercial traffic converged in the Southern Approach of the Chesapeake Bay TSS from the northeast, east and southeast.

3.16.1.2 Project Area

3.16.1.2.1 Vessel Traffic

NSRA used AIS vessel traffic data, VMS data for fishing vessels, USCG maritime incident data, NOAA nautical charts, and other publicly available data. The AIS data, which are only required on commercial vessels with a length of 65 feet (19.8 meters) or longer, was collected for the entirety of 2019 from both satellite and terrestrial receivers (NSRA 1.5, page 24). It used a 10 nautical miles radius around the Project area to determine the vessel types and density transiting in the area during this time period and to evaluate incidents (NSRA 2.3, page 31). Some smaller recreational and fishing vessels carry and AIS; however, the NSRA likely exclude most vessels less than 65 feet (19.8 meters) long that traverse the Project area, and it is recognized that this category of vessels is likely to be underreported (COP, Section 4.4.6; Dominion Energy 2023; COP Section 4.4.5; Dominion Energy 2023). COP Section 4.4.6 discusses commercial fisheries and for-hire recreational fishing, and Section 4.4.5 discusses recreation and tourism. “Other/undefined” vessel types include offshore supply vessels and research/survey vessels (COP, Appendix S, Section 6.3.4.1; Dominion Energy 2023). Figure 3.16-2 shows the main vessel types operating in the Lease Area.

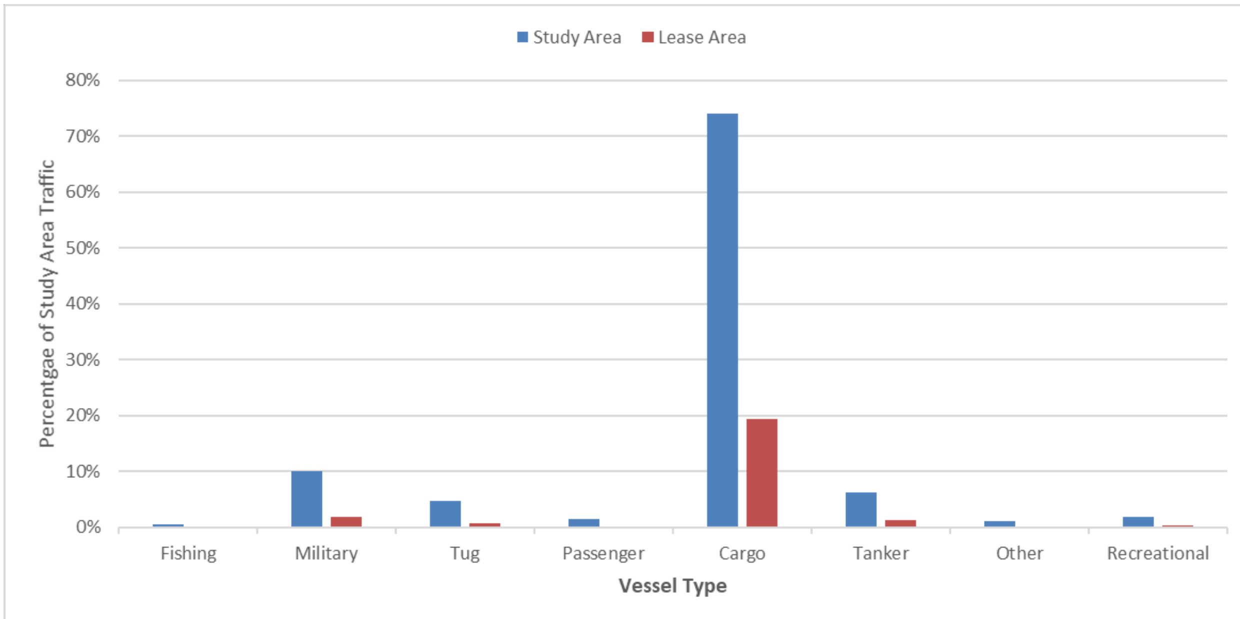


Figure 3.16-2 Main Vessel Type Distribution

During the study period, an average of approximately 22 to 23 unique vessel transits/day were recorded within the geographic analysis area. The busiest months were May and September and the quietest was December. The Lease Area was transited an average of six times/day. Overall, approximately 25 percent of vessel tracks recorded within the geographic analysis area intersected the Lease Area. The average draft recorded in the geographic analysis area was 31 feet (8.8 meters) and was only slightly deeper at 33.1 feet (10.1 meters) in the Lease Area. The average vessel speed in the geographic analysis area, excluding anchored vessels was 10.2 knots, which remained the same in the Lease Area. Figure 3.16-3 shows the offshore study area and proposed project infrastructure.

3.16.1.2.1.1 Military Vessels

Military vessels, such as carriers, destroyers, cruisers, and others, accounted for approximately 9 percent of traffic within the geographic analysis area and were the second most prolific vessel type in the geographic analysis area. They were primarily inbound or outbound from Naval Station Norfolk and the Joint Expeditionary Base–Little Creek within Chesapeake Bay conducting training within the Virginia Capes Range Complex and Operating Area and Range Complex, not within the Lease Area. More information on military vessels in the geographic study area can be found in COP, Section 4.4.8 (Dominion Energy 2023).

AIS data from 2019 on pleasure craft/sailing vessel density show very low recreational activity within and directly adjacent to the Lease Area (COP, Figure 4.4-51; Dominion Energy 2023). Figure 3.16-4 shows 2019 AIS recreational vessel density in the geographic analysis area. Recreational vessels accounted for approximately 4 percent of AIS traffic in the geographic analysis area. An average of one unique recreational vessel every 2 to 3 days was recorded in the geographic analysis area and twice a month in the Lease Area. Most of the recreational fishing activity occurs directly adjacent to shore in proximity to the export cable corridor, and the density decreases as vessels proceed offshore.

AIS, VMS, and vessel trip report data reveals that there are commercial fishing vessel transits and fishing efforts through the Offshore Project area without concentration in a specific area (COP, Figure 4.4-50; Dominion Energy 2023). However, most commercial fishing vessels are not required to carry AIS; therefore, data may under-represent existing vessel traffic. Figure 3.16-5 shows AIS CMCL fishing vessel density in the geographic analysis area.

As seen on Figure 3.16-6, AIS data demonstrate that there is relatively light cargo vessel traffic through the Lease Area, with higher vessel traffic traversing the offshore export cable route. Most of the cargo vessel activity in the Lease Area consists of transits to and from the Chesapeake Bay through the middle and the southern portion of the Lease Area, as well as additional transits just outside of the northwestern corner of the Lease Area. Traffic that traverses the middle of the Lease Area moves north, while traffic along the southern boundary continues east. During 2019, an average of 17 unique cargo vessels per day were recorded within the geographic analysis area and four vessels per day within the Lease Area (see COP Appendix S, *Navigation Safety Risk Assessment*) (Dominion Energy 2023). Container vessels were the most frequently recorded cargo vessel type within the geographic analysis area (43 percent) followed by bulk carriers (33 percent) and vehicle carriers (14 percent), as shown in COP Figure 4.4-46 (Dominion Energy 2023). The highest concentration of cargo vessels in the survey period was southwest of and through the Lease Area.

Figure 3.16-7 shows towing vessel (also referred to as tug/tow or push/tow vessels) density was light in 2019; a maximum of 10 vessel transits throughout the Lease Area (COP, Figure 4.4-47; Dominion Energy 2023). The density of towing vessels is relatively uniform throughout the Lease Area. The highest vessel density is closer to shore and within Chesapeake Bay outside the Lease Area where these vessels are transiting to and from the Port of Virginia. Throughout the survey period, an average of one unique towing vessel per day was recorded within the geographic analysis area and one unique towing vessel in 6 to 7 days within the Lease Area.

AIS 2019 data demonstrates that tankers transit the space within the southwest portion of the Lease Area. Figure 3.16-8 shows the clear pattern of tankers transiting to and from Chesapeake Bay with a light amount of vessel traffic in 2019. Tanker traffic through the offshore export cable corridor is consistent with the higher density closer to shore. Throughout the survey period an average of one unique tanker per day was recorded within the geographic analysis area and one in 3 days within the Lease Area. Liquified natural gas carriers were the most frequently recorded tanker type within the geographic analysis area (33 percent), followed by combined chemical/oil tankers (25 percent) and chemical tankers (15 percent).

Although there is not a high presence of passenger vessels that travel through the Lease Area, there is a heavy cruise line presence out of the Norfolk Terminal, with those vessels crossing the offshore export cable route. Carnival Cruise Lines, one of the world's largest cruise ship operators, uses Norfolk as a central hub for many of their Caribbean cruises. Approximately 12 cruise ships leave their Norfolk hub a year. Passenger vessels accounted for approximately 2 percent of traffic within the geographic analysis area. Throughout the survey period, an average of one unique passenger vessel every 3 days was recorded within the geographic analysis area, although the presence of passenger vessel within the Lease Area was limited.

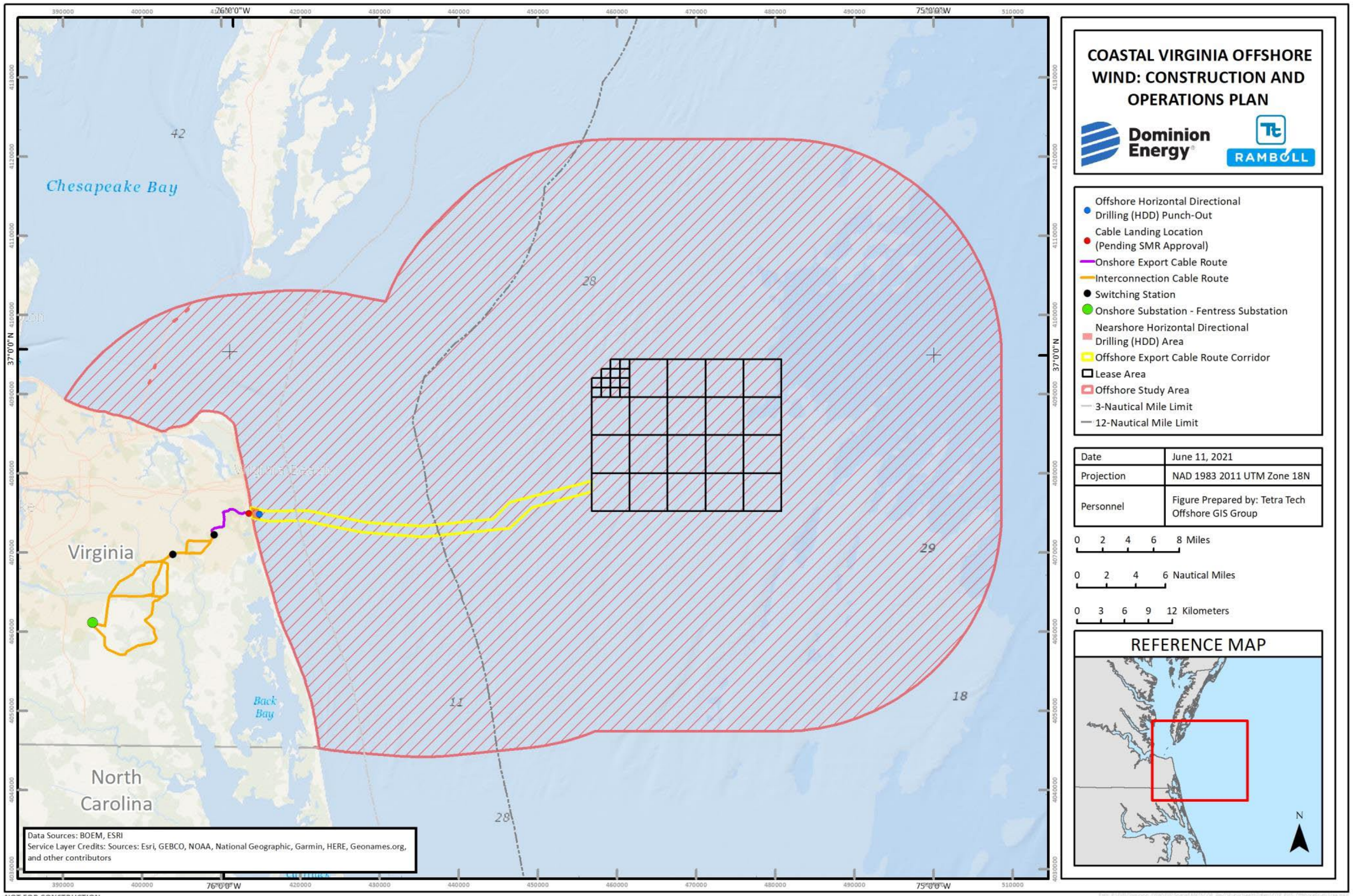


Figure 3.16-3 Offshore Study Area

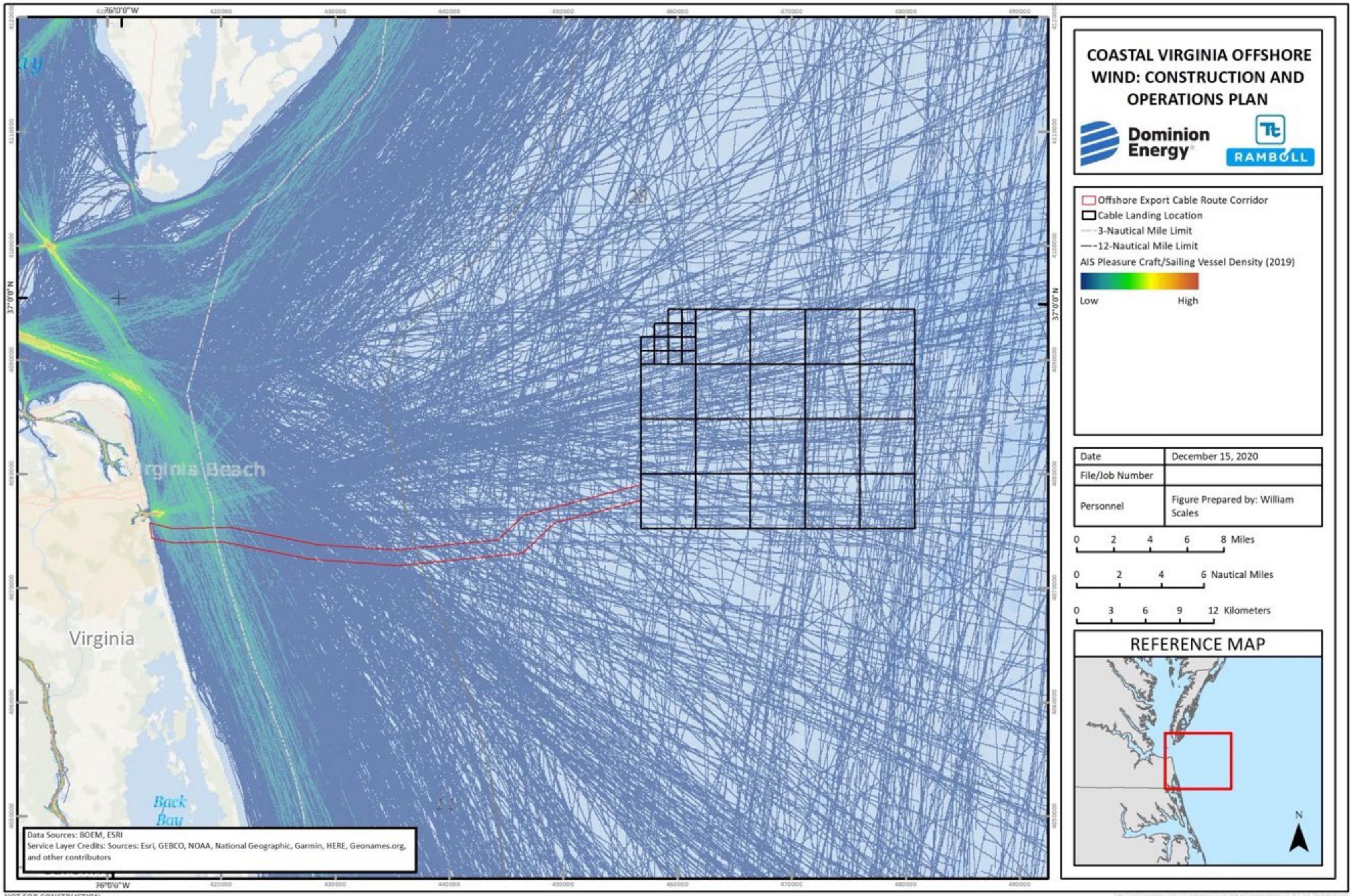


Figure 3.16-4 AIS Recreational Vessel Density (12 Months – January to December 2019)

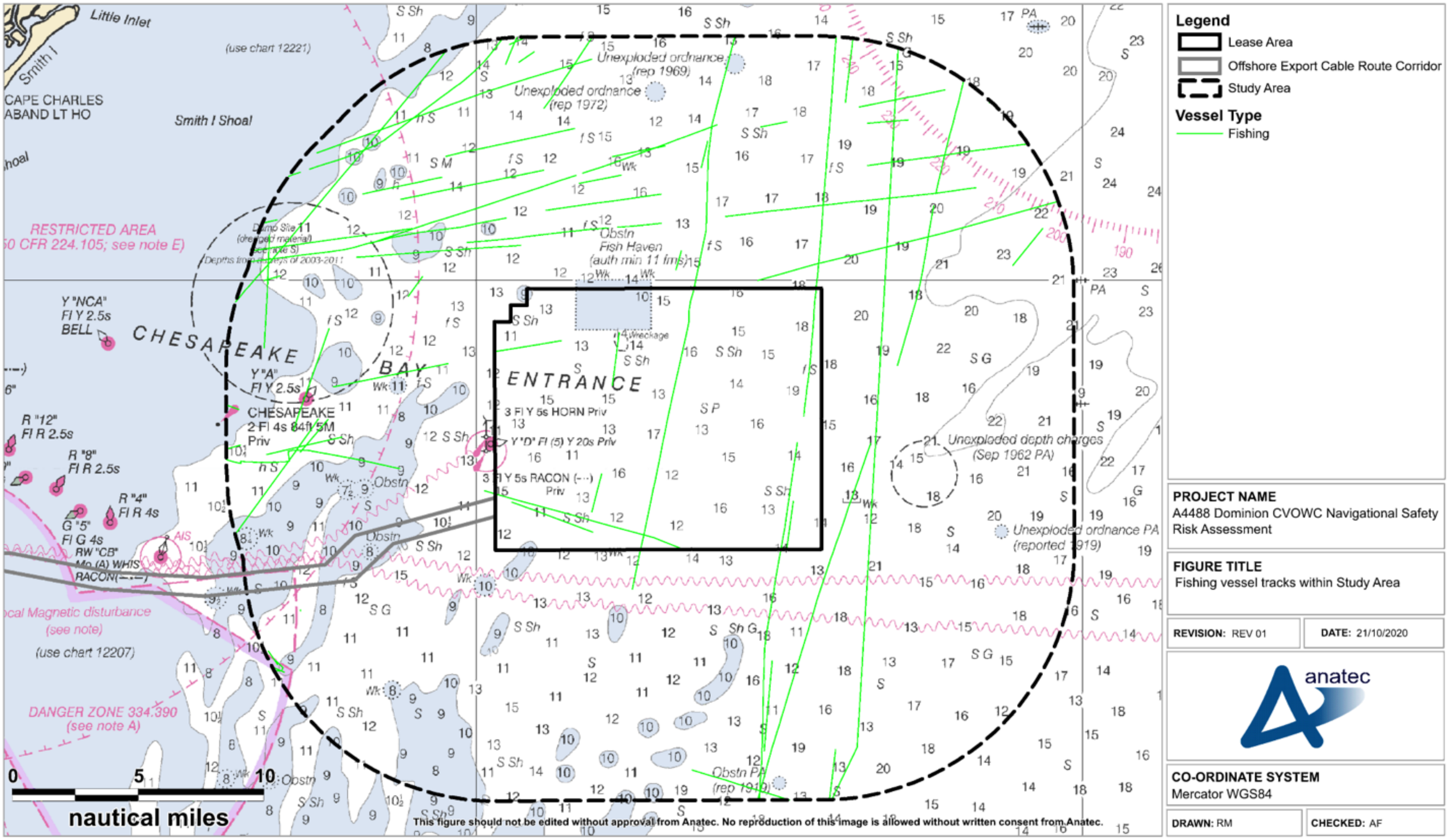


Figure 3.16-5 AIS CMCL Fishing Vessel Density (12 Months – January to December 2019)

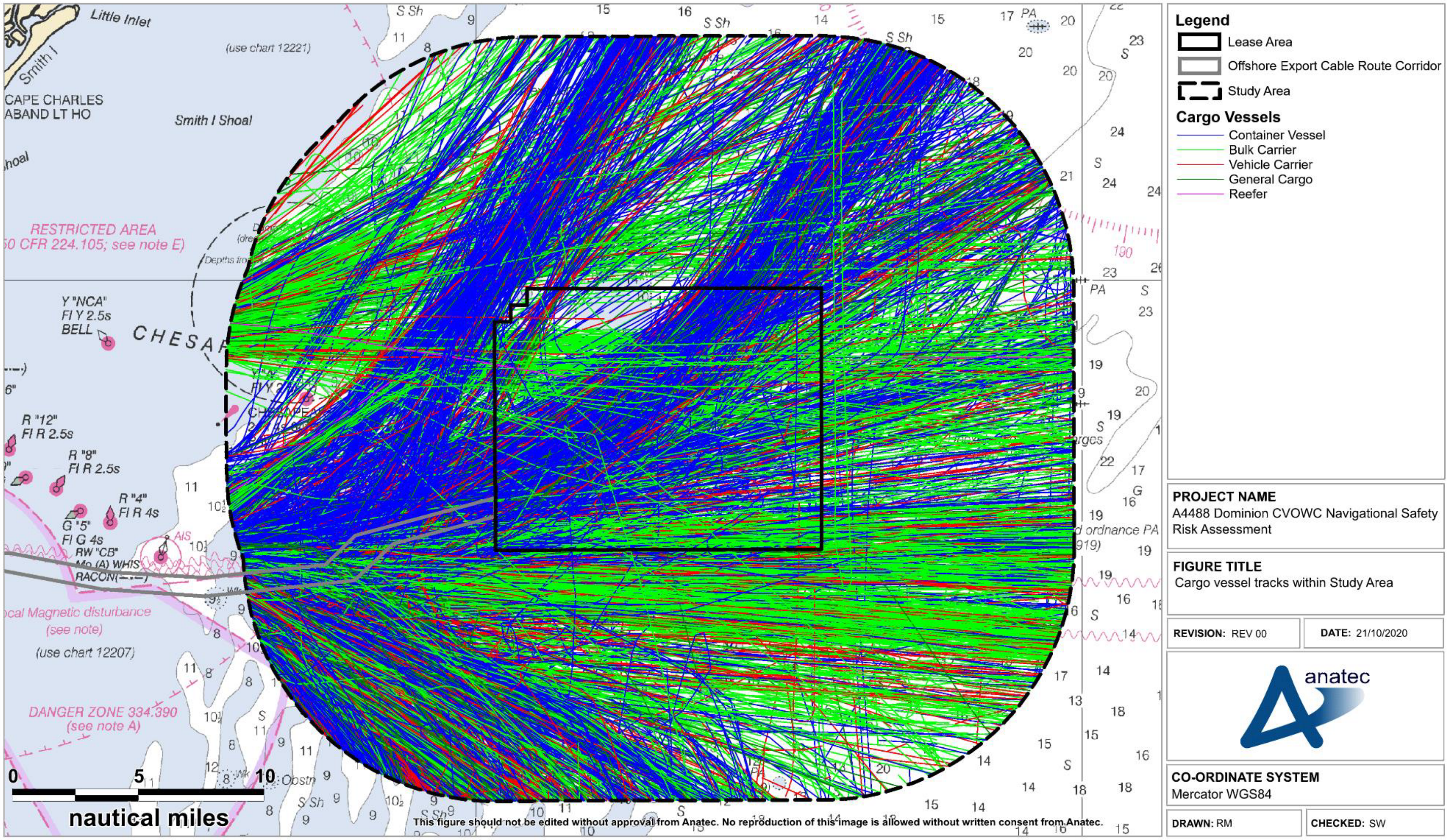


Figure 3.16-6 AIS Cargo Vessel Density (12 Months – January to December 2019)

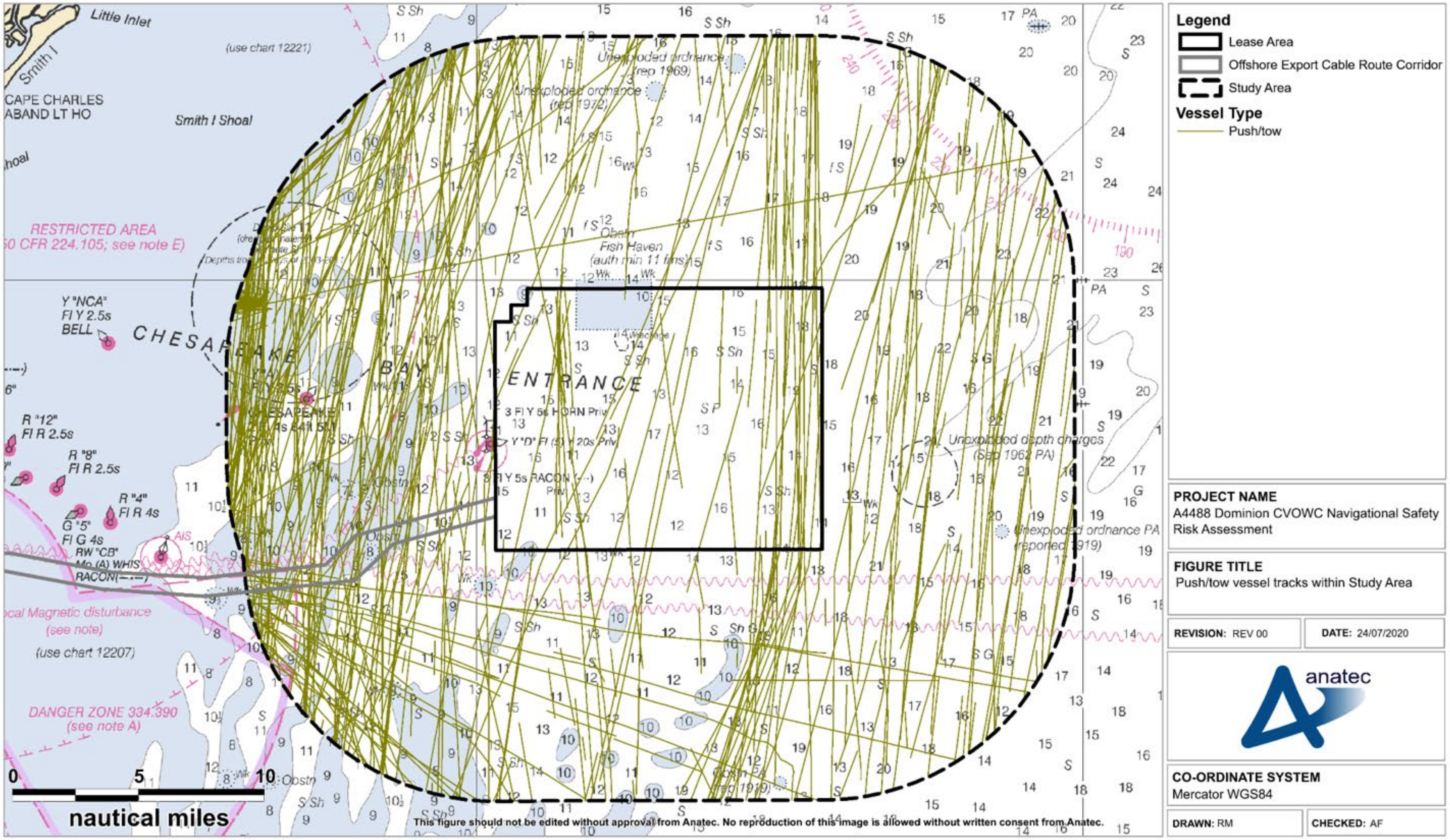


Figure 3.16-7 AIS Towing Vessel Density (12 Months – January to December 2019)

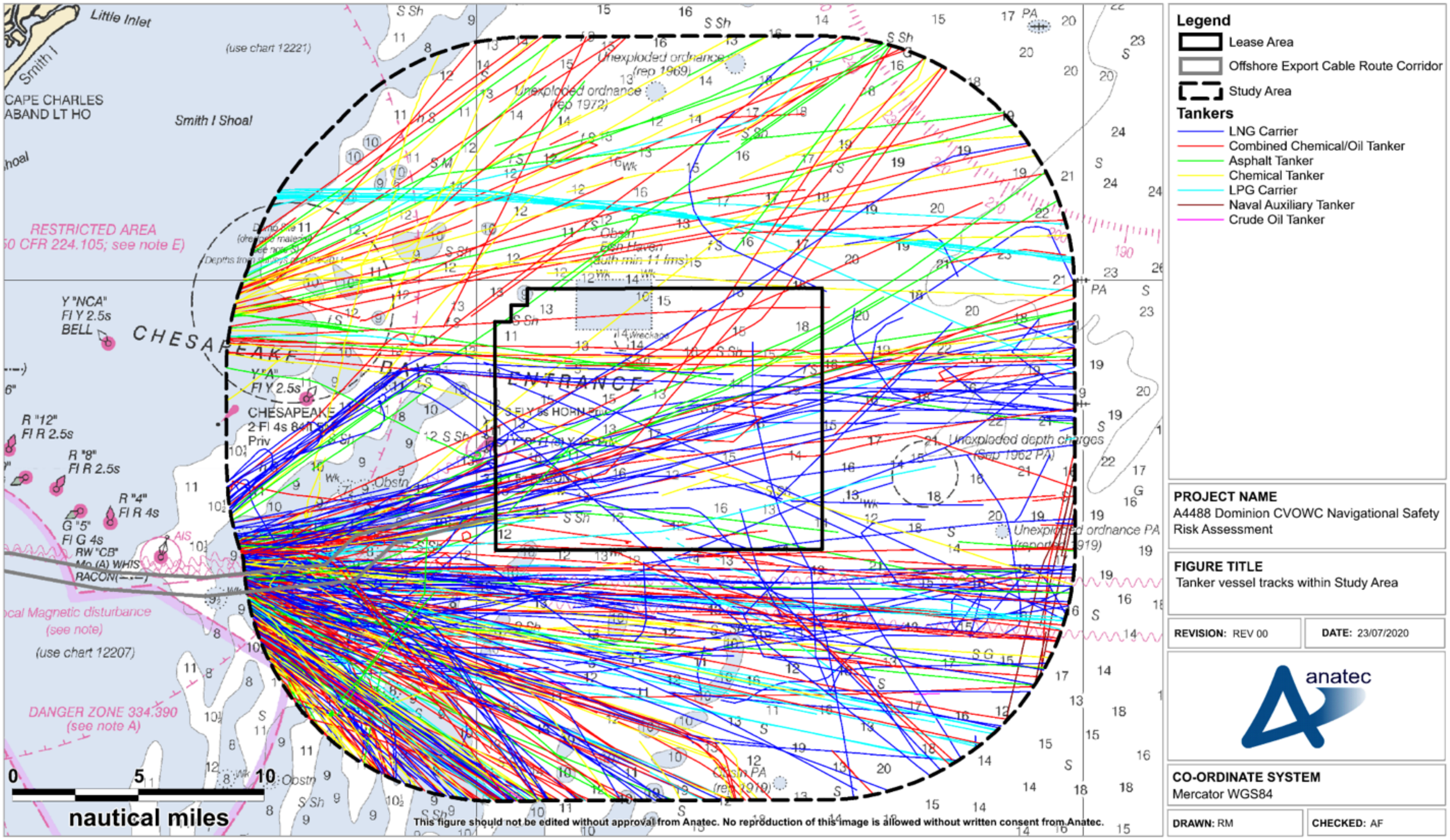


Figure 3.16-8 AIS Tanker Vessel Density (12 Months – January to December 2019)

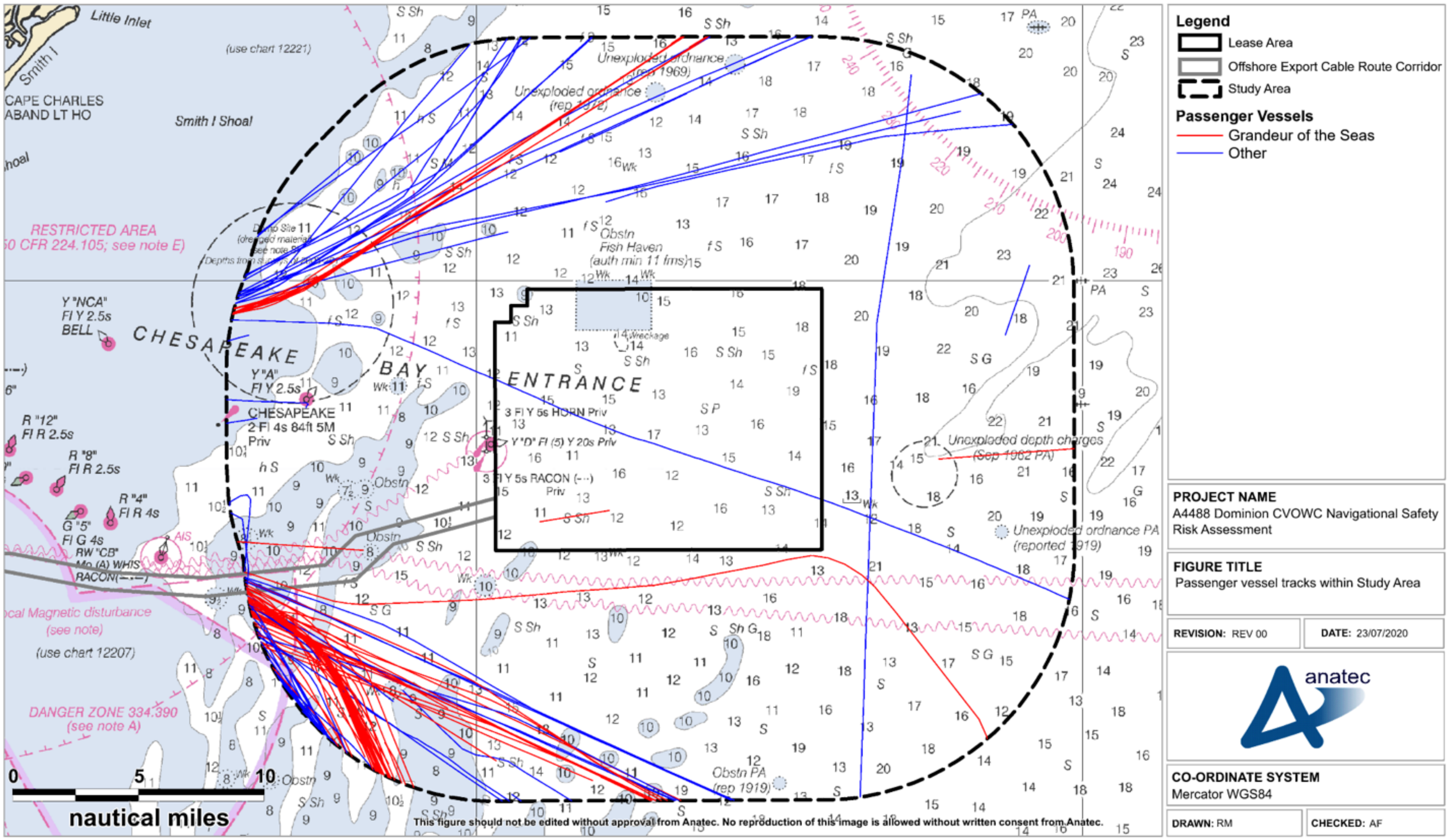


Figure 3.16-9 AIS Passenger Vessel Density (12 Months – January to December 2019)

3.16.1.2.1.2 Aids to Navigation

The only aids to navigation within 10 nautical miles (18.9 kilometers) of the Lease Area are a lit navigation buoy approximately 6.7 nautical miles (12.4 kilometers) to the west of the two existing CVOW-Pilot Project turbines (COP, Appendix S, Section 5.1.5; Dominion Energy 2023) adjacent to the western side of the Lease Area. The closest federal aid to navigation to the offshore export cable corridor is a lighted buoy equipped with AIS and Racon marking the southern extent of the Southern Approach to the Chesapeake Bay TSS, which is 0.6 nautical miles (1.1 kilometers) north of the cable alignment. USCG and the USACE administer the permits for Private Aids to Navigation on structures positioned in or near navigable waters of the United States.

3.16.1.2.1.3 Ports, Harbors, and Navigation Channels

The closest ports to the geographic analysis area and the Cable Landing Locations are Norfolk and Newport News, Virginia (Figure 3.16-1). Both ports are located inside of Chesapeake Bay on the western side of the entrance. USACE is responsible for documenting vessel and trip information of major American ports. Dry cargo vessels, tankers, and towing vessels are each typical components of vessels that traverse in and out of Norfolk Harbor and Newport News Virginia annually (USACE 2018). The NSRA considers commercial cargo vessels, military (a notable user of the area) vessels, towing, fishing and recreation (COP, Section 4.4.7; Dominion Energy 2023). Of particular relevance to the Project is the Port of Virginia within Chesapeake Bay, which is a busy cargo port comprised of six marine terminals that are capable of handling various commercial vessel types, including deep-draft vessels (COP, Appendix S, Section 5.1.12; Dominion Energy 2023).

During the study period, an average of six unique vessels per day passed through the Lease Area. The busiest month was September, and the busiest days were August 29th and September 21st with 15 vessel transits. Overall, approximately 255 of vessel track recorded withing the geographic analysis area intersected the Lease Area. The most frequently recorded vessel types within the geographic analysis area were cargo vessels at 73 percent, with 19 percent intersecting the Lease Area.

During construction, Dominion Energy has stated that they anticipate that the base construction port would be the Portsmouth Marine Terminal, Virginia, and that Project vessels would be transiting between this port and the Lease Area (COP, Appendix S, Section 18.1; Dominion Energy 2023).

The NSRA analyzed vessel incidents using AIS data collected during 2019 in its entirety. Allision, collision and grounding incidents were observed to be limited over the period studied, with no such incidents recorded within the geographic analysis area. One collision and one allision were recorded within the Export Cable Study Area, however these were both within inshore waters (COP, Appendix S, Section 9.1.4; Dominion Energy 2023). The accident frequency for collisions in the Project area is one accident in 93 years.

Over a 9-year period (2010 through 2019), the USCG conducted 18 missions within the geographic analysis area. Of these incidents, 14 involved material failure or malfunction, while three incidents involved injury to personnel. One incident occurred within the Lease Area, which was considered a serious incident, in which an injured person was medivacked to a Norfolk hospital from a vessel located 23 nautical miles (43 kilometers) off Cape Henry. A total of 26 SAR incidents were recorded within the Export Cable Study Area between 2010 and 2019, of which 10 involved material failure or malfunction. Five incidences of personnel injury occurred, four of which were considered serious incidents. (COP, Appendix S, Section 9.1.2; Dominion Energy 2023)

3.16.2 Environmental Consequences

3.16.2.1 Impact Level Definitions for Navigation and Vessel Traffic

Definitions of impact levels are provided in Table 3.16-1. There are no beneficial impacts on navigation and vessel traffic.

Table 3.16-1 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 avoided. 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.

3.16.3 Impacts of the No Action Alternative 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 activities 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 F, *Planned Activities Scenario.*

3.16.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for navigation and vessel traffic described in Section 3.16.1, *Description of the Affected Environment for Navigation and Vessel Traffic*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic are generally associated with onshore construction and operations.

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, liquid tankers (such as those used for liquid petroleum), cargo, military and search and rescue vessels, and commercial fishing vessels. Recreational vessel traffic includes cruise ships, sailboats, and charter boats. A number of federal agencies, state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing research offshore including oceanographic, biological, geophysical, and archaeological surveys. The Mid-Atlantic Regional Council on the Ocean (comprising Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, and federally recognized tribes) anticipates that regional commercial shipping may increase, and navigation routes may change in response to increasing demand for larger ships to transport goods (MARCO 2016). The Port of Virginia recently completed land-side projects to expand cargo and rail capacity and a dredging project to increase depth of Norfolk Harbor to 55 feet is scheduled for completion in 2024 (Appendix F, Section F.2.8).

Under the No Action Alternative, baseline conditions for navigation and vessel traffic would continue to follow regional current trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic are generally associated with dredging and port improvement projects, military use, marine transportation, and fisheries use and management. 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. 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.

There is one ongoing offshore wind activity within the geographic analysis area that contributes to impacts on navigation and vessel traffic: Continued O&M of the CVOW-Pilot project (2 WTGs) installed in OCS-A 0497.

3.16.3.1 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 that may affect navigation and vessel traffic in the geographic analysis area include port improvement projects, dredging projects, and installation of new structures on the OCS (see Section F.2 in Appendix F for a description of ongoing and 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. See Table F1-14 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for navigation and vessel traffic.

BOEM expects future offshore wind activities to affect navigation and vessel traffic through the following primary IPFs.

Anchoring: Future 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 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 mattress protected) to prevent drifting in the event of vessel power failure would result in damage to the export cable; risks associated with an anchor contacting an electrified cable; and impacts on the vessel operator's liability and insurance. Impacts on navigation and vessel traffic would be temporary and localized, and navigation and vessel traffic would be expected to fully recover following the disturbance.

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.

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 port visits are expected to increase as well, increasing the potential for an emergency need to anchor, creating navigational hazards for other vessels. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.

Port utilization: As described in Appendix F, future offshore wind development would support planned expansions and modifications at ports in the geographic analysis area for navigation and vessel traffic, including the Portsmouth Marine Terminal and the Port of Norfolk, Virginia. Simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for both this Project and the Kitty Hawk 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, which could lead to increased risk of allision, collision, and vessel delay. 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 of sediment from the federal channel in Norfolk Harbor and Newport News, Virginia (USACE 2019a). The project is anticipated to be completed in 2024, resulting in a channel depth of over beyond 50 feet in the harbor, which would allow it to accommodate two ultra-large container vessels simultaneously (Virginia Port Authority 2021).

Under the Cumulative No Action Alternative, three offshore wind projects in the geographic analysis area, the CVOW-Pilot Project and Kitty Hawk Offshore Wind Projects, would generate vessel traffic. The CVOW-Pilot Project is currently in operation and is the pilot project for the proposed Project. During peak activity for the Kitty Hawk Offshore Wind North Project in 2024, impacts on port utilization would be short term, continuous, and localized to the ports and their maritime approaches. Construction of Kitty Hawk Offshore Wind South is not anticipated to start until 2027.

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.

There are two port expansions currently planned that could affect the project vessel traffic. The Thimble Shoal Channel Widening and Dredging Project has been ongoing since 2019 (USACE 2019b; Weeks Marine, Inc. 2021). The project includes dredging to a depth of 55 feet and widening the channels from 1,000 feet to 1,300 feet to 1,400 feet (USACE 2022a). As of March 2023, Thimble Shoal West Channel deepening work was 99 percent finished with full completion expected in the third quarter of 2023; Thimble Shoal East Channel dredging was 90 percent complete with full completion expected the first quarter of 2024 (Royal Examiner 2023). The Atlantic Ocean Channel (Southern Approach) Phase I/Phase II Dredging Project is scheduled to commence in 2023 (USACE 2022b) The Atlantic Ocean Channel is located in the Atlantic Ocean east of the mouth of Chesapeake Bay. The channel is approximately 10 statute miles long and 1,300 feet wide. The Phase I/Phase II Project includes dredging to a depth of 59 feet (USACE 2022b).

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) (Appendix F, Attachment 2).

Presence of structures: Under the Cumulative No Action Alternative, approximately 190 WTGs (Appendix F, Table F2-1) 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. USCG noted in its final *Areas Offshore of Massachusetts and Rhode Island Port Access Route Study* (USCG 2020) 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.

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 37 years. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion (Appendix F, Attachment 2).

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. 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 37 years. Overall, the impacts of this IPF on navigation and vessel traffic would be long term (as long as structures remain), regional (throughout the entire geographic analysis area for navigation and vessel traffic), and constant (COP, Section 4.4.7; Dominion Energy 2023).

New cable emplacement/maintenance: Based on the assumptions in Appendix F, Table F2-1, the 190 WTGs associated with planned projects (Appendix F, Table F-3) would require about 453 miles (729 kilometers) of offshore export cables plus 349 miles (562 kilometers) of inter-array cables (Kitty Hawk Offshore Wind North 2021; Kitty Hawk Offshore Wind South 2022). Emplacement and maintenance of cables for these planned 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. 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 impacts of this IPF on vessel traffic and navigation under the No Action Alternative would be short term, localized, and most disruptive during peak construction activity of the offshore wind projects starting in 2024 (Appendix F, Table F-3).

Additionally, the FCC has two pending submarine tele-communication cable applications in the North Atlantic. Future new cables would cause temporary increases in vessel traffic during installation or maintenance, resulting in infrequent, localized, short-term impacts over the next 37 years. Care would need to be taken by vessels that are crossing the cable routes during these activities (Appendix F, Table F-3).

Traffic: Any offshore wind projects in the navigation and vessel traffic geographic analysis area would generate vessel traffic during construction, operation, and decommissioning. 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.

As shown in Table F-3 in Appendix F, the increase in vessel traffic and navigation risk due to offshore wind projects in the Project area would increase beginning in 2024 when 190 WTGs associated with an offshore wind project other than the Proposed Action (Kitty Hawk Offshore Wind Projects) would be under construction. During this construction period for Kitty Hawk Offshore Wind North, a maximum of 41 vessels could be operating simultaneously in the geographic analysis area at any given time (Kitty Hawk Offshore Wind North 2021: Section 3.2.7, Table 3.2-10). The presence of offshore wind project vessels would add to the overall Atlantic Coast vessel traffic levels as new offshore wind farm areas are developed, leading to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels, injuries to crews, engagement of USCG Search and Rescue, and vessel fuel spills. Increased offshore wind-related vessel traffic during construction would have short-term, constant, localized impacts on overall (wind and non-wind) vessel traffic and navigation.

After the remaining scheduled wind project is constructed, related vessel activity would decrease. 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 35-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 37 years. Even with increased port visits by deep-draft vessels, this is still a relatively small adjustment when considering the whole of Norfolk-area vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.

3.16.3.2 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, navigation and vessel traffic would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on navigation and vessel traffic. 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. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and navigation and vessel traffic would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on navigation and vessel traffic due to increased offshore construction and operations.

BOEM expects ongoing activities, future non-offshore wind activities, and future 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 impacts of ongoing activities, especially port utilization and vessel traffic, would be **moderate**. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on navigation and vessel traffic. Planned activities other than offshore wind include port expansion, new cable emplacement and maintenance, and search and rescue 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 **minor** to **moderate** impacts on navigation and vessel traffic.

Future 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 future offshore wind projects other than the Proposed Action would lead to the construction of approximately 190 WTGs 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. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with ongoing and planned activities other than offshore wind and future offshore wind activities in the geographic analysis area would result in **moderate** impacts. (BOEM 2019)

3.16.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario (NSRA Table 4-4); 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. 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 schedule, as outlined in COP Section 1, Table 1.1-3 (Dominion Energy 2023). 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.

3.16.5 Impacts of the Proposed Action on Navigation and Vessel Traffic

Impacts from the Proposed Action alone would include increased vessel traffic in and near the Wind Farm 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 impact-producing factors 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. Dominion Energy would implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project construction. COP Section 3.4.1.5, Table 3.4-5 (Dominion Energy 2023) and the NMFS BA (BOEM 2023a, 2023b) summarizes the anticipated Project-related vessel traffic during Proposed Action construction. Construction vessel trips would likely originate or terminate at Portsmouth, Virginia.

Anticipated changes in traffic from the Project were estimated to include the following.

1. Project-related vessel traffic related to construction, O&M, and decommissioning activities.
2. Additional non-Project traffic that might be generated by the presence of the wind farm, for example, pleasure vessel trips for sight-seeing or recreational fishing.
3. The modification of usual traffic routes for some ship types due to the presence of wind farm structures.

Impacts on navigation and vessel traffic would also include changes to navigational patterns and 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. NSRA Section 14 addresses the Proposed Action's impacts on recreation, while NSRA Section 15 addresses the Proposed Action's impacts on commercial fisheries and for-hire recreational fishing.

The NSRA marine risk analysis modeled the frequency of non-Project vessel accidents that could result from installation of the Proposed Action wind farm structures. The future case assessments for marine accidents accounting for Project- and location-specific environmental, traffic and operational parameters (COP, Appendix S, Section 6.5, Section 10, Section 11; Dominion Energy 2023). Baseline vessel traffic data used in the model are described in the NSRA (COP, Appendix S, Section 4.4.7; Dominion Energy

2023.) Detailed information about the risk analysis is included in COP Appendix S (Dominion Energy 2023).

The risk analysis calculated the frequency of hazards due to the following navigation hazards (COP, Appendix S, Section 10; Dominion Energy 2023).

- Increased vessel to vessel collision risk.
- Powered vessel to structure allision risk.
- Drifting vessel to structure allision risk.
- Internal fishing vessel to structure allision risk.
- Grounding vessel risk.

Anchoring: The closest official anchorages to the Offshore Project area are within or at the opening of Chesapeake Bay; however, these anchorages are for naval vessels only, not for commercial use except in cases of emergency. Vessel traffic in and out of Chesapeake Bay is regulated by the Chesapeake Bay TSS consisting of a Southern Approach and an Eastern Approach converging on a Precautionary Area (33 CFR 167.200). On the Southern Approach, the inbound and outbound traffic lanes are separated by a two-way DWR for deep-draft vessels or naval aircraft carriers (COP, Appendix S, Section 5.1.1; Dominion Energy 2023). The Lease Area is located partially within the Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway, proposed by the USCG ACPARS (COP, Section 4.4.7.1, Figure 4.4-44; Dominion Energy 2023). The potential fairway is about 200 miles (322 kilometers) long, approximately 10 nautical miles (18.5 kilometers) wide; however, the width narrows to approximately 4 nautical miles (7.4 kilometers) wide adjacent to the Lease Area and includes the customary route taken by vessels transiting between the Port of Virginia; the Port of Baltimore, Maryland; the Port of Philadelphia, Pennsylvania; and the Port of Wilmington, Delaware (USCG 2020). The proposed Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway occupies a small portion of three of the northwesternmost Lease Area aliquots. The intersection of the Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway and the Lease Area is approximately 135 acres (0.5 square kilometer), which is approximately 0.1 percent of the Lease Area. (COP, Section 4.4.7; Dominion Energy 2023)

It is not expected that anchorage areas would have an impact on the Project (COP, Appendix S, Section 16.2; Dominion Energy 2023). There would be no restrictions on anchoring in 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 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 proximity, such as the following.

- A vessel deliberately 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.
- The anchor is negligently or accidently deployed over a subsea cable.

During the study period, approximately one vessel per day was recorded at anchor within 2 nautical miles (3.7 kilometers) of the Export Cable Corridor Study Area. Dominion Energy states that they would conduct a Cable Burial Risk Assessment to further mitigate these risks (Dominion Energy 2023).

Port utilization: The Proposed Action would generate vessel traffic at the Port of Portsmouth, Virginia. The construction, maintenance and decommissioning activities associated with the Project may result in restricted access at local ports, including those used as base port by the Project. The Proposed Action would generate trips by support vessels, such as crew transports vessels, hotel vessels, tugs and miscellaneous vessels (COP, Appendix S, Section 18.1; Dominion Energy 2023) 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, including a pilotage boarding area within the Precautionary Area. The onshore O&M facility is anticipated to be based in Hampton Roads–Lynnhaven, Virginia and any Project vessel activity would be taking a similar route to/from the Lease Area. On average, the Proposed Action would generate approximately 26 annual roundtrips from the Port of Portsmouth, Virginia during regular operations (COP, Section 3.5.1; Dominion Energy 2023). 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. The Proposed Actions impacts on vessel traffic due to port utilizations would be intermittent and continuous through construction and installation O&M, and decommissioning with greater impacts during construction, installation, and decommissioning compared to O&M.

Presence of structures: The Proposed Action would include up to 202 WTGs and 3 OSSs, operating for 33 years (COP, Section 3.5; Dominion Energy 2023), within the Wind Farm Area 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. Additionally, from the Chesapeake Bay to Delaware Bay, many vessels already utilize (Figure 4.4-44) the Eastern Approach Cutoff Fairway (COP, Section 4.4.7.1, Figure 4.4-44; Dominion Energy 2023) that provides a separation of the northwest corner of the Lease Area to the majority of vessel traffic. Vessel traffic would potentially be further diverted from within the Lease Area to the ACPARS safety fairways (COP, Appendix S, Section 6.5.4; Dominion Energy 2023), if approved.

The WTG layout was designed to have a 397-foot (121-meter) buffer to the edges of the Lease Area to ensure that no structures would be outside of the Lease Area including the blades (COP, Section 3.3, Dominion Energy 2023). Vessels that exceed a height of 108 feet (33 meters) would be at risk of allision with WTG blades at mean high water should they navigate through the Wind Farm Area due to negligence, accident or emergency, and would need to navigate around the Wind Farm Area or navigate with caution through the Wind Farm Area to avoid the WTGs.

Proposed Action structures would increase the risk of allision as well as collision with other vessels navigating through WTGs and could interfere with marine radars (although other navigation tools are available to ship captains). The increased risk of allisions and collisions could, in turn, increase the risk of spills (refer to COP Section 4.1.2, for a discussion of the likelihood of spills). Nearly all vessels that travel through the Wind Farm Area where no structures currently exist would need to navigate with greater caution under the Proposed Action to avoid WTGs and OSSs; however, there would be no restrictions on use or navigation in the Wind Farm Area. WTGs with lighting and marking could serve as additional aids to navigation. Many vessels that currently navigate that area would continue to be able to navigate through the Wind Farm Area between the WTGs and OSSs.

While some non-Project vessel traffic may navigate through the Wind Farm Area, many vessels would most likely 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 Wind Farm Area for the larger commercial traffic utilizing the proposed ACPARS safety fairways

(COP, Appendix S, Section 6.5.4; Dominion Energy 2023). The NSRA assumed other vessel types, including fishing, pleasure and other vessels, would not reroute around the Wind Farm Area.

The primary increased risk in terms of allision with structures arises from the cumulative impact from the Proposed Action and the nearby Kitty Hawk Offshore Wind Projects near the southern and northwestern surface Offshore Project Components, and there is not anticipated to be a notable increase of traffic. A moderate risk with further mitigation needed for power vessel allisions and moderate to high risk with further mitigation needed for drifting vessel allisions (COP, Appendix S, Section 10.2.4; Dominion Energy 2023).

O&M of the Proposed Action would likely affect marine radar on vessels near or within the Wind Farm Area. As noted in the NSRA, 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, Appendix S, Section 8.8, Section 8.9; Dominion Energy 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 (COP, Appendix S, Section 7.1; Dominion Energy 2023) radar is the main tool used to help locate other nearby vessels that are not otherwise visible. The navigational complexity of transiting through the Wind Farm 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). Furthermore, the presence of the WTGs could complicate offshore search and rescue operations or surveillance missions within the Wind Farm Area and lead to abandoned search and rescue missions and resultant increased fatalities. This would have localized, long-term, continuous, major impacts on navigation and vessel traffic.

New cable emplacement/maintenance: The Proposed Action would require the installation of offshore export cables and inter-array and substation interconnector 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 avoid installation or maintenance areas entirely during installation and maintenance activities.

There will be construction related to the overhead interconnection cables that will cross the Atlantic Intracoastal Waterway in Chesapeake, VA. During construction activities, there may be temporary waterway closures or placement of temporary structures/vessels within the waterway that could pose a hazard or block navigation. This activity will be coordinated with all appropriate authorities to ensure the least disruption and risk possible. Dominion Energy will comply with Avian Power Line Interaction Committee (https://www.aplic.org) best practices to reduce any risk related to the overhead interconnection cables.

The presence of installation or maintenance vessels would have localized, short-term, intermittent impacts on navigation and vessel traffic.

Traffic: Construction of the Proposed Action would generate an average of 46 vessel per day throughout the duration of construction operating in the Wind Farm Area or over the offshore export cable route at any given time from 2023 through 2027, with a minimum of three and a maximum of 95 vessel trips (COP, Table 3.4-5; Dominion Energy 2023). The presence of these vessels would increase the risk of allision, collision, and spills (refer to COP Section 4.1.2 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 Hampton Roads area of Virginia (Section 3, *Description of Proposed Activity*). 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.

Project-related vessel traffic would not interfere with existing marine and navigation traffic patterns as shown in COP Appendix S. Project-related vessel traffic would follow existing transit routes to the extent practicable. During offshore export cable route construction, non-Project vessels required to 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. Non-Project vessels transiting between the Proposed Action ports and the Wind Farm Area would be able to avoid Proposed Action vessels, components, and any restricted 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 alluding 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.

Vessel traffic generated by the Proposed Action could restrict maneuvering room and cause delays accessing the port. Although vessel traffic within the Lease Area is expected to decrease once the WTGs and OSSs are in place, O&M of the Proposed Action would result in the same types of vessel traffic and navigation impacts as those described during construction (COP, Table 3.4-6; Dominion Energy 2023). During O&M, for each year of operation, Dominion Energy expects 365 operating days for the service operations vessels, with 26 annual round trips to port per vessel, and 365 operating days for each crew transfer vessel with 120 annual round trips to port per vessel (COP, Section 3.5.1; Dominion Energy 2023). Activities related to the operation of the Proposed Action would be localized, temporary, and infrequent relative to the life of the Project.

There is a potential for additional navigation risk where crossings are proposed on inland waters, specifically the Atlantic Intracoastal Waterway (AIWW) Albemarle-Chesapeake Canal (ACC). The Portsmouth Marine Terminal, which will be the construction port for this project is at the entrance of Elizabeth River, which is the beginning of the ACC. CVOW anticipates that there will be localized, short-term impacts on vessel traffic during construction and decommissioning activities at these crossings.

The NSRA risk modeling suggests that under the Proposed Action, accident frequency would increase negligibly at 1 in 1,447 years (COP, Appendix S, Table 10.2; Dominion Energy 2023). The Final Safety Assessment lists the As Low As Reasonably Practicable cumulative Risk Level associated with the Proposed Action as within either the Tolerable level, or the Broadly Acceptable level. The Final Safety Assessment table is included in EIS Appendix I along with the Risk Results Summary table from the NSRA.

Chapter 2, *Proposed Action and Alternatives,* of the EIS describes the non-routine activities associated with the Proposed Action. Examples of such activities or events that could affect navigation and vessel traffic include non-routine corrective maintenance activities, collisions or allisions between vessels or vessels and WTGs or OSSs, cable displacement or damage by anchors or fishing gear, chemical spills or releases, severe weather and other natural events, and terrorist attacks (this is listed as unlikely and not analyzed further). These activities, if they were to occur, would generally require intense, temporary activity to address emergency conditions. The occasional increased vessel activity in offshore locations near the offshore export cable route or within the Wind Farm Area working on individual WTGs or OSSs could temporarily prevent or deter navigation and vessel traffic near the site of a given non-routine event. In addition, severe weather could temporarily prevent or deter vessel operators from approaching or crossing the Wind Farm Area. Impacts on navigation and vessel traffic would be temporary, lasting only as long as severe storms or repair or remediation activities necessary to address these non-routine events.

3.16.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

Anchoring: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to anchoring impacts from ongoing and planned activities 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, as well as the low likelihood that any anchoring risk would occur in an emergency scenario. In addition, the designated official anchoring area nearby would limit the potential impacts on routine anchorage operations across the geographic analysis area.

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 be under construction in 2025, after construction to the other potential offshore wind project in the geographic analysis area has begun. 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. It is unlikely that all projects would use the same ports; therefore, the total increase in vessel traffic would likely 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. Accordingly, in context of reasonably foreseeable environmental trends, combined port utilization impacts on navigation and vessel traffic from ongoing and planned activities, including the Proposed Action, would be continuous and moderate.

Presence of structures: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an appreciable increment to the combined impacts from ongoing and planned activities including offshore wind. Structures from other offshore wind activities would generate comparable types of impacts as under the Proposed Action across the entire geographic analysis area. A total of 392 WTGs and six OSSs would be constructed under the Proposed Action and the other offshore wind projects in the geographic analysis area. The presence of structures from all offshore wind projects in the geographic analysis area 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 search and rescue operations by changing vessel traffic patterns and densities.

New cable emplacement/maintenance: In context of reasonably foreseeable environmental trends and planned activities, 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 inter-array and interconnector cable system. As shown in Appendix F, Table F-3, offshore export cable and inter-array/ interconnector cables for one other offshore wind project could be operating simultaneously while the Proposed Action is under construction. Simultaneous construction of inter-array and interconnector cables for the adjacent project could have a combined effect of temporary increases in construction traffic, although it is assumed that installation vessels would only be present above a portion of a project's inter-array/interconnector system at any given time and the cables themselves would not conflict with the project layout. Substantial areas of open ocean are likely to separate simultaneous offshore export cable and inter-array/interconnector installation activities for other offshore wind projects. As a result, the contribution of the Proposed Action to the impacts on navigation and vessel traffic from cable installation from ongoing and planned activities would be localized, short term, intermittent, and minor. The impacts of cable maintenance during operation of the Proposed Action and other ongoing and planned activities would be localized, long term, and intermittent.

Traffic: The other offshore wind project in the geographic analysis area 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 (COP, Appendix S, Table 4.3; Dominion Energy 2023) should any overlap in construction occur vessel traffic impacts could be increased. Following construction, 26 annual vessel roundtrips are anticipated to support O&M activities. 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. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to vessel traffic impacts from ongoing and planned activities would be localized, short term, and intermittent. The NSRA (COP, Appendix S; Dominion Energy 2023) was completed with consultation from key marine and navigation stakeholders as well as a comprehensive list of "regular operators" in the region identified via assessment of vessel traffic data and all comments and concerns were addressed.

3.16.5.2 Conclusions

Impacts of the 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 range from **minor** to **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 search and rescue or surveillance missions within the Wind Farm Area, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels would choose to avoid the Wind Farm Area altogether, leading to some potential funneling of vessel traffic along the Wind Farm 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. For more information regarding navigation and vessel traffic, refer to Appendix I, *Environmental and Physical Setting*, Table I-7 and Table I-8 for navigation-related mitigation measures.

Cumulative impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **minor** to **major**. The main IPF is the presence of structures, which increase the risk of collision/allision and navigational complexity, particularly if OSSs are not positioned in alignment within the rows of WTGs as under the Proposed Action. Considering all the IPFs together, BOEM anticipates the overall impacts on navigation and vessel traffic from ongoing and planned activities, including the Proposed Action, would be **minor** to **major** and short and long term, due primarily to the increased possibility for marine accidents, which could produce significant disruptions for ocean users in the geographic analysis area.

3.16.6 Impacts of Alternatives B and C on Navigation and Vessel Traffic

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. The impacts on navigation and vessel traffic from Alternatives B and C would be similar to but slightly less than the impacts from the Proposed Action. Alternatives B and C include 29 fewer WTGs and 33 fewer WTGs than the Proposed Action, respectively. However, unlike the

Proposed Action, Alternatives B and C would site the three OSSs in alignment with the rows of WTGs, thus reducing impacts on navigation and vessel traffic.

When compared to the Proposed Action, Alternatives B and C would exclude a diagonal row of three WTGs in the northwestern portion of the Lease Area, which would otherwise slightly overlap a portion of the proposed Chesapeake Bay to Delaware Bay: Eastern Approach Cutoff Fairway. As discussed in COP Section 4.4.7, regulations governing fairways in 33 CFR Part 166 provide that fixed offshore structures are not permitted within fairways because these structures would jeopardize safe navigation. USCG may establish, modify, or relocate existing fairways to improve navigation safety or accommodate offshore activities such as mineral exploitation and exploration. While the proposed Eastern Approach Cutoff Fairway has not yet been established, Alternatives B and C would deconflict any interference with the exclusion of three WTGs in the northwestern portion of the Lease Area when compared to the Proposed Action.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, incremental impacts contributed by Alternatives B and C to the combined impacts from ongoing and planned activities including offshore wind would be similar to but slightly less than those of the Proposed Action.

3.16.6.1 Conclusions

Impacts of Alternatives B and C. Construction of Alternatives B and C alone would have the same **minor** to **moderate**, short- and long-term impacts on navigation and vessel traffic as described under the Proposed Action. While Alternatives B and C may slightly reduce impacts due to the reduction in WTG positions and alignment of OSSs, including exclusion of three WTGs within a small portion of the proposed Eastern Approach Cutoff Fairway, the magnitude of impacts would not be materially different from that of the Proposed Action.

Cumulative impacts of Alternatives B and C. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B and C to the overall impacts on navigation and vessel traffic would be appreciable. Considering all of the IPFs together, BOEM anticipates that the overall impacts associated with Alternatives B and C when combined with the impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action: **minor** to **major**.

3.16.7 Impacts of Alternative D on Navigation and Vessel Traffic

Impacts of Alternative D. The impacts on navigation and vessel traffic from Alternative D would be the same as under the Proposed Action because Alternative D would use the same offshore layout as the Proposed Action (202 WTGs and three OSSs in offset positions).

Cumulative impacts of Alternative D. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the overall impacts on navigation and vessel traffic would be appreciable. As under the Proposed Action, the main IPF from which impacts are contributed is the presence of structures, which increases the risk of collision/allision and navigational complexity, particularly because the OSSs would not be positioned within the rows of the gridded WTG layout. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternative D, when combined with impacts from ongoing and planned activities including offshore wind, would be **minor** to **major**, due primarily to the increased possibility for marine accidents, which could produce significant disruptions for ocean users in the geographic analysis area.

3.16.7.1 Conclusions

Impacts of Alternative D. The impacts of Alternative D alone on navigation and vessel traffic would be the same as those of the Proposed Action and would range from **minor** to **moderate** and short and long term.

Cumulative impacts of Alternative D. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the overall impacts on navigation and vessel traffic would be appreciable and the same as under the Proposed Action. Considering all of the IPFs together, BOEM anticipates the overall impacts associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be the same as those of the Proposed Action and range from **minor** to **major**.

3.16.8 Agency-Required Mitigation Measures

The mitigation measures listed in Table 3.16-2 are recommended for inclusion in the Preferred Alternative. If these measures are adopted, some adverse impacts could be further reduced.

Table 3.16-2 Additional Agency-Required Measures[1]

<table>
<tr><th>Measure</th><th>Description</th><th>Effect</th></tr>
<tr><td>Navigation safety plan</td><td>BOEM would ensure that Dominion Energy coordinates with USCG in advance of export cable installation to develop a navigation safety plan, which may include establishing a safety zone around the cable-laying vessel(s), a monitoring plan, a mitigation plan, a schedule, PATONs, and a local notice to mariners.</td><td rowspan="2">The presence of a navigation safety plan would ensure that USCG has advance notice of Project vessel activities. Although the measures within a navigation safety plan, if implemented, would potentially reduce the risk of vessel collisions and resultant oil spills, vessel traffic would still have to adjust by giving a wide berth for slow-moving or stationary Project vessels conducting cable emplacement. Therefore, impacts would remain minor to moderate for the Proposed Action and other action alternatives.</td></tr>
<tr><td>Safety zones</td><td>Establishing safety zones should not be used as the key mitigating factor when considering risks and impacts. Commander, USCG Fifth District, may consider safety zones in the lease area, but safety zones will not be granted for the sole purpose of keeping project construction on track.</td></tr>
<tr><td>Cable maintenance and monitoring plan</td><td>BOEM would ensure that Dominion Energy develops a cable maintenance and monitoring plan that outlines a process for identifying when cable burial depths reach unacceptable risks, requires prompt remediation of exposed and shallow-buried cable segments, and includes review to address repeat exposures. The cable maintenance and monitoring plan would also describe methods for providing an accessible graphic/geo-referenced repository of locations where target burial depths were not achieved and/or cable protection was installed, and mariner notification for monitoring and remedial burial activities.</td><td>The presence of a cable maintenance and monitoring plan would ensure that a methodology is outlined for monitoring cables and identifying appropriate remediation, and that timeframes for monitoring and remediation are determined so that risks to transiting vessels are minimized to the extent possible. BOEM's requirement for the development of a cable maintenance and monitoring plan would help ensure that Dominion Energy adheres to commitments; however, impacts would remain minor to moderate for the Proposed Action and other action alternatives.</td></tr>
</table>

[1] Also identified in Appendix H, Table H-3.

3.16.8.1 Effect of Measures Incorporated into the Preferred Alternative

BOEM has identified the additional measures in Table 3.16.3 as incorporated in the preferred alternative: navigation safety plan, safety zones, and a cable maintenance and monitoring plan. These measures, if adopted, would reduce the potential for conflicts with other transiting vessels during export cable installation by establishing a navigation safety plan and cable maintenance and monitoring plan. However, overall impacts on navigation and vessel traffic would remain minor to moderate.

3.17. Other Uses (Marine Minerals, Military Use, Aviation)

This section discusses potential impacts on other uses not addressed in other portions of the EIS, including marine minerals, military use, aviation, cables and pipelines, radar systems, and scientific research and surveys, that would result from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis areas for these topics are described in Appendix F, *Planned Activities Scenario*, and shown on Figure 3.17-1.

- **Aviation and air traffic, military and national security, and radar systems:** Areas within 10 miles (16.1 kilometers) of the offshore export cable route corridor, interconnection cable route corridor, onshore export cable route corridor, and Wind Farm Area and Lease Area, as well as Norfolk International Airport; Newport News/Williamsburg International Airport; Naval Station Norfolk; Naval Air Station Oceana; Naval Auxiliary Landing Field Fentress; and Dam Neck Annex, Virginia Beach (Figure 3.17-1).
- **Cables and pipelines:** Areas within 1 mile (1.6 kilometers) of the offshore export cable route corridor, interconnection cable route corridor, onshore cable route corridor, Wind Farm Area, and the Lease Area that could affect future siting or operation of cables and pipelines (Figure 3.17-1).
- **Scientific research and surveys:** Same geographic analysis area as finfish, invertebrates, and EFH (Figure 3.17-1).
- **Marine minerals:** Areas within 0.25 mile (0.4 kilometer) of the export cable route corridor and Wind Farm Area that could affect marine minerals extraction (Figure 3.17-1).

These areas encompass locations where BOEM anticipates direct and indirect impacts associated with Project construction, O&M, and conceptual decommissioning.

3.17.1 Description of the Affected Environment for Other Uses

3.17.1.1 Marine Minerals

BOEM's Marine Mineral Program manages non-energy minerals (primarily sand and gravel) in federal waters of the OCS and leases access to these resources to target shoreline erosion, beach renourishment, and restoration projects. The geographic analysis area includes one active OCS lease area, and the offshore export cable route corridor would cross portions (23 aliquots) of sand resource areas but not cross the active sand borrow areas.

There are two ocean dredge disposal sites in the geographic analysis area. The Dam Neck Ocean Disposal Site (DNODS) is located approximately 2.4 nautical miles (4.4 kilometers) off the coast of Virginia Beach, Virginia, and would be crossed by the offshore cable export route. The DNODS was designated by USEPA for the ocean placement of suitable dredged material on March 31, 1988, and is active today. The DNODS receives approximately 1.2 million cubic yards of dredged material every 2 years to support the maintenance dredging of federal navigation channels (COP, Section 2.1.1.2; Dominion Energy 2023a). The Norfolk Ocean Disposal Site is located approximately 14.91 miles (24 kilometers) off the coast of Cape Henry, Virginia, at the mouth of the Chesapeake Bay, north of the Project area. The Norfolk Ocean Disposal Site was designated by USEPA for placement of suitable dredged material at this ocean site on July 2, 1993, and is active today. Ocean dredge disposal sites and the Project area are shown in COP Figure 4.4-60 (Dominion Energy 2023a). The DNODS is jointly managed by the USEPA and USACE and is specifically utilized by the USACE Norfolk District and Baltimore District.

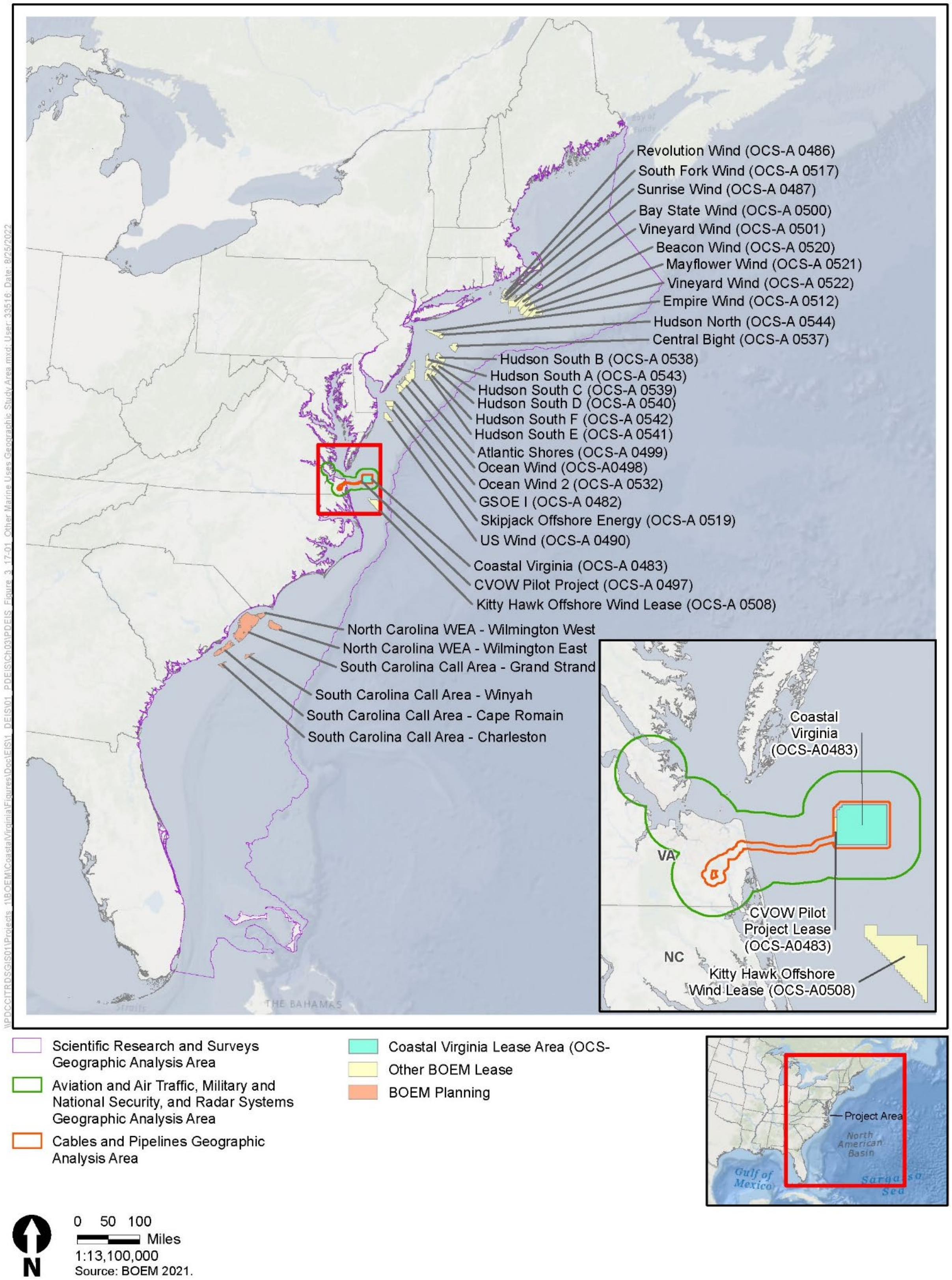


Figure 3.17-1 Other Marine Uses Geographic Analysis Area

Placement of material in the DNODS requires a permit under Section 103 of the Marine Protection, Research and Sanctuaries Act Section from USACE, which would be subject to USEPA review and concurrence, and must be consistent with the DNODS Site Management and Monitoring Plan.

USACE requires that buried cables be located only in DNODS Cells 2 and 5 and those cables be buried at depths greater than 6 feet below the native bottom sediment. In consultation with USACE, Dominion Energy would bury all cables in DNODS to a minimum depth of 6.56 feet (2 meters) beneath native substrate (Dominion Energy 2023b). Cable cover would be limited to existing material already within the boundary of the DNODS and in the offshore export cable corridor, unless formally reviewed and concurred upon by USEPA.

3.17.1.2 National Security and Military Uses

3.17.1.2.1 Virginia Capes Operating and Warning Areas and State Military Reservation Areas

The Wind Farm Area is located near VACAPES (COP, Figure 4.4-54; Dominion Energy 2023a). The closest distance from the Wind Farm Area to VACAPES is 1,805 feet (550 meters). Operations throughout VACAPES occur intermittently, with durations ranging from a few hours to several weeks, and are dispersed off the coasts of Virginia and North Carolina but largely concentrated in VACAPES (COP, Figure 4.4-53; Dominion Energy 2023a). The U.S. Navy uses VACAPES for various exercises and training, with areas in the geographic analysis area designated as: Danger Zones (defined by 33 CFR 334.2 as “a defined water area (or areas) used for target practice, bombing, rocket firing or other especially hazardous operations, normally for the armed forces”), Danger Areas (defined by 33 CFR 334.2 as “airspace of defined dimensions within which activities dangerous to the flight of an aircraft may exist at specified times”), and Restricted Areas (defined by 33 CFR 334.2 as areas where public access is prohibited or limited due to general use by the U.S. Government). Danger Zones and Restricted Areas are shown in COP Figure 4.4-55 (Dominion Energy 2023a). The offshore export cable route corridor intersects VACAPES Danger Zone 334.380(a) and VACAPES Danger Zone 334.390(A), and also intersects the SMR Danger Zone (the SMR is formerly known as Camp Pendleton). The offshore export cable route corridor is also adjacent to one Danger Area and to Naval Restricted Area 334.320(a) (COP, Section 4.4.8.1; Dominion Energy 2023a).

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. Dominion Energy has been coordinating with DoD throughout Project development, and previously coordinated with DoD on the CVOW-Pilot Project. All CVOW-C survey, construction, and O&M activities would be coordinated closely with the DoD. If Project activities encounter military operations in the Project area, VACAPES Fleet Area Control and Surveillance Facility (Giant Killer) would be contacted. This VACAPES facility is dedicated to supporting homeland defense and advancing the combat readiness of U.S. Atlantic Fleet and Joint Forces by providing control, surveillance, management, sustainment, and ready access to assigned airspace, operating areas, training ranges, and resources.

There is the potential for MEC, including anti-aircraft munitions, from the VACAPES and associated firing ranges. Prior to the installation of inter-array cables Dominion Energy would complete route clearance, including MEC mitigation, to identify and remove as appropriate any obstructions within the cable installation corridors. MEC identification surveys would be completed in a 164 feet (50 meters) corridor around the inter-array cable corridor and offshore export cable route corridor to allow for re-routing of the cable as necessary to avoid identified features where clearance is not possible. Wider corridors would be used in higher risk areas, including the DNODS and crossings of telecommunications cables. MEC identification surveys began in spring 2023 and would be completed prior to construction activities beginning in 2024, at which point all needed mitigation would occur. MEC mitigation would entail relocation of MEC that could not be avoided by micrositing. Relocation of MEC would be done by using a suction pump to uncover and reconfirm classification of MEC, then lifting and shifting MEC to the minimum distance needed to clear the activity-specific exclusion zone. The seabed disturbance footprint for each MEC mitigation would be 161.5 square feet (15 square meters). MEC would be relocated 16.4 to 164.0 feet (5 to 30 meters) outside of construction activity areas and would remain within the export cable corridor or Lease Area to a location that would not disturb surveyed historical and archaeological resources.

3.17.1.2.2 Special-Use Airspace

As shown on COP Figure 4.4-56 (Dominion Energy 2023a), the Offshore Project area would be located between VACAPES AIR-K and W-72 special use airspace areas. The closest regulated military airspace is 0.36 mile (0.58 kilometer) from the Lease Area.

3.17.1.2.3 Naval Air Station Oceana

Naval Air Station Oceana (NAS Oceana) is located in Virginia Beach, Virginia, approximately 1.6 linear miles (2.6 kilometers) from the cable landing location. NAS Oceana contains approximately 7 miles (11 kilometers) of runways, with more than 4,000 acres (1,619 hectares) of facilities to serve military air traffic on the East Coast. The mission of NAS Oceana is to support the Navy's Atlantic and Pacific Fleet Force of Strike Fighter Aircraft and Joint/Inter-Agency Operations and to ensure readiness of the 16 homebased F/A-18 Hornet Strike Fighter Squadrons. NAS Oceana's Apollo Soucek Field has four runways, three measuring 8,000 feet (2,438 meters) in length and one measuring 12,000 feet (3,658 meters). NAS Oceana is also home to numerous Fleet Support units, commands, and departments.

A portion of the onshore export cable route, interconnection cable route, and the Harpers Switching Station would be located on property owned by the Navy, as part of NAS Oceana, in an area that is currently managed as part of the agricultural out lease program. Dominion Energy is in the process of coordinating with NAS Oceana for the appropriate real estate leasing necessary to utilize this parcel to route the onshore export cable, pending Navy approval, at this location (COP, Section 4.4.8.1; Dominion Energy 2023a). Demolition of an existing Navy golf maintenance facility would occur at the same location as the construction of the switching station, and construction of a new golf maintenance facility would occur on-site at NAS Oceana northwest of the Harpers Switching Station. During demolition and construction of a new golf maintenance facility, temporary maintenance operations and storage would be located at existing areas on-site at NAS Oceana. In addition to the construction of the switching station itself, installation of stormwater management facilities, realignment of two existing golf fairways, and relocation of existing NAS Oceana fencing and Dewey Road would occur.

3.17.1.2.4 State Military Reservation

The SMR, formerly known as Camp Pendleton, is located in Virginia Beach, Virginia, and is used primarily for Virginia Army National Guard training activities. The SMR covers 365 acres (148 hectares) and includes the following facilities: a firing range in the eastern portion of the base, a reserve center along the western border, various training areas in the beaches and dunes areas, and an explosives test facility. The SMR is primarily used for training in special warfare, ordnance, overland assault, beach assault, and tactical air operations radar. The offshore export cable route corridor would intersect the SMR Danger Zone/Pendleton Danger Zone as shown in COP Figure 4.4-55 (Dominion Energy 2023a). The cable landing location would utilize the proposed parking lot west of the firing range at the SMR, located east of Regulus Avenue and north of Rifle Range Road. Additionally, the onshore export cable route would run underground through the SMR. Dominion Energy is in the process of coordinating with the Virginia Department of Military Affairs-Virginia Army National Guard (VDMA-VaARNG)for the appropriate real estate leasing necessary to use this parcel to route the onshore export cable at this location (COP, Section 4.4.8.1, Dominion Energy 2023a); the easement agreement will be finalized after the Virginia State Corporation Commission (SCC) review of the project is complete.

3.17.1.2.5 Dam Neck Annex

Dam Neck Annex, which is part of NAS Oceana, is located directly south of the SMR in Virginia Beach, Virginia, covering approximately 1,900 acres (769 hectares). The mission of Dam Neck Annex is to provide training in specified combat systems operation and maintenance, specialized skills training, and training systems support to operational and systems commands. Major tenants of Dam Neck Annex include Naval Special Warfare Development Group; Tactical Training Group, Atlantic; and Atlantic Targets & Marine Operations. Facilities include firing ranges, weapons gunline, helicopter pad, weapons compound, and beach/dune training areas. Danger Zones associated with the installation's offshore ranges are shown in COP Figure 4.4-55 (Dominion Energy 2023a).

3.17.1.2.6 Naval Auxiliary Landing Field Fentress

The Naval Auxiliary Landing Field Fentress (NALFF) is located in Chesapeake, Virginia. Strike Fighter Squadron 106 NALFF serves as a major carrier landing training facility for aircraft stationed at NAS Oceana and Chambers Field. The 329-acre (133-hectare) installation includes one 8,000-foot (2,438-meter) runway equipped to simulate an aircraft carrier flight deck. Operations are intended to familiarize pilots with aircraft carrier landings and are primarily conducted at nighttime. The interconnection cable route options would be located 0.45 mile (0.72 kilometer) from the NALFF property boundary, and the onshore substation would be located 1.36 miles (2.19 kilometers) from the NALFF property boundary (Dominion Energy 2023c).

3.17.1.2.7 U.S. Coast Guard

The geographic analysis area includes the USCG Fifth District in the Atlantic area, which is based in Portsmouth, Virginia, and is responsible for all USCG missions between New Jersey and the southern border of North Carolina. The closest USCG station to the Lease Area and offshore export cable route is located as a tenant at the Joint Expeditionary Base Little Creek–Fort Story (JEBLCFS) (for a list of additional nearby USCG stations, see COP Appendix S, *Navigation Safety Risk Assessment*, Figure 9.1; Dominion Energy 2023a). During a recent 10-year time period (2010–2019), 18 USCG Search and Rescue (SAR) incidents were recorded within 10 miles of the Lease Area, and an additional 21 SAR incidents were recorded within a few miles of the offshore export cable route (COP, Appendix S, Section 9.1.2; Dominion Energy 2023a). No allision, collision, or grounding incidents were recorded during the same time period within 10 miles of the Lease Area; one collision and one allision were recorded within a few miles of the offshore export cable route (COP, Appendix S, Section 9.1.4; Dominion Energy 2023a).

3.17.1.2.8 Joint Expeditionary Base Little Creek

The Joint Expeditionary Base Little Creek-Fort Story (JEBLCFS) is a Joint Base in Hampton Roads, Virginia, and includes two properties: Joint Expeditionary Base Little Creek (previously the Army Post of Fort Story and the Naval Amphibious Base Little Creek) and Joint Expeditionary Base Fort Story. The Fort Story Historic District is part of the JEBLCFS, and relevant impacts on cultural resources are described in COP Appendix O, Section O.3.1.3.12 (Dominion Energy 2023a).

3.17.1.3 Aviation and Air Traffic

Multiple public, private-use, and military airports and heliports serve the region surrounding the Project area, including Norfolk International Airport, Newport News/Williamsburg International Airport, Hampton Roads Executive Airport, Chesapeake Regional Airport, and NAS Ocean/Apollo Soucek Field. Air traffic is expected to increase in and around the geographic analysis area; for example, the Norfolk

International Airport 2021 Master Plan anticipates a 34 percent increase in total operations from 2018 to 2038 (Norfolk Airport Authority 2021).

The Wind Farm Area is outside of U.S. territorial waters; therefore, the FAA does not have a mandate to conduct aeronautical studies for WTGs associated with the proposed Project. Engineering details for the Onshore Project components have not yet been finalized. Once line engineering details are more complete, each proposed transmission line structure will be entered into the FAA's Obstruction Evaluation Notice Criteria Tool to identify potential hazards to air navigation that would require additional FAA Evaluation/Part 2 Notification (Notice of Proposed Construction or Alteration).

The proposed Project lies within the Atlantic Test Range Geographical Area of Concern, with the potential to impact test capabilities of the Advanced Dynamic Aircraft Measurement System at Patuxent River Naval Air Station. Dominion Energy is coordinating with the Department of the Navy on the undersea cable route and cable landing location and whether there are plans to put monitoring equipment on the undersea cables—and coordinating on the use of foreign-owned or controlled vendors in the Project—and anticipates providing updates to BOEM in late 2022. Discussions with DoD are ongoing based on the findings of this informal review.

3.17.1.4 Cables and Pipelines

The offshore export cable route corridor crosses three submarine telecommunication cables, the MAREA, DUNANT, and BRUSA submarine cables. All three cables make landfall at the Croatan Beach Parking Lot in Virginia Beach, Virginia. The offshore export cable route corridor would likely also cross the easement for the CVOW-Pilot Project Offshore Export Cable Route Corridor, which lands at the SMR Beach Parking Lot.

There are no pipelines identified in the offshore portion of the geographic analysis area. The Commonwealth of Virginia Legislature passed a bill in 2020 that is intended to discourage future oil and gas development off the coast of Virginia by prohibiting the issuance of leases or easements in Virginia state territorial waters for the purpose of oil and gas infrastructure, including pipelines, gathering systems, storage, and processing (Virginia HB1016) (COP, Section 4.4.9.1; Dominion Energy 2023a).

In the onshore portion of the geographic analysis area, there are multiple existing Dominion Energy transmission lines, existing natural gas pipelines operated by Virginia Natural Gas, and an existing pipeline that transports jet fuel and is operated by NuStar Energy, L.P. (Dominion Energy 2022). Figure 3.17-2 shows the cables and pipelines in the geographic analysis area.

3.17.1.5 Radar Systems

There are several radar systems in the general vicinity of Project, including DoD, FAA, and NOAA radar sites, as well as high-frequency (HF) Coastal Radar sites. Relevant radar operations may include those associated with the Advanced Dynamic Aircraft Measurement System at Naval Air Station Patuxent River and the Re-locatable Over the Horizon Radar system located at Naval Support Activity Hampton Roads, Northwest Annex in Chesapeake, Virginia, and the North American Aerospace Defense Command (NORAD) homeland defense radar (including Oceana, Virginia Air Route Surveillance Radar [ARSR-4], and NAS Oceana Airport Surveillance Radar (ASR-11). In addition, the following HF radar systems may experience impacts: Jennette's Pier HF Radar, Little Island Park HF Radar, Assateague Island HF Radar, and Cedar Island HF Radar. WTGs that are near to or in the direct line of sight of land-based radar systems can interfere with the radar signal, causing shadows or clutter in the received signal.

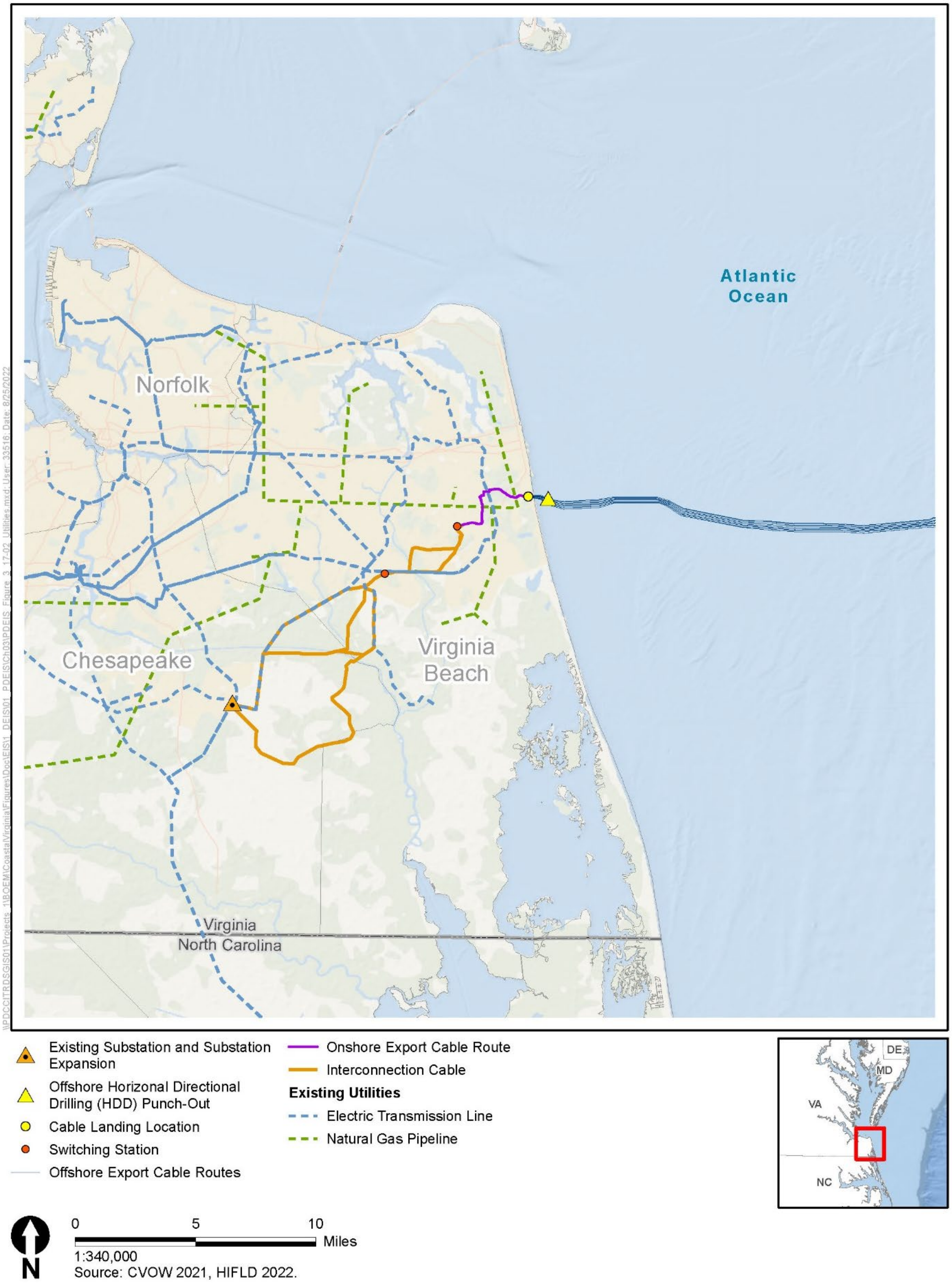


Figure 3.17-2 Cables and Pipelines in the Other Uses Geographic Analysis Area

Existing radar systems will continue to provide weather, navigational, and national security support to the region if impacts from the WTGs are mitigated. The number of radars and their coverage area are anticipated to remain at current levels for the foreseeable future (COP, Section 4.4.10; Dominion Energy 2023a).

3.17.1.6 Scientific and Research Surveys

Various federal, state, and educational organizations regularly conduct scientific research, including aerial- and ship-based scientific surveys, within the geographic analysis area. This includes long-term and seasonal scientific surveys conducted by NOAA and Virginia Institute of Marine Science (VIMS) for several regional programs. Some survey programs of note included the following.

- NOAA's NEFSC:
  - Atlantic Bottom Trawl Survey, a more than 50-year multispecies stock assessment tool using a bottom trawl
  - Sea Scallop/Integrated Habitat Survey, a sea scallop stock assessment and habitat characterization tool, using a bottom dredge and camera tow
  - Surfclam/Ocean Quahog Survey, a stock assessment tool for both species using a bottom dredge
  - Ecosystem Monitoring Program, a more than 40-year shelf ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units
  - Atlantic Marine Assessment Program for Protected Species shipboard and aerial surveys
  - Marine Recreational Information Program
- Fisheries Large Pelagics Survey VIMS:
  - Longline shark survey
  - Northeast Area Monitoring and Assessment Program survey
  - Real-time Opportunity for Development Environmental Observations

Fisheries-independent data are collected during these surveys to inform stock assessments, set harvest quotas, and support other fisheries management goals (COP, Section 4.4.11.1; Dominion Energy 2023a). Surveys also support management of NOAA trust resources, including fisheries, marine mammal species, and threated and endangered species. Additionally, these surveys support numerous other science products produced by NOAA Fisheries, including ecosystem and climate assessments.

Very few geophysical and geotechnical activities for oil and gas exploration in the mid-Atlantic have been conducted due to a moratoria on Atlantic oil and gas leasing activities during most of the past 30 years. Previous surveys from the 1970s employed older technologies that are considered to be less precise than those used today. No other ongoing long-term surveys were identified within the Offshore Project area. In addition, there is no overlap between the Offshore Project area and oil and gas/geological and geophysical testing areas (COP, Section 4.4.11.1; Dominion Energy 2023a).

BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies because of offshore wind farms. On December 4, 2022, NOAA and BOEM published a Federal Survey Mitigation Strategy for the Northeast U.S. Region to address anticipated impacts of offshore wind energy development on NOAA scientific surveys (Hare et al. 2022). This implementation strategy also defines stakeholders, partners, and other ocean users that will be engaged throughout the process and identifies potential resources for successful implementation. Activities described in the implementation strategy are designed to mitigate the effect of offshore wind energy development on NOAA surveys and is referred to as the Federal Survey Mitigation Program. The mitigation program will include survey-specific mitigation plans for each affected survey including both vessel and aerial surveys. The implementation strategy is intended to guide the implementation of the mitigation program through the duration of wind energy development in the Northeast U.S. region.

3.17.2 Environmental Consequences

3.17.2.1 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation)

Definitions of impact levels are provided in Table 3.17-1. There would be no beneficial impacts on other uses.

Table 3.17-1 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation)

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.
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.

3.17.3 Impacts of the No Action Alternative on Other Uses (Marine Minerals, Military Use, Aviation)

When analyzing the impacts of the No Action Alternative on other uses, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind activities 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 F.

3.17.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for marine minerals, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys described in Section 3.17.1, *Description of the Affected Environment for Other Uses*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. 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. No offshore developments, such as the installation of new structures on the OCS outside of planned offshore wind projects, were identified (see Appendix F, Section F.2 for a complete 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.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on other uses include:

- Continued O&M of the Block Island 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 Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect other uses through the primary IPFs of traffic and presence of structures. Ongoing offshore wind activities would have the same types of impacts from traffic and presence of structures that are described in detail in Section 3.17.3.2, *Cumulative Impacts of the No Action Alternative*, for planned offshore wind activities but the impacts would be of lower intensity.

3.17.3.2 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).

BOEM expects future offshore wind development to affect other uses through the following IPFs.

3.17.3.2.1 Marine Mineral Extraction

Presence of structures: There are two other planned future offshore wind project with offshore project components in the active OCS sand borrow area within the geographic analysis area: the Kitty Hawk Wind North and South Offshore Export Cable Routes would be located near the active sand borrow area and crosses the adjacent potential sand resource area. During O&M, users would be restricted from collecting sand resource areas within the vicinity of the offshore export cables to avoid uncovering the buried cable or to avoid disturbing remedial surface cable protection. Future projects would identify borrow areas through consultation with the BOEM Marine Minerals Program and USACE before approving offshore wind cable routes. There is one existing offshore wind project in the geographic analysis area: the CVOW-Pilot Project's offshore export cable route is located 1.6 nautical miles north of the sand resource area (BOEM 2015).

There are no other planned offshore wind projects in the geographic analysis area that would create space use conflicts with ocean dredge disposal sites. There is one existing offshore wind project in the geographic analysis area: the CVOW-Pilot Project intersects the DNODS with its offshore export cable route, which was sited based on recommendations made by USACE (BOEM 2015; Dominion Energy 2018).

The adverse impacts associated with the presence of structures on sand and marine mineral extraction of future offshore wind activities are anticipated to be long term and minor.

Traffic: The Kitty Hawk Wind North and South Export Cable Routes would be near the existing active sand borrow area and crosses the adjacent potential sand resource area. During construction and maintenance, vessel traffic associated with the sand borrow area could be temporarily disrupted due to vessels associated with cable construction and maintenance. Impacts would be greatest during construction during overlapping periods of construction with CVOW-C (the construction period of Kitty Hawk North would overlap with CVOW-C's construction period from 2024-2027 while Kitty Hawk South's construction period would overlap in 2027) (Appendix F, Table F-3). There may also be infrequent low levels of vessel traffic associated with maintenance of the existing CVOW-Pilot Project offshore export cable route.

The Kitty Hawk Wind North and South Export Cable Routes would be near, but would not intersect with, the DNODS. During construction and operation, there would be vessel traffic associated with offshore export cables. During such events, there may be a need to divert ocean dredge disposal traffic near dredge disposal sites due to the operations of the export cable maintenance vessels. There may also be maintenance vessels associated with operations of the CVOW-Pilot Project offshore export cable route.

The adverse impacts on vessel traffic associated with sand and marine mineral extraction of future offshore wind activities are anticipated to be temporary and minor.

3.17.3.2.2 National Security and Military Uses

Presence of structures: Existing stationary facilities within the geographic analysis area are limited to meteorological buoys operated for offshore wind farm site assessment. Dock facilities and other structures are concentrated along the coastline. Generally, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for USCG SAR operations or other non-typical activities. Smaller-draft vessels moving within or near the wind installation have a higher risk of allision with offshore wind structures.

The CVOW-Pilot Project (construction completed and currently in operation) is located in the geographic analysis area, adjacent to the CVOW-C Lease Area (BOEM 2015). A small portion of the offshore export cable is located within the VACAPES Operations Area and parts of a special-use airspace area, and crosses live-fire danger zones operated by the Dam Neck Fleet Combat Center. The two project WTGs are located between sections of the VACAPES Operations Area. No other planned offshore wind stationary facilities are located in the geographic analysis area. The overall impacts from the presence of structures on military and national security uses from future offshore wind energy activities are anticipated to be minor.

Traffic: Impacts on military operations from vessel traffic related to the construction and operation of future and ongoing offshore wind activities (Kitty Hawk Wind North and South, and CVOW-Pilot Project) on the OCS are expected to be short term and localized. Vessel traffic is expected to increase during construction. Military and national security vessels may experience minor impacts due to congestion and delays in ports due to the increase in offshore wind facility vessels. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success.

3.17.3.2.3 Aviation and Air Traffic

Presence of structures: One existing offshore wind project was identified with WTGs in the geographic analysis area: the CVOW-Pilot Project has two 12-MW WTGs adjacent to the CVOW-C Lease Area. No additional offshore wind projects were identified with WTGs in the geographic analysis area. Two nearby future offshore wind project (Kitty Hawk Wind North and South) was identified that may have construction equipment located onshore and in ports within the geographic analysis area, as well as the presence of construction equipment (cranes and barges) offshore within the geographic analysis area. As a result, there may be short-term interference with airspace and aviation radar system. It is expected that the presence of structures on navigation risks and space use conflicts would be negligible with the implementation of mitigation measures.

3.17.3.2.4 Cables and Pipelines

Presence of structures: Three submarine telecommunication cables are located within the geographic analysis area. In addition, the existing CVOW-Pilot Project Offshore Export Cable Route Corridor is located within the geographic analysis area and makes landfall in the SMR Beach Parking Lot.

There are no pipelines identified in the offshore portion of the geographic analysis area. Further, the existing CVOW-Pilot Project cable landing location and onshore export cable do not intersect any cables or pipelines.

Up to 453 miles (729 kilometers) of export cables and up to 349 miles (562 kilometers) of inter-array cables are expected to be installed in the geographic analysis area as part of future offshore wind energy project infrastructure (Kitty Hawk Wind North and South). One existing offshore wind project (CVOW-Pilot Project) has approximately 24 miles (44.5 kilometers) of offshore export cable installed. 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 inter-array cables associated with those projects are removed. Impacts on existing cables and pipelines due to anticipated future offshore wind projects are expected to be negligible.

3.17.3.2.5 Radar Systems

Presence of structures: WTGs that are near to or in the direct line of sight of land-based radar systems can interfere with the radar signal, causing shadows or clutter in the received signal. The location of WTGs in the proposed Kitty Hawk Wind North and South Projects could also impact the same military radar systems as the Proposed Action: the Advanced Dynamic Aircraft Measurement System at Naval Air Station Patuxent River and the Re-locatable Over the Horizon Radar system located at Naval Support Activity Hampton Roads, Northwest Annex in Chesapeake, Virginia, and the NORAD radar. There are two WTGs associated with the existing CVOW-Pilot Project in the geographic analysis area that could also affect the HF radar systems.

BOEM expects project proponents to conduct an independent radar analysis. Accordingly, project proponents would coordinate with the NOAA Integrated Ocean Observing System (IOOS) Office's Surface Currents Program to identify potential impacts and implement mitigation measures specific to oceanographic HF radar systems, and with the FAA and NWS Radar Operations Center to identify potential impacts and any mitigation measures specific to aeronautical, military, and weather radar systems. NEXRAD WSR-88D radars are used by the Tri-Agency (NOAA, FAA, and DoD), and the NOAA National Weather Service Radar Operations Center conducts its own analysis of WTGs. 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 3.16, *Navigation and Vessel Traffic*, for a discussion of impacts on marine vessel radar. As a result, impacts are expected to range from negligible to moderate.

3.17.3.2.6 Scientific Research and Surveys

Presence of structures: Construction of other wind energy projects between 2023 and 2030 in the geographic analysis area would add up to 3,226 WTGs, 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 EIS incorporates by reference the detailed summary of and potential impacts on NOAA's scientific research provided in the Vineyard Wind 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 and impacts on the random-stratified statistical design that is the basis for assessments, advice, and analyses. 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. Similarly, changes to existing survey methodologies or disruption of long-term surveys of fish and shellfish would create uncertainties in understanding stock or population change, biomass estimates, or other parameters used in projecting fishery quotas. Offshore wind facilities would disrupt survey sampling statistical designs, such as random-stratified sampling. Impacts on the statistical design of region-wide surveys would 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. 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.

3.17.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, other uses would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on other uses. These effects are primarily driven by offshore construction impacts, the presence of structures, and traffic.

BOEM expects ongoing activities and future offshore wind activities to have continuing impacts on military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys primarily through presence of structures that introduce navigational complexities and vessel traffic.

BOEM anticipates that the impacts of ongoing activities other than offshore wind on other uses would be **negligible** for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems. 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 long-term and **major** due to the impacts from climate change and fishing on the marine environment.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and other uses would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on other uses due to increased offshore construction, presence of structures, and traffic.

In addition to ongoing activities, BOEM anticipates that the impacts of planned non-offshore wind activities would also contribute to impacts on other uses. Planned activities expected to occur in the geographic analysis area other than offshore wind include increasing vessel traffic; continued residential, commercial, and industrial development onshore and along the shoreline; and continued development of FAA-regulated structures including cell towers and onshore wind turbines. BOEM anticipates that any issues with aviation routes or radar systems would be resolved through coordination with DoD or FAA, as well as through implementation of navigational marking of structures according to FAA, USCG, and BOEM requirements and guidelines. BOEM anticipates that the impacts of planned activities other than offshore wind would be **negligible** for aviation and air traffic, and cables and pipelines. Impacts of planned activities other than offshore wind are anticipated to be **minor** for marine minerals, for military and national security uses, radar systems, and scientific research and surveys due to the lack of proposed development in the offshore area.

Considering all the IPFs collectively, it is anticipated that ongoing and planned offshore wind activities in the geographic analysis area would result in **negligible** to **major** impacts. BOEM anticipates that the overall impacts associated with offshore wind in the geographic analysis area combined with ongoing activities and planned activities would be **negligible** for aviation and air traffic, cables and pipelines, and radar systems; **minor** for marine mineral extraction and national security and military uses, and **major** for scientific research and surveys.

3.17.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *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.
- Timing of offshore construction and installation activities.

Variability of the proposed Project design exists as outlined in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Below is a summary of potential variances in impacts.

- **WTG size and location:** larger (16 MW compared to 14 MW) turbines located closer to shore within the Wind Farm Area could increase impacts on land-based radar systems, movements of civilian and military aircraft, and military vessels.
- **WTG spacing:** Removal of groups of WTGs, creating spacing of greater than 1 nautical miles, could allow for scientific research and surveys in those areas, decreasing the impact.
- **Timing of construction:** Construction could affect submarine or surface military vessel activity during typical operations and training exercises.
- **Offshore cable route options:** The route chosen (including variants within the general route) could conflict with marine mineral extraction or cables and pipelines.

3.17.5 Impacts of the Proposed Action on Other Uses (Marine Minerals, Military Use, Aviation)

3.17.5.1 Marine Mineral Extraction

Space use conflicts: During O&M, users would be restricted from collecting sand resources in areas within the vicinity of the offshore export cables to avoid uncovering the buried cable or due to the presence of remedial surface cable protection. In the event that existing sand resource areas are considered for designation as sand borrow areas, Dominion Energy would work with the appropriate federal and state agencies to safeguard the export cable assets under the Proposed Action.

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to space use impacts on marine mineral extraction from ongoing and planned activities would be long-term, localized, and minor.

Traffic: The construction and maintenance of offshore export cables and corresponding increased construction and maintenance vessel traffic may impact vessel traffic associated with sand borrow and dredge disposal activity through temporary restrictions to the sand borrow areas in the geographic analysis area. Dominion Energy has proactively sited the offshore export cables to avoid active sand borrow sites and disposal sites to the extent practicable in an effort to avoid impacts. In the event that existing sand resource areas are considered for designation as sand borrow areas, Dominion Energy would work with the appropriate federal and state agencies to safeguard the export cable assets.

Construction and maintenance and repair of offshore export cables could also temporarily affect access to the DNODS. Dominion Energy would provide advance notice of construction and maintenance activities through local notices to mariners (LNTMs) and broadcast LNTMs, as well as on the Project website. Dominion Energy would also monitor and control Project vessel movements to minimize impacts on sand-borrowing and dredge-spoil dumping activities. Advanced notice of construction and maintenance activities within DNODS would be provided to USEPA to avoid affecting site monitoring efforts.

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to vessel traffic impacts on marine mineral extraction from ongoing and planned activities would be long term, localized, and minor.

3.17.5.2 National Security and Military Uses

Presence of structures: The addition of up to 202 WTGs and up to three OSSs would increase the risk of allisions for military 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. This includes impacts on USCG SAR operations, which have a preferred WTG spacing of at least one nautical mile. Impacts may include limited capability for USCG aviation assets to conduct SAR activities and limitations from adverse weather conditions. Additional information regarding impacts on navigation and vessel traffic from the Proposed Action are discussed in Section 3.16, *Navigation and Vessel Traffic*. Project structures would be marked as a navigational hazard per FAA, BOEM, and USCG guidelines, and WTGs would be visible on military and national security vessel and aircraft radar, minimizing the potential for allision and increased navigational complexity. Dominion Energy would work with the DoD and USCG to facilitate training exercises within the Lease Area. Additional navigational complexity would increase the risk of collision and allisions for military and national security vessels or aircraft within the Project area.

The construction of the cable landing location in the SMR and the onshore export cable through the SMR would be the same for the Proposed Action and could temporarily disturb some DoD activities. The construction of the onshore export cable through NAS Oceana would result in disturbance of agricultural land (open space). Once construction is complete, the lands, roads, and parking lots would be restored to previous conditions. To minimize potential construction effects on DoD activities, the DoD would be provided timely information regarding the planned construction activities and schedule. Dominion Energy will continue to coordinate with NAS Oceana on the proposed onshore export cable route.

DoD issued a response to Dominion Energy's COP on April 21, 2023 (Sample pers. comm.) and identified potential impacts on the U.S. Navy (including the U.S. Fleet Forces Command and the Naval Air Warfare Center Aviation Division) and U.S. Army, due to space use conflicts and other potential security risks. DoD included measures required to mitigate impacts of construction and O&M on U.S. Navy and U.S. Army operations (Appendix H, Table H-2).

Overall, presence of stationary structures from the Proposed Action in the Wind Farm Area would cause localized, long-term, minor impacts from increased space use conflicts.

Traffic: Increased vessel traffic in the Wind Farm Area, offshore export cable route, and cable landing location in Virginia Beach 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 highest and would be reduced during operations. Dominion Energy would schedule and track Project-related vessels to best manage congestion and traffic flow in coordination with USCG, DoD, and other national security stakeholders. Where practical, Project vessels would utilize transit lanes, fairways, and predetermined passage plans consistent with existing waterway uses and would send and receive AIS signals for awareness and collision avoidance. USCG would publish LNTMs and broadcast LNTMs to inform mariners and aviators of Project activities in the area. Additionally, Dominion Energy would publish an operations plan on the Project website to inform mariners and other interested parties on what work is being done in the Offshore Project area.

Approved cable routes would be coordinated with USCG to mitigate impacts on the private and Federal Aids to Navigation (ATON) and to facilitate USCG asset operational support for temporary or permanent changes to the ATON constellation. Dominion Energy coordinated with USACE on determining appropriate cable burial depths along the offshore export cable route and in or near any federal channels.

In context of reasonably foreseeable environmental trends, combined impacts, most likely to occur during construction and decommissioning timeframes, associated with the Proposed Action and ongoing and planned activities would be localized, temporary, and minor.

3.17.5.3 Aviation and Air Traffic

Presence of structures: The Proposed Action would install up to 202 WTGs with maximum blade tip heights of 869 feet (265 meters) AMSL in the Wind Farm Area. Based on an Obstruction and Airspace Evaluation Analysis and an Air Traffic Flow Analysis conducted by Capitol Airspace Group (COP, Appendix T; Dominion Energy 2023a), there are no anticipated adverse impacts on published instrument departure or approach procedures or 14 CFR 77.19 imaginary surfaces. The height of the WTGs should not require an increase to the minimum enroute altitudes in the area; however, the height of 48 WTGs would exceed the obstacle clearance surface and require an increase to the Norfolk International Airport TRACON Minimum Vectoring Altitude (MVA) Sector B or create an isolation area with a higher segment altitude. Historical air traffic data indicates that the required changes to ORF TRACON MVA Sector B should not affect a significant volume of radar vectoring operations. As a result, it is possible that Norfolk International Airport TRACON would be willing to increase the affected MVAs to accommodate wind development up to 869 feet (265 meters) tall. This mitigation option is subject to FAA approval.

Dominion Energy will continue to consult with the DoD Clearinghouse for an informal review of onshore and offshore Project Components. Dominion Energy solicited comments directly from the FAA and Virginia Department of Aviation on September 23, 2021, as part of the SCC filing and during BOEM's review of the COP. As several portions of the proposed route would be within 20,000 linear feet (6,096 meters) of either the Fentress Airfield or NAS Oceana, Dominion Energy will submit Form 7460-1 to the FAA for each segment of the proposed Project that would be within 20,000 linear feet (6,096 meters) of the airfield and/or for any structure that would meet or exceed 200 feet (61 meters) above ground level. Twenty-four of Dominion Energy's potential interconnection cable route and switching station/substation structures, and associated temporary construction cranes, would require submission of Form 7460-1 (Dominion Energy 2022). As of September 2022, the FAA has not provided a response to Dominion Energy's VAA SCC filing.

In the context of reasonably foreseeable environmental trends and planned activities, the Proposed Action and other offshore wind projects would contribute to impacts on aviation and air traffic. 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. Navigational hazards and space use conflicts would exist during construction, operations, and maintenance, and would be gradually eliminated during decommissioning as offshore WTGs are removed. Adverse impacts on air traffic are anticipated to be negligible if mitigation measures are approved by the FAA and implemented.

3.17.5.4 Cables and Pipelines

Presence of structures: Three submarine telecommunication cables and one active offshore wind export cable are present in the geographic analysis area. These cables would be crossed by the offshore export cable route corridor under the Proposed Action. Installation of the offshore export cables would cross four active submarine cables. Dominion Energy would coordinate with cable owners and would follow standard industry procedures for crossing utility lines and avoid adverse impacts on these existing lines.

The presence of future 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 offshore export cables for the Proposed Action 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 inter-array cables are removed.

Project structures including WTGs and OSSs, 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. FAA, USCG, and BOEM navigational hazard marking as well as the relative infrequency of maintenance activities would minimize the risk of allision under the Proposed Action. 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.

Interconnection Cable Route Option 1 would overlap with Dominion Energy–owned transmission lines: 1.8 miles (2.9 kilometers) for Line #2118/147, 6.1 miles (9.8 kilometers) for Line #271/I74, and 1.9 miles (3.1 kilometers) for Line #2240/I74 (Dominion Energy 2022). The maximum construction and operational corridor for Interconnection Cable Route Option 1 would be 250 feet (76.2 meters). Final heights of overhead interconnection cable infrastructure would be determined by Dominion Energy following site-specific surveys and detailed engineering. Impacts on onshore transmission lines in the geographic analysis area resulting from the Proposed Action would be minimal and temporary, as they are owned by Dominion Energy and within existing rights-of-way. Therefore, installation of onshore interconnection cables would be coordinated to minimize disruption to services. By considering using existing corridors to the maximum to the extent practicable when planning new transmission lines, Dominion Energy is complying with Virginia SCC requirements (COP, Section 2.1.2.4; Dominion Energy 2023a).

Impacts on natural gas and jet fuel pipelines in the geographic analysis area resulting from the Proposed Action would be minimal. The onshore export cable route would cross a Virginia Natural Gas pipeline at one location, while Interconnection Cable Route Option 1 would cross a Virginia Natural Gas pipeline in two locations (Dominion Energy 2022). Dominion Energy would use a combination of open trench, microtunneling, and HDD for installing the onshore export cables (COP, Section 2.1.2.2; Dominion Energy 2023a) to avoid impacts on the two natural gas pipeline crossings. Interconnection Cable Route Option 1 would also cross the NuStar Energy L.P. jet fuel pipeline in location using an overhead crossing (Dominion Energy 2022).

In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts on cables and pipelines from ongoing and planned activities could result in some localized and long-term impacts. However, these impacts would be negligible because they can be avoided by standard protection techniques.

3.17.5.5 Radar Systems

Presence of structures: There are several radar systems in the general vicinity of Project, including DoD, FAA, and NOAA radar sites, as well as HF Coastal Radar sites. DoD issued a response to Dominion Energy's COP on April 21, 2023 (Sample pers. comm.), which indicated that impacts from the Proposed Action on military operations in the area would be likely. Impacts could include radar operations associated with the Advanced Dynamic Aircraft Measurement System at Naval Air Station Patuxent River, the Re-locatable Over the Horizon Radar system located at Naval Support Activity Hampton Roads, Northwest Annex in Chesapeake, Virginia, the U.S. Navy's underwater cable office, and NORAD radar. DoD is requiring implementation of two mitigation strategies for impacts on NORAD radar: overlapping radar coverage and Radar Adverse Impact Management (Appendix H, Table H-2). Additionally, Dominion Energy would need to continue to engage and coordinate with U.S. Navy for impacts on its Advanced Dynamic Aircraft Measurement System radar.

In addition, the following HF radar systems that are part of the NOAA IOOS network would be within the line of sight of all or some WTGs, which would present interference: Jennette's Pier HF Radar and Little Island Park HF Radar. Two additional NOAA IOOS member HF radar systems are expected to experience radar effects, such as clutter beyond line of sight: Assateague Island HF Radar and Cedar Island HF Radar. Dominion Energy would continue to engage and implement plans with the NOAA IOOS Surface Currents Program, in coordination with the applicable university owners and operators of these HF radar systems, to assess and mitigate potential WTG impacts.

Equipment (cranes and barges) used during construction of offshore project components would not exceed the height of the WTGs. Dominion Energy would be in direct communication with relevant agencies and personnel to alert the appropriate parties to planned construction movements and actions. All WTG Components and construction equipment would be properly lighted and marked in accordance with FAA's Advisory Circular 70/7460-1M within FAA jurisdiction and beyond, or other methods as deemed required during consultation and as applicable. Cranes would also be used during construction of the onshore substation and for loading/unloading materials in ports. If the introduction of new cranes is required, an FAA Notice Criteria check (14 CFR 77.9) and additional airspace and aviation radar system assessment would be performed to determine whether there are potential airspace impacts and FAA filing is required during the storage or transit of Project materials and Offshore Project components.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the impacts on radar systems from ongoing and planned activities, primarily due to the presence of WTGs within the line of sight causing interference with 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.

3.17.5.6 Scientific Research and Surveys

Presence of structures: Scientific research and surveys, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs, would be affected during the construction and operations of the Proposed Action; however, research activities may continue within the proposed Project area, as permissible by survey operators. The Proposed Action would affect survey operations by excluding certain portions of the Lease Area occupied by Project components from sampling. Additionally, NOAA's Office of Marine and Aviation Operations has determined that the NOAA Ship Fleet will not conduct survey operations in wind facilities with 1 nautical miles or less separation between turbine foundations. The Proposed Action WTGs would have a spacing of 0.75 by 0.93 nautical mile (1.34 to 1.72 kilometers) between WTGs, which would mean survey operations in the Wind Farm Area would likely be curtailed.

This Final EIS incorporates by reference the detailed analysis of potential impacts on scientific research and surveys provided in the Vineyard Wind Final EIS (BOEM 2021). The analysis in the Vineyard Wind Final EIS is summarized under the discussion of the No Action Alternative in Section 3.17.3.1, *Impacts of the No Action Alternative*.

The Proposed Action would install up to 202 WTGs with a maximum blade tip of 869 feet (265 meters) AMSL. Aerial survey track lines for cetacean and sea turtle abundance surveys could not continue at the current altitude (600 feet AMSL) within the Project area because the planned maximum-case scenario for WTG blade tip height would exceed the survey altitude. The increased altitude necessary for safe survey operations could result in lower chances of detecting marine mammals and sea turtles, especially smaller species. Agencies would need to expend resources to update scientific survey methodologies due to construction and operation of the Proposed Action, as well as to evaluate these changes on stock assessments and fisheries management, resulting in major impacts for scientific research and surveys.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts on scientific research and surveys from ongoing and planned activities would be long term and major, particularly for NOAA surveys that support commercial fisheries and protected-species research programs. 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.

3.17.5.7 Conclusions

Impacts of the Proposed Action. Under the Proposed Action, up to 202 WTGs with a maximum blade tip of 869 feet (265 meters) AMSL would be installed, operate, and eventually be 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 temporary 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 offshore export cable routes would intersect sand borrow areas and ocean dredge disposal areas, resulting in potential long-term, **minor** impacts.

- **Military and national security uses:** The installation of WTGs in the Project area would result in increased navigational complexity, allision risk, and vessel traffic, creating potential long-term, **moderate** adverse impacts on USCG SAR operations and military and national security uses.
- **Aviation and air traffic:** Potential impacts on aviation and air traffic would be **negligible** with the implementation of mitigation measures, if approved by the FAA.
- **Cables and pipelines:** Potential impacts on cables and pipelines would be **negligible** due to the use of standard protection techniques to avoid impacts.
- **Radar:** Potential **minor** 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 Dominion Energy would continue to coordinate with the FAA, DoD, and NOAA on impacts.
- **Scientific research and surveys:** Potential impacts on scientific research and surveys would generally be **major**, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs. 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.

Cumulative impacts of the Proposed Action. In context of reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **major**. Considering all IPFs collectively, BOEM anticipates that the overall impacts associated with the Proposed Action when combined with ongoing and planned activities would range from **negligible** to **minor** marine mineral extraction, aviation and air traffic, cables and pipelines, and radar systems; and **moderate** for most military and national security uses. The presence of structures associated with the Proposed Action is the primary driver for impacts on other marine uses. Impacts on NOAA 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.

3.17.6 Impacts of Alternatives B and C on Other Uses (Marine Minerals, Military Use, Aviation)

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. Construction of Alternative B would reduce the number of WTGs to up to 176 (inclusive of three spare WTG positions) and locate the three OSSs, in the gridded alignment with the WTGs. WTGs would have a 14.7-MW capacity with power boost technology and be 836 feet (255 meters) AMSL in the Wind Farm Area. All other offshore design parameters and potential variability in the design would be the same as under the Proposed Action. However, under Alternative B, the Fish Haven area located along the northern boundary of the Lease Area would be an exclusion zone; eight WTGs and associated infrastructure would not be developed or placed in the Fish Haven area. Additionally, three WTGs and associated inter-array cables would be excluded from the northwest corner of the Lease Area to avoid vessel traffic. Onshore components would be the same as the Proposed Action.

Alternative C would use a similar layout as Alternative B but would further avoid sand ridge habitat and shipwrecks through a combination of micrositing WTGs, inter-array cables and/or OSSs, the removal of four WTGs within priority sand ridge habitat, and the relocation of one WTG, totaling up to 172 WTGs (inclusive of two spare WTG positions). This configuration would minimize linear seafloor impacts on priority sand ridge habitat. Onshore components would be the same as the Proposed Action.

Impacts of Alternatives B and C 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, radar systems, and scientific research and surveys. Alternatives B and C could decrease impacts on radar systems by removing some WTGs (though not those located closest to shore) and slightly decreasing the size of the WTGs from 16 MW to 14 MW. Alternatives B and C could reduce localized impacts on scientific research and surveys by avoiding placing structures in sand ridges and troughs; however, the structures present throughout the remainder of the Lease Area would exclude certain portions of the Project area from potential vessel and aerial sampling.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternatives B and C to the cumulative impacts on other uses would be the same as described under the Proposed Action.

3.17.6.1 Conclusions

Impacts of Alternatives B and C. Implementation of Alternatives B or C 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 resulting from individual IPFs associated with these alternatives would be **negligible** for cables and pipelines and aviation and air traffic; **minor** for marine mineral extraction and radar systems; **moderate** for marine mineral extraction; and **major** for scientific research and surveys.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends in the area, the contribution of the Alternatives B or C to the impacts of individual IPFs resulting from ongoing and planned activities would range from temporary to long-term and **negligible** to **major**. Considering all IPFs collectively, BOEM anticipates that the overall impacts associated with Alternatives B or C when combined with ongoing and planned activities would range from **negligible** to **minor** for marine mineral extraction, aviation and air traffic, cables and pipelines, and radar systems; and **moderate** for most military and national security uses, and **major** for scientific research and surveys.

3.17.7 Impacts of Alternative D on Other Uses (Marine Minerals, Military Use, Aviation)

Impacts of Alternative D. Under Alternative D, BOEM would approve either Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Hybrid Route) (Alternative D-2) to reduce impacts of the proposed Project on onshore sensitive habitats. Interconnection Cable Route Option 1 would be an entirely overhead route, while Hybrid Interconnection Cable Route Option 6, would involve installation of the interconnection cable using a hybrid of overhead and underground construction methods. Both interconnection cable route options are intended to avoid and minimize impacts on onshore sensitive habitats, including wetlands, surface waters, and ecological cores.

Interconnection Cable Route Option 6 would have an equal degree of overlap with existing Dominion Energy–owned transmission lines as Interconnection Cable Route Option 1, and therefore impacts would be the same between Alternative D-1 and Alternative D-2 (minimal). The maximum construction and operational corridor for the underground portion of Interconnection Cable Route Option 6 would be 86.5 feet (26 meters); the overhead portion would be 250 feet (76.2 meters), which is equivalent to the corridor width for Interconnection Cable Route Option 1. Interconnection Cable Route Option 6 would also have an equivalent number of natural gas and jet fuel pipeline crossings as Interconnection Cable Route Option 1, and therefore impacts would be the same between Alternative D-1 and Alternative D-2 (minimal).

While Interconnection Cable Route Option 6 (Alternative D-2) would be partially underground, thus reducing the number of structures with potential aviation and air traffic impacts, impacts from Interconnection Cable Route Option 1 (Alternative D-1) are already expected to be negligible with appropriate mitigation measures, so there would be no difference. Impacts of Alternatives D-1 or D-2 would be the same as those of the Proposed Action for military and national security uses because onshore impacts would be related to the cable landing location and onshore export cable route and not the switching station or interconnection cable routes. Additionally, because the Offshore Project components of Alternatives D-1 and D-2 are the same as the Proposed Action, impacts of Alternative D on marine mineral extraction, radar systems, and scientific research and surveys would be the same.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative D to the cumulative impacts on other uses would be the same as described under the Proposed Action.

3.17.7.1 Conclusions

Impacts of Alternative D. Implementation of Alternatives D-1 or D-2 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 resulting from individual IPFs associated with these alternatives would be **negligible** for cables and pipelines and aviation and air traffic; **minor** for marine mineral extraction and radar systems; **moderate** for marine mineral extraction; and **major** for scientific research and surveys.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative D to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action and would range from temporary to long-term and **negligible** to **major**. Considering all IPFs collectively, BOEM anticipates that the overall impacts associated with Alternative D when combined with ongoing and planned activities would range from **negligible** to **minor** for marine mineral extraction, aviation and air traffic, cables and pipelines, and radar systems; and **moderate** for most military and national security uses, and **major** for scientific research and surveys.

3.17.8 Agency-Required Mitigation Measures

In the Draft EIS, BOEM analyzed general radar systems mitigations as outlined in the BOEM OCS Study 202-039. After publication of the Draft EIS, BOEM coordinated with radar system operating agencies to identify CVOW-C-specific proposed mitigation measures, which are analyzed below and in Appendix H, Table H-3. The mitigation measures listed in Table 3.17-2 are recommended for inclusion in the preferred alternative.

Table 3.17-2 Additional Agency-Required Measures[1]

Measure	Description	Effect
Mitigation for oceanographic high-frequency radars	BOEM will require that Dominion Energy coordinates with the radar operators and the Surface Currents Program of NOAA Integrated Ocean Observing System (IOOS) Office to assess if the Project causes radar interference to the degree that radar performance is no longer within the specified radar system's operation parameters or fails to meet mission objectives. If either is the case, the lessee must notify BOEM, make publicly available via NOAA IOOS the near real-time accurate numerical telemetry of surface current velocity, wave height, wave period, wave direction, and other oceanographic data measured at Project locations selected by the Lessee in coordination with the affected radar operators and the NOAA IOOS Surface Currents Program; and, if requested by the affected radar operators or the NOAA IOOS Surface Currents Program, share with them accurate numerical time-series data of blade rotation rates, nacelle bearing angles, and other information about the operational state of each turbine in the wind development area to aid interference mitigation.	The proposed mitigation measures would reduce some of the impacts of the Project on oceanographic high-frequency radars and would ensure that the Surface Currents Program could continue to meet its mission objectives. However, the overall impact rating would remain minor, as the mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.

Mitigation for ARSR-4 and ASR-8/9 radars	Dominion Energy will enter into a mitigation agreement with DoD for impacts on ARSR-4 and for ASR-8/9 radars. Possible mitigation measures might include the following:
	• Passive aircraft tracking using ADS-B or signal/transponder
	• Increasing aircraft altitude near radar
	• Sensitivity time control (range-dependent attenuation)
	• Range azimuth gating (ability to isolate/ignore signals from specific range-angle gates)
	• Track initiation inhibit, velocity editing, plot amplitude thresholding (limiting the amplitude of certain signals)
	• Modification mitigations for ARSR-4 and for ASR-8/9 systems:
	  o Utilizing the dual beams of the radar simultaneously
	  o In-fill radars
		The mitigation measure would ensure that DoD ARSR-4 and ASR-8/9 radar activities could continue in the Lease Area and Onshore Project area. However, the overall Project impact on military and national security uses would remain minor, as the primary cause of the impact level is the presence of WTG structures in the Lease Area, and mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.

Mitigation for NORAD radar impacts	Dominion Energy will enter into a mitigation agreement with DoD for impacts on the North American Aerospace Defense Command (NORAD). Mitigation measures include the following: • Notify the NORAD 30-to-60 days ahead of project completion and when the project is complete and operational for Radar Adverse Impact Management (RAM) scheduling. • Contribute funds ($80,000) toward the execution of	The proposed mitigation measures would reduce some of the impacts of the Project on NORAD. However, the overall Project impact on military and national security uses would remain minor, as the primary cause of the impact level is the

Measure	Description	Effect
	the RAM for each affected radar. • Curtailment for National Security or Defense Purposes as described in the leasing agreement.	presence of WTG structures in the Lease Area
Mitigation for impacts to DON operations	Dominion Energy will enter into a mitigation agreement with DoD for impacts on the Department of the Navy (DON). Mitigation measures include the following: • Coordinate prior to mobilization and work with DON to develop communication protocols for construction activities, providing relevant notifications and regular updates to U.S. Fleet Forces Command (USFFC) and the Naval Air Warfare Center Aviation Division (NAWCAD). • Following construction, develop communication protocols to ensure notification and coordination with USFFC and NAWCAD on relevant operations and maintenance activities with the potential to impact military activities. • Work with DoD/DON to prevent, minimize, or mitigate effects on radar systems to potentially include curtailment of turbine operation for National Security or Defense purposes. • Spinning turbines may conflict with the DON's Advanced Dynamic Aircraft Measurement System. Dominion Energy must facilitate a DON risk assessment through deployment of distributed fiber optic sensing technology and passive acoustic monitoring, and mitigate risks to national security, if identified. • Provide DoD/DON notification and opportunity to assess risk related to foreign investment and material vendors for the project, and must address risk to national security requiring mitigation, if identified. • Continue to coordinate with the DON regarding real estate leasing with NAS Oceana regarding access for the proposed Interconnection Cable Route Options.	The mitigation measure would ensure that DoD/DON and U.S. Army activities could continue in the Lease Area and Onshore Project area, as possible while avoiding structures, without the risk of inadvertently capturing sensitive information from DoD/DON activities or affected DoD/DON radar systems. However, the overall Project impact on military and national security uses would remain minor, as the primary cause of the impact level is the presence of WTG structures in the Lease Area and mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.

[1] Also Identified in Appendix H, Table H-3.

3.17.8.1 Effect of Measures Incorporated into the Preferred Alternative

BOEM has identified measures in Table 3.17-2 and Appendix H, Table H-3 as incorporated in the preferred alternative. These measures, if adopted, would have the effect of reducing some of the impacts on radar systems and military and national security uses. The mitigation measure for oceanographic high-frequency radars was developed through coordination with the NOAA Integrated Ocean Observing System Office. This mitigation measure would de-conflict CVOW-C Project development and the ability of this office to meet mission objectives and would reduce impacts; however, the overall Project impact on radar systems would remain minor. The remaining measures were identified as a result of Military Aviation and Installation Assurance Siting Clearinghouse reviews. Three measures would reduce impacts on NORAD radar through RAM scheduling and funding, as well as Curtailment for National Security or

Defense Purposes, and two measures would reduce impacts on DoD/DON radar systems (including the DON's Advanced Dynamic Aircraft Measurement System) through coordination with DoD/DON coordination and risk assessment. These mitigation measures would de-conflict CVOW-C Project development and the ability of this office to meet mission objectives and would reduce impacts; however, the overall Project impact on radar systems would remain minor. Three measures would reduce impacts on DON operations onshore through coordination on construction activities, real estate leasing on NAS Oceana property, and communication protocols for USFFC and NAWCAD operations. Overall Project impacts on military and national security uses would remain moderate through the presence of structures. One measure would identify and reduce impacts on the U.S. Army from UAS to avoid the risk of inadvertently capturing sensitive information from U.S. Army activities. However, overall Project impacts on military and national security uses would remain minor, as the primary cause of the impact level would be the presence of WTG structures in the Lease Area and vessel traffic.

3.18. Recreation and Tourism

This section discusses potential impacts on recreation and tourism resources from the proposed Project, alternatives, and ongoing and planned activities in the recreation and tourism geographic analysis area. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.18-1, includes the 40-mile (64.4-kilometer) visual analysis area measured from the borders of the Wind Farm Area. The geographic analysis area encompasses parts of Accomack County, Northampton County, the City of Norfolk, the City of Virginia Beach, and Chesapeake City, Virginia, and Currituck and Dare Counties, North Carolina. Section 3.11, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the Project area.

3.18.1 Description of the Affected Environment for Recreation and Tourism

3.18.1.1 Regional Setting

Proposed Project facilities would be within and off the coast of Virginia and North Carolina. The coastal areas support ocean-based recreation and tourist activities that include boating, swimming, surfing, scuba diving, sailing, and paddle sports. As indicated in Section 3.11, *Demographics, Employment, and Economics*, recreation and tourism contribute substantially to the economies of Virginia and North Carolina's coastal counties. Tourism in Virginia's coastal communities is a multibillion-dollar industry. More than 19 million people visited Virginia Beach in 2017, generating about $1.7 billion annually in total expenditures (City of Virginia Beach 2017; COP, Section 4.4.5.1; Dominion Energy 2023).

Coastal Virginia and North Carolina have 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 Virginia and North Carolina 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.

3.18.1.2 Project Area

Recreational and tourist-oriented activities are concentrated in the coastal communities in the City of Virginia Beach and the City of Chesapeake. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of 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, diving, fishing tournaments, and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding.

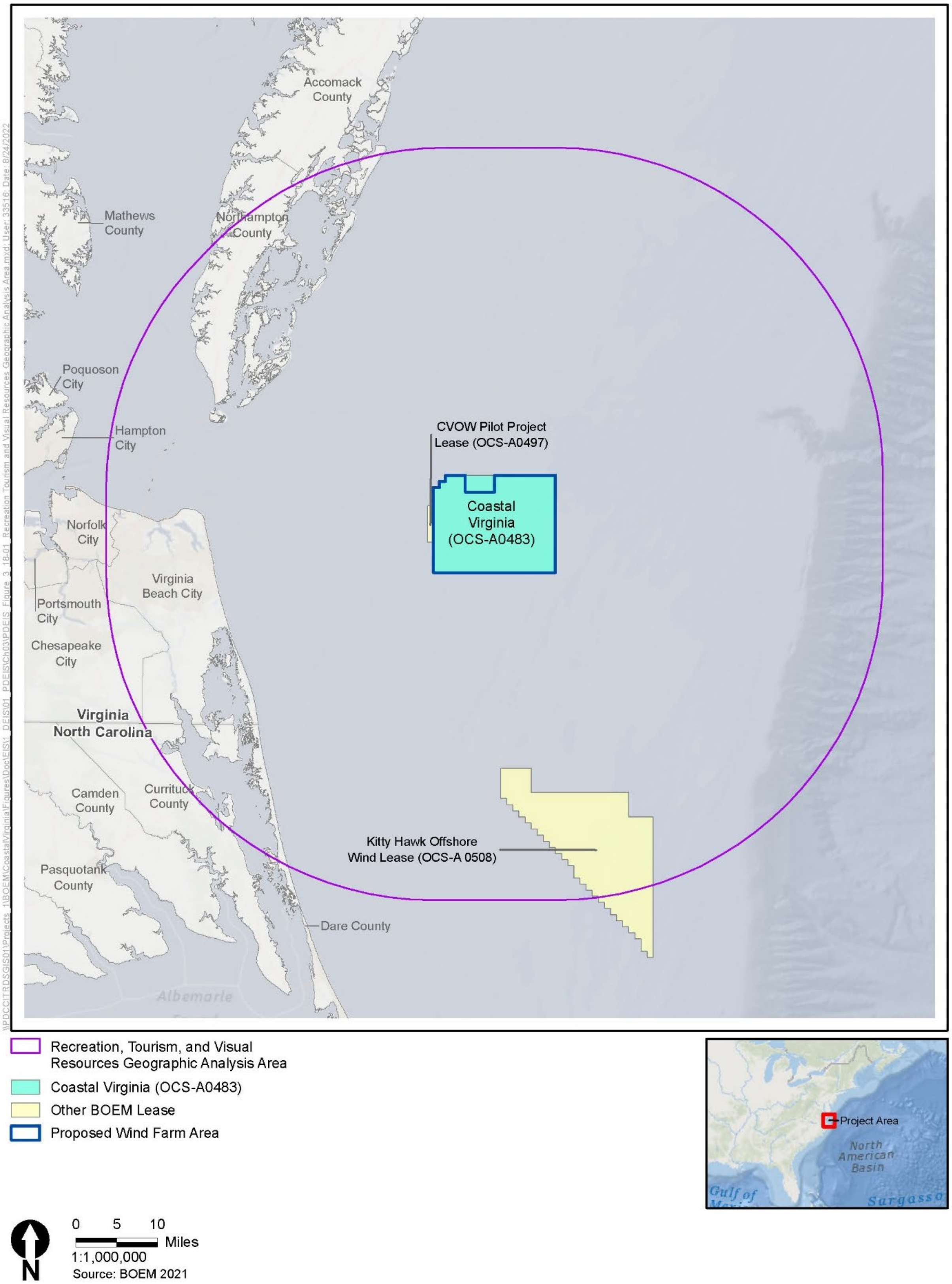


Figure 3.18-1 Recreation, Tourism, and Visual Resources Geographic Analysis Area

Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks. As discussed in Section 3.11, *Demographics, Employment, and Economics*, recreation and hospitality are major sectors of the economy in the City of Virginia Beach and the City of Chesapeake, supported by ocean-based recreation uses.

Inland recreational facilities are also popular but have less of a relationship to possible impacts of the Project; this section does not address these facilities in detail, except where Project components would intersect with these facilities. These include inland waters such as ponds and rivers, wildlife sanctuaries, golf courses, athletic facilities, parks, and picnic grounds.

3.18.1.2.1 Coastal and Offshore Recreation

Many marine recreational activities, such as swimming, surfing, kayaking, paddle boarding, wind surfing, fishing, sailing, and boating, occur along the coast of Virginia almost all year-round. Scuba diving and snorkeling are identified as a dominant use offshore from the Virginia coast year-round with dive sites that include shipwrecks, artificial reefs, and other structures. Recreational boating and sailing are very popular and primarily occur in nearshore coastal waters rather than offshore waters (COP, Sections 4.4.6.2 and 4.4.11.1; Dominion Energy 2023).

There is a large and robust recreational fishing industry in Virginia and North Carolina. In 2018, there were about 6.4 million recreational saltwater angler trips (i.e., charter, party, private/rental, and shore boats) in Virginia and about 16.6 million trips in North Carolina. The popular recreational saltwater species caught in the area include, but are not limited to, sciaenid drums including Atlantic croaker (*Micropogonias undulatus*) and seatrout, bluefish, tuna/mackerel, cartilaginous fishes (sharks, skates, and rays), porgies, jacks, and black sea bass (COP, Section 4.4.6.2; Dominion Energy 2023). There are also annual recreational fishing tournaments held in coastal towns in Virginia and North Carolina. Saltwater fishing tournaments target a variety of fish including billfish, tuna, seabass, shark, grouper, and others. Tournaments for specific highly migratory species occur from late June to early September (COP, Sections 4.4.6.2 and 4.4.11.1; Dominion Energy 2023).

Recreational shellfishing is important to the region and occurs primarily in state waters and not in the Offshore Project area, commonly targeting blue crabs, scallops, quahogs, Atlantic surf clams, and softshell clams. Spearfishing occurs in portions of the Offshore Project area and often targets fish at offshore structures, the Triangle wrecks, and surface structures, such as buoys (COP, Section 4.4.6.2; Dominion Energy 2023).

3.18.1.2.1.1 Accomack County

Accomack County lies on the Delmarva Peninsula, on the northern part of Virginia’s eastern shore, and encompasses approximately 1,310 square miles (3,393 square kilometers). The county is known for its 45-mile (72-kilometer) stretch of oceanside barrier islands, which are kept in their natural state and can be accessed by the public (Accomack County 2021). Aside from its barrier islands, bays, and inlets, there are eight public beaches, one yacht club, 29 public boating access sites, and 40 miles (64 kilometers) of shoreline on both the Chesapeake Bay and the Atlantic Ocean (BOEM 2012). Popular marine recreational activities in the county include swimming in the Atlantic Ocean, surfing, fishing, boating, and wildlife viewing off the shore. There are many businesses that offer boat and fishing tours and rentals, and there are many public piers at which fishing tournaments, crabbing, and clamming take place. Scenic boat cruises are popular among tourists and take place through the Chincoteague and Assateague Channels and along the Assateague Island National Seashore (Chincoteague Chamber of Commerce 2021).

3.18.1.2.1.2 Northampton County

Northampton County is located on the southern part of the Delmarva Peninsula on Virginia's eastern shore and encompasses 795 square miles (2,095 square kilometers). The county is known for its over 100 miles (161 kilometers) of shoreline on the Chesapeake Bay and Atlantic Ocean, and it has three public beaches and two marinas (BOEM 2012). Popular recreational activities include kayaking, fishing on the piers, renting yachts, and visiting the uninhabited barrier islands. There are 12 barrier islands, which are open to the public for non-commercial recreational day use, such as hiking, bird watching, fishing, hunting, crabbing, and clamming (Northampton County 2019). Private ecotours and sunrise/sunset cruises that go between the sandy beaches and islands are very popular (Cape Charles Harbor 2020).

3.18.1.2.1.3 City of Norfolk

The City of Norfolk encompasses 66 square miles (106 square kilometers), is located is southeastern Virginia, and is bordered by Chesapeake Bay. It has 7 miles (11 kilometers) of Chesapeake Bay beachfront, and all of the beaches are public. Popular recreational activities include sailing, kayaking, swimming, jogging and walking along the shoreline, surfing, and canoeing. There is a harbor for ocean-going cruise vessels of up to 3,000 passengers, and there is the East Ocean View Community Center Pier, which hosts anglers and boaters (City of Norfolk 2021). A lot of recreational diving that occurs along the Virginia coast is supported by several dive companies in the city that offer charters to artificial reefs, shipwrecks, ledges, and other sites in the Offshore Project area (COP, Section 4.4.11.1; Dominion Energy 2023).

3.18.1.2.1.4 City of Virginia Beach

The City of Virginia Beach is in southeastern Virginia and encompasses 310 square miles (499 square kilometers). It has 28 miles (45 kilometers) of public beach, 38 miles (61 kilometers) of shoreline, and 29 miles (74 kilometers) of scenic waterways (City of Virginia Beach 2017). There are about six public beaches, nine marinas, and 13 yacht clubs. The shorefront is one of the most popular attractions, where people partake in swimming, annual surfing championships, fishing, paragliding, and sailing (BOEM 2012). The city is also known for its 3-mile Virginia Beach Boardwalk, which is lined with hotels and restaurants, and for its guided boat tours of the Back Bay and Atlantic Ocean (Visit Virginia Beach 2021).

Several dive companies in Virginia Beach, such as Chesapeake Bay Diving Center and Lynnhaven Dive Center, support recreational scuba and free dives by offering charters to artificial reefs, shipwrecks, ledges, and other sites of interest in the Offshore Project area (COP, Section 4.4.11.1; Dominion Energy 2023). Recreational fishing vessels are supported by the ports of Rudee Inlet and Lynnhaven, from where fishermen travel to areas of "hard bottom" seabed structures and other structures near the Offshore Project area. Virginia Beach also hosts a number of very popular fishing tournaments for highly migratory species, which occur from late June to early September (COP, Section 4.4.6.2; Dominion Energy 2023). Whale-watching tours are also popular in coastal Virginia between late November and March but occur year-round in Virginia Beach. Dolphin tours take place between June and late October (COP, Section 4.4.11.1; Dominion Energy 2023).

3.18.1.2.1.5 Chesapeake City

The City of Chesapeake encompasses 353 miles and is adjacent to Virginia Beach City (City of Chesapeake 2021). Since it is surrounded by land, it does not offer as many opportunities for coastal recreation, as does Virginia Beach City.

3.18.1.2.1.6 Currituck County

Currituck County encompasses 526 miles (847 kilometers) and is located in the northeastern-most corner of North Carolina (United States Census Bureau 2010). It has six public beaches, 20 miles (32 kilometers) of shoreline, one marina, and two yacht clubs (BOEM 2012). The county is known for its sandy beaches, where tourists partake in surfing, fishing, kayaking, parasailing, paddleboarding, kiteboarding, and walking along the shore (Currituck County 2021). Fishing and crabbing are also popular activities in the Currituck Sound (Currituck County Tourism 2021). In 2009, there were 65 ocean-related establishments that directly employed 451 people (BOEM 2012).

3.18.1.2.1.7 Dare County

Dare County is in northeastern North Carolina, adjacent to the Atlantic Ocean, and it encompasses 1,563 square miles (2,515 square kilometers). It has 110 miles (177 kilometers) of shoreline, known as the Outer Banks (Dare County 2021). The county is known for its beaches, which offer sailing tours, fishing, snorkeling, water sports, and horseback riding (Outer Banks 2021). It has two public beaches, 10 marinas, and 13 yacht clubs. In 2009, there were 269 ocean-related establishments, which employed 3,746 people directly. Popular attractions include the Cape Hatteras Lighthouse and the Bodie Island Lighthouse (BOEM 2012).

3.18.1.2.2 Onshore Recreation

3.18.1.2.2.1 Accomack County

Accomack County is home to myriad habitats, such as farmland, marshes, forests, and wetlands. The 9,000-acre (3,642-hectare) Chincoteague National Wildlife Refuge is located in the north portion of the county and has opportunities for swimming, hiking, fishing, and bird watching. The beaches and salt marshes are particularly popular for viewing shorebirds, seabirds, and other migrating waterfowl. The Accomack County Department of Parks and Recreation takes care of three parks: Arcadia Park (25 acres (10 hectares]), Wachapreague Park (15 acres [6 hectares]), and Nandua Middle Park (Accomack County 2021). Along the nature trails, tourists partake in bird watching of over 300 species of migratory birds, pony watching, and biking (Chincoteague Chamber of Commerce 2021).

The main areas of tourism in the county are nature, agriculture, and beach and recreational resorts. Tourists partake in wine tours, horseback riding, and golfing. In 2010, domestic travelers spent about $145.08 million in the county, and there were 116 establishments dedicated to leisure and hospitality. Approximately 23 percent of all housing units in Accomack County are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.2.2.2 Northampton County

Northampton County is known for its undeveloped coastal landscapes that allow for many recreational activities, such as wildlife viewing, hiking, and cycling. The county is home to two wildlife refuges: the Eastern Shore of Virginia National Wildlife Refuge (1,200 acres [486 hectares]) and Fisherman Island National Wildlife Refuge (1,850 acres [749 hectares]) (BOEM 2012). Tourists enjoy bird watching along the Eastern Seaboard during spring and fall migration and enjoy the variety of artist markets, galleries, and film festivals more inland (Northampton County 2019). In 2010, domestic travelers spent $63.26 million, and there were 43 establishments dedicated to leisure and hospitality (BOEM 2012).

3.18.1.2.2.3 City of Norfolk

Inland Norfolk is home to three beach parks, museums, the National Maritime Center, art festivals, and the Norfolk Botanical Garden. Popular activities in the parks include walking, hiking, and wildlife viewing (City of Norfolk 2021). There are also many bike lanes and trails, such as the 10.5-mile (16.9-kilometer) Elizabeth River Trail, which are popular among cyclists. Tourists also partake in kayaking and fishing the Lafayette River (Visit Norfolk n.d.).

3.18.1.2.2.4 City of Virginia Beach

Virginia Beach is home to 255 local parks (covering 4,500 acres), several state parks, and one national wildlife refuge: the Back Bay National Wildlife Refuge (10,000 acres [4,047 hectares]) (BOEM 2012). Popular inland activities include traversing the Sandbridge dunes, hiking and cycling along the 200 miles (322 kilometers) of bikeways and trails, and kayaking and fishing in the 120 miles (193 kilometers) of waterways. First Landing State Park is a 2,888-acre park with 1.25 miles (2.01 kilometers) of beach, and 19 miles (31 kilometers) of hiking trails through salt marsh habitat, freshwater ponds, dunes, forests, tidal marshes, and cypress swamps. Other popular attractions include museums; Pungo, an 8,000-acre (3,237-hectare) farmland community; breweries; Atlantic Fun Park; and Cape Henry Light House (Visit Virginia Beach 2021). In 2010, domestic travelers spent $1.13 billion in the city, and there were 1,266 establishments for leisure and hospitality (BOEM 2012).

3.18.1.2.2.5 Chesapeake City

The City of Chesapeake is home to the Great Dismal Swamp National Wildlife Refuge, which is a protected area of more than 112,000 acres (45,325 hectares) and contains 200 species of birds, 100 species of butterfly, and other rare native mammals. The refuge has freshwater marshes, cypress swamps, and barrier islands. The city is also home to Lake Drummond, a 3,100-acre (1,255-hectare) lake popular among anglers. Popular activities in the city include hiking, camping, fishing, and birdwatching along the Virginia Birding and Wildlife Trail, which is home to over 213 species of birds (Visit Chesapeake 2021).

3.18.1.2.2.6 Currituck County

There are two wildlife refuges in Currituck County: Currituck National Wildlife Refuge (8,501 acres) and part of Mackay Island National Wildlife Refuge (8,219 acres [3,326 hectares] on Knotts Island). People partake in bird watching, hiking, kayaking, and cycling (BOEM 2012). Tourists also enjoy wildlife viewing due to the population of Corolla Wild Horses in the Currituck Outer Banks (Currituck County 2021). The county is also famous for its Historic Corolla Park and the Currituck Beach Lighthouse (Currituck County Tourism 2021). In 2010, domestic visitors spent $117.12 million in the county, and there were 87 establishments dedicated to leisure and hospitality. Approximately 31.8 percent of housing units in the county are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.2.2.7 Dare County

Dare County has five national protected areas, including the Pea Island National Wildlife Refuge (6,000 acres) and the Alligator National Wildlife Refuge (152,000 acres [61,512 hectares]), which is home to songbirds, raptors, and ducks (BOEM 2012; Dare County 2021; Outer Banks 2021). Popular activities include golfing, touring gardens, visiting historic sites and museums, bird-watching festivals, and traversing fresh and saltwater habitats. Tourism provides more than 13,800 jobs in the county, employing one-third of the county's residents. Annually, tourism generates more than $116.5 million in state and local tax revenue, and visitor spending is over $1.27 billion (Outer Banks 2021). In 2009, there were 381 establishments dedicated to leisure and hospitality. Approximately 44 percent of housing units are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.3 Visual Resources

As discussed in Section 3.20, *Scenic and Visual Resources*, the proposed Project's Offshore Components, including the WTGs, inter-array cables, and OSSs would be in federal waters within the Lease Area. The boundary of the Lease Area is 20.45 nautical miles (37.87 kilometers) from the northwest corner to the Eastern Shore Peninsula and 23.75 nautical miles (43.99 kilometers) from Virginia Beach, Virginia. Existing visual intrusions offshore include buoys, channel markers, marine vessel traffic, the Chesapeake Light Tower, and the two existing WTGs of the CVOW-Pilot Project. These features are visible during daytime hours, and safety and warning lights are visible during nighttime hours from certain viewing locations. Air traffic (including nighttime safety lighting on aircraft) arriving and departing from military and civilian airports is also commonly seen in the Offshore Project 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 glare of shorefront developments (COP, Section 4.3.4.2; Dominion Energy 2023).

Within the 40-mile-radius geographic analysis area, the distance from coastal viewpoints to the Project would vary from slightly more than 25 miles (40 kilometers) to nearly 40 miles (64 kilometers) to the nearest WTG. The most apparent views of WTGs were found to be within 27 to 28 miles (43.5 to 45.1 kilometers) from the Lease Area, where views are oriented toward the ocean and horizon. Within these areas, beach/shoreline and elevated viewpoints, such as multi-story buildings and/or lighthouses with ocean views, would have the most conspicuous views of the WTGs (COP, Section 4.3.4.3; Dominion Energy 2023).

3.18.2 Environmental Consequences

3.18.2.1 Impact Level Definitions for Recreation and Tourism

Definitions of impact levels are provided in Table 3.18-1.

Table 3.18-1 Impact Level Definitions for Recreation and Tourism

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on the recreation setting, 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.
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.

3.18.3 Impacts of the No Action Alternative 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 activities 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 F.

3.18.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for recreation and tourism in the geographic analysis area described in Section 3.18.1, *Description of the Affected Environment for Recreation and Tourism*, 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 recreation and tourism include 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 Virginia and North Carolina 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. The beach, and by proxy the ocean, is a primary concern for the local jurisdictions' tourism industry (City of Virginia Beach 2017). There is one ongoing offshore wind activity within the geographic analysis area that could contribute to impacts on recreation and tourism.

3.18.3.2 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).

BOEM expects future offshore wind activities to affect recreation and tourism through the following primary IPFs.

Anchoring: This IPF would potentially affect recreational boating through both the presence of an increased number of anchored vessels in the geographic analysis area and the creation of offshore areas with scour protection where recreational vessels may experience limitations or difficulty in anchoring.

Future offshore wind development in the geographic analysis area is anticipated to result in increased survey activity and overlapping construction periods beginning in 2024, with two other projects (Kitty Hawk Offshore Wind Projects) under construction at one time during 2024 through 2027 (Appendix F, Table F3). Increased vessel anchoring during future offshore wind development between 2024 and 2030 would affect recreational boaters. The greatest volume of anchored vessels would occur in offshore work areas during construction. Future offshore wind projects may generate similar numbers of active and anchored vessels to the Proposed Action, depending on project size and construction schedule: the CVOW-C Project would have an estimated average of 46 daily vessel trips generated throughout the duration of construction, ranging from a minimum of 3 trips per day to a maximum of 95 trips per day (COP, Section 3.4.1.5; Dominion Energy 2023). Anchored construction-related vessels may be within temporary safety zones established in coordination with USCG for active construction areas (COP, Section 4.4.9.2; Dominion Energy 2023).

Vessel anchoring would also occur during maintenance and monitoring activities. Following construction of planned offshore wind projects (if approved), the presence of operating offshore wind projects in the geographic analysis area would result in a long-term increase in the number of vessels anchored during periodic maintenance and monitoring. One ongoing offshore wind project, the CVOW-Pilot Project, is currently in the operations phase. There are only two WTGs, so the long-term increase in the number of vessels during period maintenance and monitoring would be small.

Anchored construction, survey, or service vessels would have localized, temporary impacts on recreational boating. Recreational vessels could navigate around anchored vessels with only brief inconvenience. The temporary turbidity from anchoring would briefly alter the behavior of species important to recreational fishing (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*) and sightseeing (primarily whales, but also dolphins and seals) (Section 3.15, *Marine Mammals*). Inconvenience and navigational complexity for recreational vessels would be localized, variable, and long term, with increased frequency of anchored vessels during surveying and construction and reduced frequency of anchored vessels during operations.

Land disturbance: Future offshore wind development for Kitty Hawk Offshore Wind Projects would require installation of onshore transmission cable infrastructure, which would cause temporary traffic delays and could temporarily affect access to adjacent properties, resulting in localized, temporary disturbances of recreational activity or tourism-based businesses near cable routes and construction sites for substations and other electrical infrastructure. These impacts would only occur during construction and occasionally during maintenance events. The impacts during maintenance of the ongoing two-WTG CVOW-Pilot Project would be similar. The extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term impacts during construction or maintenance and would not have long-term impacts on recreation and tourism use.

Lighting: Construction-related nighttime vessel lighting would be used if future 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 two future offshore wind projects (Kitty Hawk Offshore Wind Projects) in the geographic analysis area during the project's active construction phase. Vessel lighting would enable recreational boaters to safely avoid nighttime construction areas. The impact on recreational boaters would be localized, sporadic, short term, and minimized by the limited offshore recreational activities that occur at night.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines in 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 71 WTGs. The amassing of these WTGs and associated synchronized flashing strobe lights affixed with red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle within the offshore wind lease areas would have long-term negligible 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 (COP, Section 4.3.4.3; Dominion Energy 2023).

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 study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS). A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5 to 8 miles [8 to 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. All of the WTG positions envisioned in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

The Virginia and North Carolina shore are within the viewshed of the WTGs and have been extensively developed for recreation and tourism. 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 tidal 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 activities. 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 Virginia and North Carolina shore and elevated areas, with less impact on the recreation and tourism industry as a whole.

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. Based on historical air traffic data, activation of the ADLS, if implemented, would occur for about 25 hours and 33 minutes over a 1-year period, as compared to standard continuous FAA hazard lighting (COP, Appendix T; Dominion Energy 2023). It is anticipated that an ADLS-controlled obstruction lighting system could result in over a 99 percent reduction in system-activated duration as compared to a traditional always-on obstruction lighting system.

Cable emplacement and maintenance: Under the No Action Alternative, future offshore wind export cables from the Kitty Hawk Offshore Wind Projects could total approximately 453 miles (729 kilometers), while inter-array cables could total approximately 349 miles (562 kilometers) (Appendix F, Table F2-1). One existing offshore wind project (CVOW-Pilot Project) has approximately 24 miles (44.5 kilometers) of offshore export cable installed. Specific cable locations associated with future offshore wind projects are unknown and, therefore, have not been identified in the geographic analysis area. Cables for other future offshore wind projects would likely be emplaced in the geographic analysis area between 2024 and 2030. Based on the assumptions in Appendix F, these cables could affect up to 130,145[1] acres (52,667.8 hectares) (Appendix F, Table F2-2).

Offshore cable emplacement for future offshore wind development projects would have temporary, localized, adverse impacts on recreational boating while cables are being installed, because vessels would

[1] Kitty Hawk Wind South has three export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Carolina) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-foot-wide corridor to Virginia and 1,000-foot-wide corridors to North Carolina to allow for optimal routing of the cables.

need to navigate around work areas, and recreational boaters would likely prefer to avoid the noise and disruption caused by installation. Cable installation could also have temporary impacts on fish and invertebrates of interest for recreational fishing, due to the required dredging, turbulence, and disturbance; however, species would recover upon completion (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). The degree of temporal and geographic overlap of each cable is unknown, although cables for some projects could be installed simultaneously. Active work and restricted areas would only occur over the cable segment being emplaced at a given time. Once installed, cables would affect recreational boating only during maintenance operations, except that the mattresses covering cables in hard-bottom areas could hinder anchoring and result in gear entanglement or loss.

Impacts of cable emplacement and maintenance on recreational boating and tourism would be short term, continuous, adverse, and localized.

Noise: Noise from construction, pile driving, HRG survey activities, trenching, O&M, and vessels could result in adverse impacts on recreation and tourism.

Onshore construction noise from cable installation at the landfall sites, and inland if cable routes are near 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 noise from HRG survey activities, pile driving, trenching, and construction-related vessels would intrude upon the natural sounds of the marine environment. This noise could cause some boaters to avoid areas of noise-generating activity, although some of the most intense noise could be within safety zones that USCG may establish for areas of active construction, which would be off-limits to boaters. Noise from pile driving is estimated to produce sound power levels of 87 dBA in-air at 400 feet (122 meters) (COP, Section 4.1.4.2; Dominion Energy 2023). 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 the construction noise (Kirkpatrick et al. 2017).

During operations, the continuous noise generated by WTG operation is not expected to produce sound in excess of background levels at any onshore locations (COP, Section 4.1.4.2; Dominion Energy 2023). Accordingly, the impact of noise on recreation and tourism during construction would be adverse, intense, and disruptive, but short term and localized. Multiple construction projects at the same time would increase the number of locations in the geographic analysis area that experience noise disruptions. The impact of noise during O&M would be localized, continuous, and long term, with brief, more-intensive 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 in the lease areas and along cable routes, as discussed in Sections 3.9, *Commercial Fisheries and For-Hire Recreational Fishing,* 3.13, *Finfish, Invertebrates, and Essential Fish Habitat,* and 3.15, *Marine Mammals*. Because most recreational fishing takes place closer to shore than the Lease Area, only a small proportion of recreational fishing would be affected by construction in the Lease Area, where most of the noise impacts would occur. Recreational fishing such as for 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 temporary impacts resulting from the noise generated by future offshore wind construction. Construction noise could contribute to temporary impacts on marine mammals, with resulting impacts on marine sightseeing that relies on the presence of mammals, primarily whales. However, as noted in Section 3.15, *Marine Mammals,* future 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, therefore, little effect on recreational fishing or sightseeing.

Future offshore wind surveying and construction would occur in the geographic analysis area between 2024 and 2030. Future offshore wind construction would result in short-term, localized, adverse impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple construction projects would increase the spatial and temporal extent of temporary disturbance to marine species in the geographic analysis area. BOEM's assumed construction schedule for future offshore wind projects in Appendix F, Table F-3 indicates the possibility of two other wind projects under development in the Lease Area. As indicated in Appendix F, up to 190 offshore WTGs and three OSSs could be installed within a 6-year period in the Lease Area, not including the Proposed Action. No long-term, adverse impacts are anticipated that would result in population-level harm to fish and marine mammal populations.

Port utilization: The geographic analysis area for recreation and tourism contains the PMT and Newport News Marine Terminal, which would be used by the Proposed Action (COP, Section 3.3.2.6; Dominion Energy 2023). Areas outside the geographic analysis area for recreation and tourism that are likely to be used for staging and construction, such as the ports that would be used by the Proposed Action, may provide facilities for recreational vessels or may be on waterways shared with recreational marinas, and may experience increased activity and undergo expansion and dredging. The ports listed above and other regional ports suitable for staging and construction of future offshore wind development 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 placement of 190 WTGs and three OSSs in the Lease Area in the geographic analysis 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, future offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects.

The WTGs and OSSs installed in the Wind Farm Area 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. The increased number of fishing trips out of nearby ports could also support increased angler expenditures at local bait shops, gas stations, and other shore-side dependents (COP, Sections 4.2.4.3, 4.4.11.2, and 4.4.6.3; Dominion Energy 2023).

The presence of future offshore wind structures would increase the risk of allision or collision with other vessels and the complexity of navigation in the Lease Area. Generally, the vessels more likely to allide with WTGs or OSSs would be smaller vessels moving within and near wind installations, such as recreational vessels. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly over the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success, as described in greater detail in Section 3.17, *Other Uses (Marine Minerals, Military Use, Aviation).*

Future offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the adverse impact of the future offshore wind structures on recreational boating would be limited by the distance of the wind turbines offshore. AIS data from 2018 show that there is typically very low recreational activity from craft/sailing vessels within and directly adjacent to the Lease Area (COP, Section 4.4.7.1; Dominion Energy 2023). In addition, sailing in the geographic analysis area primarily occurs nearshore, just along the coastline, rather than farther offshore (COP, Section 4.4.11.1; Dominion Energy 2023).

The geographic analysis area would have an estimated 403 foundations with scour protection and 240 acres (97 hectares) of hard protection for export and inter-array cables, which results in an increased risk of entanglement (Appendix F, Table F2-2). The cable protection would also present a hazard for anchoring, as anchors could have difficulty holding or become snagged and lost. 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 in the geographic analysis area continue to engage with both USCG and NOAA in developing a comprehensive aid to navigation plan for the entire Lease Area (COP, Section 4.4.7.1; Dominion Energy 2023). 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. Because anchoring is uncommon in water depths where the WTGs for future offshore wind projects excluding the proposed Project 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.

Future offshore wind structures could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The wind structures could 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, Sections 4.2.4.2, 4.4.11.2, and 4.4.6.3; Dominion Energy 2023). The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters and sightseeing vessels traveling farther from shore to fish in the Lease Area. Although the likelihood of recreational vessels visiting the offshore WTG foundations 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 (Section 3.9, *Commercial Fisheries and For-Hire Fishing*).

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 3.20, *Scenic and Visual Resources*, 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 recreation/tourism 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 recreation/tourism 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, and that Block Island Wind Farm's WTGs provide excellent sites for fishing and shellfishing (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 development) 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 study focused on the changes to the vacation rental market after the construction of Block Island Wind Farm found that Block Island Wind Farm led to significantly increased nightly reservations, occupancy rates, and monthly revenues for properties in Block Island during peak tourism season in July and August (Carr-Harris and Lang 2019). The study estimates that the Block Island Wind Farm caused a 7-night increase in reservations, a 19 percent increase in occupancy rates, and a $3,490 increase in rental property revenue during July and August. Outside of peak tourism season, the Block Island Wind Farm did not have an impact on the vacation rental market.

However, a 2003 survey focused on tourists' feelings about potential offshore wind development in Cape Cod, Massachusetts found that, based on visual simulations of prospective offshore wind facilities, 3.2 percent of tourists said they would spend an average of 2.9 fewer days in Cape Cod, and a further 1.8 percent said they would not visit at all if the wind turbines were built (Haughton et al. 2003).

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 (BOEM 2021).

The wind turbines used for the visual simulations in the studies cited above used smaller WTGs than are proposed for the planned offshore wind projects in the region, including the Proposed Action. The studies cited in the Final EIS used 579-foot (176.5-meter) WTGs that would be visible out to 32.4 miles (52.1 kilometers). The 869-foot (265-meter) CVOW-C Project WTGs would be visible out to 39 miles (62.8 kilometers). Greater eye-level heights would increase the visible distance in both cases. Both the WTGs used in the studies and the WTGs proposed as part of the CVOW-C Project would have the WTG hubs, nacelles, navigation lights, and rotor blades visible to viewers on the nearest beach. The visibility of the WTGs would be variable, depending on current meteorological, moonlight, and sunlight conditions. In views seaward, there would be periods of high, moderate, low and no visibility. Therefore, in both the 2018 Parsons and Firestone studies and for the CVOW-C Project, the WTGs' hubs, nacelles, navigation lights, and rotor blades would be visible to viewers on the nearest beach. The taller CVOW-C Project WTGs would result in increased numbers of WTGs visible in the wind farm. Such additional WTGs would be seen as lower than or below the tops of the forward row of WTGs and would be increasingly obscured by those intervening in the view. The wind farm would be perceived as a mass of WTGs, rather than as individual WTGs.

As described under the IPF for light, the Virginia and North Carolina shore within the viewshed of the WTGs is 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 currently available studies, portions of the 190 WTGs 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: Future offshore wind project construction and decommissioning and, to a lesser extent, future offshore wind project operation would generate increased vessel traffic that could inconvenience recreational vessel traffic in the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the future offshore wind construction areas.

Vessel traffic for two planned projects in the geographic analysis area (Kitty Hawk Offshore Wind Projects) is not known but is anticipated to be similar to that of the Proposed Action, which is projected to generate an average of 46 daily vessel trips between ports and offshore work areas over the entire construction phase and a maximum of 95 vessel trips daily during peak construction activity (COP, Section 3.4.1.5; Dominion Energy 2023). As shown in Appendix F, Table F-3, between 2024 and 2030 two offshore wind projects (not including the Proposed Action) could be under construction simultaneously (in 2024–2027). During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 46 vessel trips daily from Atlantic Coast ports to worksites along the Virginia and North Carolina Lease Area, with as many as 95 vessels present (either underway or at anchor) during times of peak construction.

Establishment of two future offshore wind projects could occur in the Geographic Analysis Area between 2024 and 2030. O&M activities for the project are anticipated to generate an average of 46 vessel trips per day between a port and the Wind Farm Areas. Based on the estimates for the proposed projects, the cumulative No Action Alternative would generate an average of 46 vessel trips per day.

Increased vessel traffic would require increased alertness on the part of recreational or tourist-related vessels and would result in minor delays or route adjustments. The likelihood of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. The possibility of delays and risk of collisions would increase if more than one future offshore wind facility is under construction at the same time. Vessel traffic associated with future offshore wind would have long-term, variable, adverse impacts on vessel traffic related to recreation and tourism. Higher volumes during construction would result in greater inconvenience, disruption of the natural marine environment, and risk of collision. Vessel traffic during operations would represent only a modest increase in the background volumes of vessel traffic, with minimal impacts on recreational vessels.

3.18.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, recreation and tourism would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent, **minor** impacts on recreation and tourism.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and recreation and tourism would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on recreation and tourism due to noise, presence of structures, vessel traffic, and port utilization from increased onshore and offshore construction and operation.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing impacts on recreation and tourism. BOEM anticipates that the impacts of ongoing activities, including ongoing vessel traffic and the noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, or offshore cables, would be **negligible**. In addition to ongoing offshore wind activities, planned activities other than offshore wind may also contribute to impacts on recreation and tourism. Offshore activities other than offshore wind would have localized, temporary impacts on recreational boating and would not affect the area's scenic quality. BOEM anticipates that the impacts of planned activities other than offshore wind would be **minor**. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor** impacts on recreation and tourism, driven primarily by marine construction and dredging to install and maintain offshore cables, piers, seawalls, and harbors.

Considering all of the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area combined with ongoing activities, reasonably foreseeable environmental trends, and planned activities other than offshore wind would result in **minor** adverse impacts and **minor beneficial** impacts. Future offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and vessel traffic during construction and the presence of offshore structures during operations. Noise and vessel traffic would have impacts on visitors, who may avoid onshore and offshore noise sources and vessels, and on 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 constraints and risks, potential entanglement and loss, and visual impacts from offshore structures. BOEM also anticipates that the future offshore wind activities in the geographic analysis area would result in **minor beneficial** impacts due to the presence of offshore structures and scour protection, which could provide opportunities for fishing and sightseeing.

3.18.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *Project Design Envelope and Maximum-Case Scenario*) 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.
- The arrangement of WTGs, as it affects accessibility of the Wind Farm Area to recreational boaters.
- The time of year during which onshore and nearshore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Below is a summary of potential variances in impacts.

- **WTG number, size, location, and lighting:** More WTGs and larger, 16-MW turbines located within the Lease Area but 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.

- **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.

3.18.5 Impacts of the Proposed Action on Recreation and Tourism

The Proposed Action would have long-term, minor impacts on recreation and tourism in the geographic analysis area due to the visual impact of the up-to 202 WTGs from coastal locations and the greater navigational risks for recreational vessels in the Wind Farm Area. It would also have long-term, minor beneficial impacts due to the fish aggregation effects associated with the WTGs and OSSs, resulting in new fishing and sightseeing opportunities. The Proposed Action would have short-term, minor impacts during construction due to the temporary impacts of noise and vessel traffic on recreational vessel traffic, the natural environment, and species important for recreational fishing and sightseeing.

Anchoring: Anchoring by construction and maintenance vessels would contribute to disturbance of marine species and inconvenience recreational vessels that must navigate around the anchored vessels. The Proposed Action would generate an average of 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods in the Wind Farm Area (COP, Section 3.4.1.5; Dominion Energy 2023). BOEM anticipates that USCG may establish temporary safety zones around offshore wind construction areas, which would minimize the potential for recreational boater interaction with anchored construction vessels in these areas. Vessel anchoring for construction of the Proposed Action would have localized, short-term, minor impacts on tourism and recreation due to the need to navigate around vessels and work areas and the disturbance of species important to recreational fishing (COP, Sections 4.2.4.3 and 4.4.9.2; Dominion Energy 2023).

Land disturbance: Onshore construction and installation of the export cables would affect recreation and tourism where construction activity interferes with access to recreation sites or increases traffic, noise, or temporary emissions that degrade the recreational experience.

The entirety of the 46.48 acres (18.8 hectare) footprint of the proposed Harpers Switching Station would overlap with the Aeropines Golf Club in Virginia Beach, Virginia. Within that footprint, the relocation of fairways and a maintenance building would occur on 6.1 acres (2.5 hectares). Construction of the switching station would result in a temporary disruption of access to these facilities until they are relocated. Another golf course, the Battlefield Golf Club, is adjacent to the existing Fentress Substation in Chesapeake, Virginia. Construction activities to upgrade the Fentress Substation may result in temporary impacts on the golf course, such as increases in traffic, noise, or temporary emissions; however, no long-term, permanent impacts on nearby recreational facilities are anticipated. Additionally, construction of the onshore interconnection cable along Dam Neck Road could result in temporary, construction-related impacts on the Princess Anne Athletic Complex in Virginia Beach, Virginia. Because the onshore interconnection cable corridor would use existing ROW to the maximum extent possible and the Princess Anne Athletic Complex is set off the road, long-term impacts are not anticipated.

As discussed in Section 3.11, *Demographics, Employment, and Economics*, the employment and economic impact would be localized, short term, and minor. As discussed in Section 3.14, *Land Use and Coastal Infrastructure*, technologies may be used to minimize impacts on land disturbance. Dominion Energy has committed to implementing a construction schedule to minimize activities in the onshore export cable route during the peak recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction, to the extent practicable (COP, Section 4.4.3.3; Dominion Energy 2023). These measures would minimize impacts on recreation and tourism from construction activities.

Light: When nighttime construction occurs, the vessel lighting for vessels traveling to and working at the Proposed Action's offshore construction areas may be visible from onshore locations depending on the distance from shore, vessel height, and atmospheric conditions. Visibility would be sporadic and variable. Although most construction is expected to occur during daylight hours, construction vessels would use work lights to improve visibility during night or poor visibility, in accordance with USCG requirements.

During operations, the Proposed Action would have a discrete contribution to nighttime visibility of the WTGs due to required aviation hazard lighting. FAA lighting from all of the Proposed Action's WTGs could be visible up to 36.2 miles away depending on weather and viewing conditions (COP, Section 4.3.4.3; Dominion Energy 2023). Dominion Energy has committed to implementing ADLS as an APM that would activate the Proposed Action's WTG lighting only when aircraft approach the WTGs (COP, Section 4.3.4.3; Dominion Energy 2023). The implementation of ADLS would reduce the duration of the potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. During times when the Proposed Action's aviation warning lighting is visible, this lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. Due to the limited duration and frequency of such events and the distance of the Proposed Action's WTGs from shore, visible aviation hazard lighting for the Proposed Action would result in a long-term, intermittent, negligible impact on recreation and tourism. Onshore, Dominion Energy would implement lighting-reduction measures, such as downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent practicable (COP, Section 4.2.2.3; Dominion Energy 2023).

New cable emplacement and maintenance: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism. The Proposed Action would require up to 416.9 miles (671 kilometers) of total length of offshore export cables and up to 300 miles (484 kilometers) total length of inter-array cables (COP, Section 1.2, Table 1.2-1; Dominion Energy 2023). Array cable installation would require a maximum of 10 vessels (three main laying, two burial, four support vessels, and one post-installation survey vessel) (COP, Section 3.4.1.5; Dominion Energy 2023). Offshore export cable installation would require a maximum of 11 vessels (three main laying, three main cable jointing, three burial, and two support vessels) (COP, Section 3.4.1.5; Dominion Energy 2023). Recreational vessels traveling near the offshore export cable routes would need to navigate around vessels and access-restricted areas associated with the offshore export cable installation. Dominion Energy has committed to coordinate with USCG through the use of Local Notices to Mariners to communicate with recreational fishers, among others, of construction and maintenance activities and vessel movements, which would minimize potential adverse impacts associated with cable emplacement and maintenance activity (COP, Section 4.4.7.3; Dominion Energy 2023). The localized, temporary need for changes in navigation routes due to Proposed Action construction would constitute a minor impact.

Cable installation could also affect species of interest for recreational fishing and sightseeing through turbidity resulting from cable installation, although species would recover upon completion (Sections 3.19, *Sea Turtles*, and 3.16, *Navigation and Vessel Traffic*), resulting in localized, short-term, minor impacts on recreation and tourism (COP, Sections 4.2.4.3, 4.2.5.2, and 4.4.6.3; Dominion Energy 2023).

Specific cable locations associated with future offshore wind projects have not been identified in the geographic analysis area. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of cable emplacement and maintenance on recreational marine activities from ongoing and planned activities would likely be short term and minor.

Noise: Noise from O&M, pile driving, trenching, and vessels could result in impacts on recreation and tourism. Temporary impacts on recreation and tourism would result from impacts in the Wind Farm Area and along the offshore export cable route on species important to recreational fishing and marine sightseeing (COP, Sections 4.4.5.2, 4.1.5.3 and 4.2.4.3; Dominion Energy 2023). The temporary behavioral disruptions of offshore fish, shellfish, and whales due to startle responses or avoidance of the ensonified area during construction (Sections 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, and 3.15, *Marine Mammals*) would have a minor impact on recreational fishing or marine sightseeing.

In addition to the temporary disruption to fish and shellfish, noise generated by offshore construction and onshore cable installation would have impacts on the recreational enjoyment of the marine and coastal environments, with minor impacts on recreation and tourism. Offshore construction noise would occur from vessels, trenching, and pile driving along the offshore export cable route and in the Wind Farm Area. Noise from pile driving is estimated to produce sound power levels of 87 dBA in-air at 400 feet (122 meters) (COP, Section 4.1.4.2; Dominion Energy 2023). Where areas within or near the offshore export cable route and Wind Farm Area are available for recreational boating during construction, increased noise from construction would temporarily inconvenience recreational boaters.

Overall, construction noise from the Proposed Action alone would have localized, short-term, minor impacts on recreation and tourism. Offshore operational noise from the WTGs would be similar to the noise described for other projects under the No Action Alternative and would, therefore, have continuous, long-term, negligible impacts.

Port utilization: Within the geographic analysis area, the Proposed Action would use facilities at PMT and Newport News Marine Terminal to support the staging of components and construction vessels for the Project. Planned upgrades to the PMT will derive from roughly $8 billion of direct investment by Dominion Energy and a contribution of up to a $40 million from the Commonwealth of Virginia for site improvement and readiness (Chapter 2, *Proposed Action and Alternatives*; COP, Section 4.4.1.2; Dominion Energy 2023). Increased vessel traffic and construction activity during upgrades at PMT and Newport News Marine Terminal 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 Proposed Action's up-to 202 WTGs and three OSSs would affect recreation and tourism through increased navigational complexity; risk of allision or collision; attraction of recreational vessels to offshore wind structures for fishing and sightseeing; the adjustment of vessel routes used for sightseeing and recreational fishing; the risk of fishing gear loss or damage by entanglement due to scour or cable protection; and potential difficulties in anchoring over scour or cable protection.

Construction and installation, expected to begin in 2023 and be completed in 2027, would affect recreational boaters. Risk of allision with anchored vessels would increase incrementally during construction, because more anchored vessels would be in the geographic analysis area (Appendix F, Table F-3). Dominion Energy has committed to marking potential hazards in coordination with USCG, developing Local Notices to Mariners that would include locations of partially installed structures, and advising mariners of safety zones around all Offshore Project components, which would minimize potential adverse impacts associated with structure construction activities (COP, Section 4.4.7.2; Dominion Energy 2023). AIS data from 2019 show that there is typically very low recreational activity from craft/sailing vessels within and directly adjacent to the Lease Area (COP, Section 4.4.7.1; Dominion Energy 2023). In addition, sailing in the geographic analysis area primarily occurs nearshore, just along the coastline, rather than farther offshore (COP, Section 4.4.11.1; Dominion Energy 2023). Impacts would be mitigated through the use of navigation-related measures.

During O&M of the Proposed Action, the permanent presence of WTGs would create obstacles for recreational vessels. At their lowest point, WTG blade tips would be 82 feet (24 meters) above the surface (COP, Table 3.3-1; Dominion Energy 2023). At this height, larger sailboats would need to navigate around the Wind Farm Area, while smaller vessels could navigate unobstructed (except for the WTG monopiles).

Outside of avoiding certain operations during the construction phase, there are no planned or enforceable restrictions to vessels operating in the Wind Farm Area. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success. Between 2010 and 2019, 18 SAR incidents were recorded in the geographic analysis area: 14 involved material failure or malfunction while three involved injury to personnel. Also during this time were 26 SAR incidents in the export cable geographic analysis area: 10 involved material failure or malfunction and five involved personnel injury, four of which were considered serious incidents (COP, Appendix S, Section 9.1.2; Dominion Energy 2023).

Recreational anglers may avoid fishing in the Wind Farm Area due to concerns about their ability to safely fish within or navigate through the area. Navigational hazards and scour/cable protection due to the presence of structures from ongoing and planned activities, including the Proposed Action, would result in major adverse impacts on commercial fisheries and moderate adverse impacts on for-hire recreational fishing; minimal beneficial impacts on for-hire recreational fishing due to the artificial reef effect may be long term. BOEM does not anticipate that fish aggregation due to the presence of structures would result in considerable changes in fish distributions across the geographic analysis area. For-hire fishing operations are part of the recreation and tourism industry and are included in the impacts on recreational boating and fishing anticipated in this section. The detailed discussion of impacts on for-hire fishing activities provided in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, may also be applicable to impacts on recreational fishing in general. Overall, the impacts on recreational fishing, boating, and sailing generally would be negligible, while the impacts on for-hire fishing would be minor because these enterprises are more likely to be materially affected by displacement.

Although some recreational anglers would avoid the Wind Farm Area, the scour protection around the WTG foundations would likely attract forage fish and game fish, which could provide new opportunities for certain recreational anglers. Evidence from Block Island Wind Farm indicates an increase in recreational fishing near the WTGs (Smythe et al. 2018). The fish aggregation and reef effects of the Proposed Action could also create foraging opportunities for marine species and mammals, such as seals and harbor porpoises, possibly attracting recreational boaters and sightseeing vessels (Glarou et al. 2020). In addition, future offshore wind development could attract sightseeing boats offering tours of the wind facilities. 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 (COP, Sections 4.2.5.2, 4.4.11.2, and 4.4.6.3; Dominion Energy 2023).

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 would likely be the same: minor adverse impacts on recreational fishing, recreational sailing and boating, and for-hire recreational fishing, as well as minor beneficial impacts. A lack of a common turbine spacing and layout throughout all wind projects within the geographic analysis area could make it more difficult for SAR aircraft to perform operations in the Lease Area. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of offshore structures on marine recreational activities from ongoing and planned activities would be minor due to the increased number of offshore structures and reduction of SAR capacity based on the layout of the WTG and OSSs, and minor beneficial impacts would occur due to the opportunity for fishing and sightseeing provided by WTGs.

As it relates to visual impacts of presence of structures, the Proposed Action's 202 WTGs would also affect recreation and tourism through visual impacts. During construction, viewers in certain locations along the Virginia and North Carolina shore would see increased vessel traffic transporting components from fabrication and manufacturing facilities to the Project area. Vessel traffic is commensurate along the Atlantic Coast and vessel use for construction would be similar to existing vessel traffic in the area. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a temporary, negligible impact on recreation and tourism.

The WTGs would be in open ocean approximately 27 statute miles east of Virginia Beach. The maximum-case WTGs would have a height of 869 feet (265 meters) at the tip of the rotor blade, a hub height at 489 feet (149 meters) (COP, Appendix I-1, Figure I-1-2 and Section I-1.2.3; Dominion Energy 2023). At 31 miles (49.9 kilometers), the tip of the rotor blade (in the upright position) would be above the horizon line (COP, Appendix I-1, Section I-1.4.1; Dominion Energy 2023). Between 28.1 and 35.8 miles, only the WTG blades would be potentially visible above the horizon from the perspective of a beach-elevation viewer (COP, Appendix I-1, Section I-1.4.1, Figure I-1-7; Dominion Energy 2023). Dominion Energy has voluntarily committed to using ADLS and non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint colors as described in Appendix I, *Environmental and Physical Settings*, to reduce impacts. Additionally, the lower sections of each WTG would be marked with high-visibility (RAL Number 1023) yellow paint from the water line to a minimum height of 50 feet (15 meters) (COP, Appendix I-1, Section I-1.2.3; Dominion Energy 2023).

The visual impact of future offshore wind structures could affect recreation and tourism. The visual contrast created by the WTGs could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer's orientation, activity, and purpose for visiting the area. As discussed in Section 3.20, *Scenic and Visual Resources*, the magnitude of impact is defined by the contrast, scale of the change, prominence, field of view (FOV), viewer experience, geographical extent, and duration, correlated against the sensitivity of the receptor, as simulated from onshore KOPs. The seascape character units, open ocean character unit, landscape character unit, and viewer experiences would be affected during construction, 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 in Appendix M.

BOEM expects the impact of visible WTGs on the use and enjoyment of recreation and tourist facilities and activities during O&M of the Proposed Action to be long term, continuous, and minor. Beaches with views of WTGs could gain trips from the estimated 2.5 percent of beach visitors for whom viewing the WTGs would be a positive result, offsetting some lost trips from visitors who consider views of WTGs to be negative (Parsons and Firestone 2018).

Portions of 392 WTGs from the Proposed Action combined with future offshore wind projects could be visible from coastal and elevated locations in the geographic analysis area. The simulations prepared by Dominion Energy show anticipated views in clear conditions of future offshore wind projects associated with the No Action Alternative combined with the Proposed Action (COP, Appendix I, Attachment I-1-5; Dominion Energy 2023). The WTGs would be discernable on a clear day, with the color and irregular forms of the WTGs contrasting with the uninterrupted horizontal horizon line associated with the open ocean. As shown in the simulations, the Proposed Action WTGs would contribute the most from the closest locations, such as Virginia Beach. Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year (COP, Appendix I, Section I-1.4.1; Dominion Energy 2023).

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk, primarily during Project construction and decommissioning, along routes between ports and the offshore construction areas. The Proposed Action would generate an average of 46 and a maximum of 95 vessel trips during the construction period (COP, Section 3.4.1.5; Dominion Energy 2023).

Recreational vessels may experience delays within the ports serving construction (outside the geographic analysis area), but most recreational boaters in the geographic analysis area would experience only minor inconvenience from construction-related vessel traffic. Vessel travel requiring a specific route that crosses or approaches the offshore export cable routes could experience minor impacts (COP, Section 4.4.7.2; Dominion Energy 2023).

For regularly scheduled maintenance and inspections, Dominion Energy anticipates that, on average, the Proposed Action would generate approximately 46 trips daily. Operation of the Proposed Action would have localized, long-term, intermittent, minor impacts on recreational vessel traffic near ports and in open waters due to the periodic and limited nature of regularly scheduled maintenance. Impacts during decommissioning would be similar to the impacts during construction and installation.

Activities requiring repair of WTGs, equipment or cables, or 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. With implementation of the navigation-related APMs, the impacts of non-routine activities on recreation and tourism would be minor.

3.18.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

The contribution of the Proposed Action to the anchoring impacts on recreational boating from ongoing and planned activities would likely be localized, short term, and minor during the period in which offshore wind projects are being constructed in the geographic analysis area. A greater number of vessels would be anchored when multiple offshore wind projects are under construction at one time within the Lease Area, potentially resulting in minor impacts.

The exact extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for future offshore wind energy projects. Therefore, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined land disturbance impacts on recreation and tourism from ongoing and planned activities would be localized, short term, and minor, as impacts are expected to be similar to those of other common construction projects.

Future offshore wind projects could cause aviation hazard lighting from 190 additional WTGs (392 total WTGs, including the Proposed Action) to be potentially visible in the geographic analysis area. Without the use of ADLS, lighting from future offshore wind projects other than the Proposed Action would include red flashing lights on top of WTG nacelles and at the midpoint of WTG towers. In context of reasonably foreseeable environmental trends, ADLS would reduce the nighttime impact significance from minor to negligible due to substantially limited hours of lighting (COP, Section 4.3.4.3; Dominion Energy 2023).

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the noise impacts on marine recreational activities from ongoing and planned activities would likely be localized, short term, and minor during construction, and long term and negligible during operation.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to port utilization impacts on recreation and tourism from ongoing and planned activities would be negligible.

The combined visual impacts on recreation and tourism from ongoing and planned activities, including the Proposed Action, would likely be continuous, long term, and minor in the overall geographic analysis area, with minor impacts on the closest locations. Impacts would be reduced when atmospheric conditions limit the number of WTGs discernable from any one viewing location.

The Proposed Action is anticipated to be under construction concurrently with two other projects: Kitty Hawk Offshore Wind North and South, OCS-A 0508. During anticipated concurrent construction periods, construction vessel traffic would increase between the proposed ports and the Lease Areas or cable installation work areas associated with each wind project, requiring increased alertness on the part of recreational or tourist-related vessels, and possibly resulting in a greater number of minor delays or route adjustments. The risk of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. Modest levels of vessel traffic are anticipated from offshore wind operations (COP, Section 4.4.7.2; Dominion Energy 2023). In context of reasonably foreseeable environmental trends, combined vessel traffic impacts on recreation and tourism from ongoing and planned activities, including the Proposed Action, would be short term, variable, and minor during construction and long term, intermittent, localized, and negligible during operations.

3.18.5.2 Conclusions

Impacts of the Proposed Action. In summary, the impacts resulting from individual IPFs associated with the Proposed Action alone would range from **negligible** to **minor** and **negligible** to **minor beneficial**. Impacts would result from short-term impacts during construction: noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs; and the long-term presence of scour protection and structures in the Wind Farm Area during operations, with resulting impacts on recreational vessel navigation and visual quality. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures.

Cumulative impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **minor** with **negligible** to **minor beneficial** impacts. Considering all of the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the impacts associated with ongoing and planned activities would result in **minor** impacts with **minor beneficial** impacts. The main drivers for this impact rating are the minor visual impacts associated with the presence of structures and lighting; impacts on fishing and other recreational activity from noise, vessel traffic, and cable emplacement during construction; and beneficial impacts on fishing from the reef effect.

3.18.6 Impacts of Alternatives B and C on Recreation and Tourism

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. The impacts of Alternatives B and C on recreation and tourism would be the same as those of the Proposed Action except for the impact of the presence of structures. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives B and C would be similar to those described under the Proposed Action. Construction of Alternative B or C would install fewer WTGs—up to 176 WTGs (inclusive of three spare WTG positions)—and construction of Alternative C would install up to 172 WTGs (inclusive of two spare WTG positions) and their associated inter-array cables, which would reduce the construction impact footprint and installation period. Turbine sizes under Alternatives B and C would also be reduced by using only 14-MW WTGs, whereas the Proposed Action would allow for up to 16-MW WTGs. Alternatives B and C would also align the three OSSs with the common grid layout of the

WTGs, similar to the Proposed Action. Lastly, Alternative C would also allow for the removal of four WTGs within priority sand ridge habitat as well as the relocation of one WTG and associated inter-array cables. The removal and relocation of these WTGs would allow for a reconfiguration of inter-array cabling to minimize linear seafloor impacts on priority sand ridge habitat. All other design parameters and potential variability in the design would be the same as under the Proposed Action.

The removal of structures under Alternative B to avoid the Fish Haven area and under Alternative C to further avoid priority sand ridge habitats would decrease the risk of recreational or commercial fishing gear loss or damage due to entanglement on the scour protection and inter-array and export cable hard protection. Navigation would also be improved and the risk of allisions or collisions with other vessels would be reduced by aligning the three OSSs with the common grid layout of WTGs. Though minimized, the risk of allision and collisions would still exist under Alternatives B and C and could discourage recreational boaters traveling to and through the Wind Farm Area.

The exclusion zone would minimize impacts on commercial and recreational fisheries resources in the area. Fishing activities could continue, and mobile target species would be less likely to be displaced by construction noise and presence of structures. However, recreational fishing could see a slight decrease in fish due to fewer structures providing reef habitat for targeted species.

Construction of fewer WTGs proposed under Alternatives B and C would result in fewer vessels and vessel trips during construction as compared to the Proposed Action, 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 3.15, *Marine Mammals*, and 3.19, *Sea Turtles*).

Alternative C's avoidance of priority sand ridge habitats in the southern portion of the Lease Area would protect soft-bottom habitat and benthic species of interest from disturbance, injury, or mortality; reduce changes in water quality; and reduce underwater noise and vibration during construction. Alternative C would also avoid shipwrecks, which may be of interest to recreational divers.

The removal of 29 WTGs for Alternative B and 33 WTGs for Alternative C would result in negligible impacts on the viewshed from the shore when compared to the Proposed Action. As described in Section 3.20, *Scenic and Visual Resources*, the visual differences between the WTG array of Alternatives B and C and the Proposed Action WTG array would not be noticeable to the casual viewer standing on the Virginia Beach oceanfront and would not have a substantive effect on recreation and tourism.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts from ongoing and planned activities would be the same as under the Proposed Action.

3.18.6.1 Conclusions

Impacts of Alternatives B and C. Alternatives B and C would reduce the overall offshore footprint of the Project. Alternatives B and C would remove WTG positions without relocation and reduce turbine sizes, slightly reducing the visual impact of WTGs and reducing the impacts associated with construction and installation, O&M, and decommissioning. Alternatives B and C would also exclude the Fish Haven area in the northern portion of the Lease Area to reduce impacts on fisheries resources. Alternative C would avoid complex habitat through micrositing and relocation and removal of structures. Accordingly, the impacts resulting from individual IPFs associated with Alternatives B and C would be reduced in comparison to the impacts associated with the Proposed Action but would not change the overall impact magnitudes, which are anticipated to be short term and range from **negligible** to **minor** and **negligible** to **minor beneficial** on recreation and tourism.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **minor** adverse impacts with **negligible** to **minor beneficial** impacts.

3.18.7 Impacts of Alternative D on Recreation and Tourism

Impacts of Alternative D. Alternative D would have the same number of WTGs and the same offshore cable route as the Proposed Action and, therefore, the same anticipated impacts on offshore recreation and tourism. Alternative D has two potential cable routes. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). Alternative D-2 would follow the same route as Interconnection Cable Route Option 6, except for the switching station. Alternative D-1 would be installed entirely overhead. The overall length of Alternative D-1 and Alternative D-2 would be the same (14.3 miles [23.0 kilometers]). However, portions of Alternative D-2 would be installed via underground methods, while Alternative D-1 would be installed entirely overhead.

The Chicory Switching Station associated with Alternative D-2, Interconnection Cable Route Option 6, would cover a larger operational footprint than the Harpers Switching Station; however, this is not anticipated to result in additional impacts on recreation and tourism. Trenching required for underground installation of portions of the interconnection cable route under Alternative D-2 may have potential short-term implications for recreational beach users, such as temporary beach closures. No long-term implications are anticipated. Therefore, land disturbance and visual impacts associated with recreational activities and tourism from interconnection cable construction and operation would be slightly less under Alternative D in comparison to the Proposed Action. Overall, the differences in impacts on recreation and tourism between Alternative D and the Proposed Action would be negligible.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.18.7.1 Conclusions

Impacts of Alternative D. No long-term implications are anticipated. Therefore, land disturbance and visual impacts associated with recreational activities and tourism from interconnection cable construction and operation would be slightly less under Alternative D in comparison to the Proposed Action. Overall, the differences in impacts on recreation and tourism between Alternative D and the Proposed Action would be negligible.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action: short-term impacts ranging from **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts. The overall impacts of Alternative D combined with ongoing and planned activities on recreation and tourism would be the same as the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts.

3.18.8 Agency-Required Mitigation Measures

The mitigation measure listed in Table 3.18-2 is recommended for inclusion in the Preferred Alternative.

Table 3.18-2 Additional Agency-Required Measures: Recreation and Tourism[1]

Measure	Description	Effect
Lighting	Dominion Energy will comply with BOEM's detailed Lighting and Marking Guidelines and NPS sustainable lighting best practices.	Compliance with BOEM's lighting and marking guidelines and NPS sustainable lighting best practices could reduce the impact of the Proposed Action on onshore parks and wildlife refuges where nighttime dark sky is a defining characteristic.

[1] Also Identified in Appendix H, Table H-3.

3.18.8.1 Effect of Measures Incorporated into the Preferred Alternative

No mitigation measures for recreation and tourism are required through completed consultations, authorizations, or permits as listed Appendix H, *Mitigation and Monitoring*, Table H-2. BOEM has identified the following additional mitigation measure in Table 3.18-2 and Appendix H, Table H-3 as incorporated in the Preferred Alternative: Lighting. If adopted, this mitigation measure would require Dominion Energy to comply with BOEM's detailed Lighting and Marking Guidelines and NPS sustainable lighting best practices. This mitigation measure has the potential to reduce impacts described under the Light IPF for the Proposed Action. If implemented, this mitigation measure could reduce the impact of WTG lighting on onshore parks and wildlife refuges where nighttime dark sky is a defining characteristic of the park and would be distributed by the Proposed Action.

3.19 Sea Turtles

This section discusses potential impacts on sea turtles likely to be present in the proposed Project area resulting from the Proposed Action, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area. The sea turtle geographic analysis area, as shown on Figure 3.19-1, encompasses two LMEs, namely the Northeast U.S. OCS and Southeast U.S. OCS LMEs. These LMEs capture most of the movement range of sea turtles within the U.S. Atlantic Ocean waters. Due to the large size of the geographic analysis area, analysis in this EIS focuses 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).

3.19.1 Description of the Affected Environment for Sea Turtles

This section discusses potential impacts on sea turtle species from the proposed Project, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.19-1. The geographic analysis area for sea turtles includes LMEs along the Northeast and Southeast Atlantic OCS that capture the majority of habitats in the United States and movement for sea turtle species.

This section also summarizes information on sea turtles occurring offshore Virginia that is provided in the COP (Section 4.2.6, Appendix R, Table 4.2-26, Figure 4.2-37; Dominion Energy 2023) as well as BOEM wind project documents (e.g., BOEM 2012, 2014), the *Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf* (Baker and Howsen 2021), the Ocean Biodiversity Information System (OBIS 2021), and the most recent recovery plans and 5-year reviews available for each species. The CVOW-C COP (Dominion Energy 2023) Section 4.2.6.1 provides detailed descriptions of sea turtle occurrence, ecology, and distribution within the Project area; these sections may be incorporated by reference within this analysis or summarized, as applicable, for the effects determinations presented in the EIS. Information applicable to the analysis but not included in the COP is also provided in this section.

Five sea turtle species have reported occurrences along the East Coast in both coastal and offshore waters. They are the loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and hawksbill sea turtle (*Eretmochelys imbricata*). All five species are listed as either threatened or endangered under the Endangered Species Act and are also identified as threatened or endangered by Virginia Department of Wildlife Resources (2021a).

Except for the polar regions, sea turtles occupy all oceans, with higher densities and most nesting occurring in tropical and subtropical seas and foraging well into temperate regions. Sea turtles can remain underwater for extended periods, which allows them to spend as little as 3 to 6 percent of their time at the water surface (Lutcavage et al. 1997; NSF and USGS 2011). However, sea turtles may remain at the surface for long periods of time resting or basking. Freitas et al. (2019) found that tagged juvenile loggerhead sea turtles spent roughly one third of the time at the surface (0 to 3 feet [0 to 1 meter] deep), specifically, spending 43 percent of the time at the surface during the day and 29 percent of the time during the night. Therefore, while sea turtles have the capability for spending long periods submerged, dive patterns will vary with activity, temperature, life stage, and environment. Sea turtles in the Atlantic often travel long distances between temperate foraging areas, offshore nursery areas, and tropical or sub-tropical nesting beaches (Cailouet et al. 2020; Evans et al. 2019; Mansfield et al. 2021; Meylan 1995; Patel et al. 2021), making them a common fauna group found in offshore and nearshore environments of Virginia.

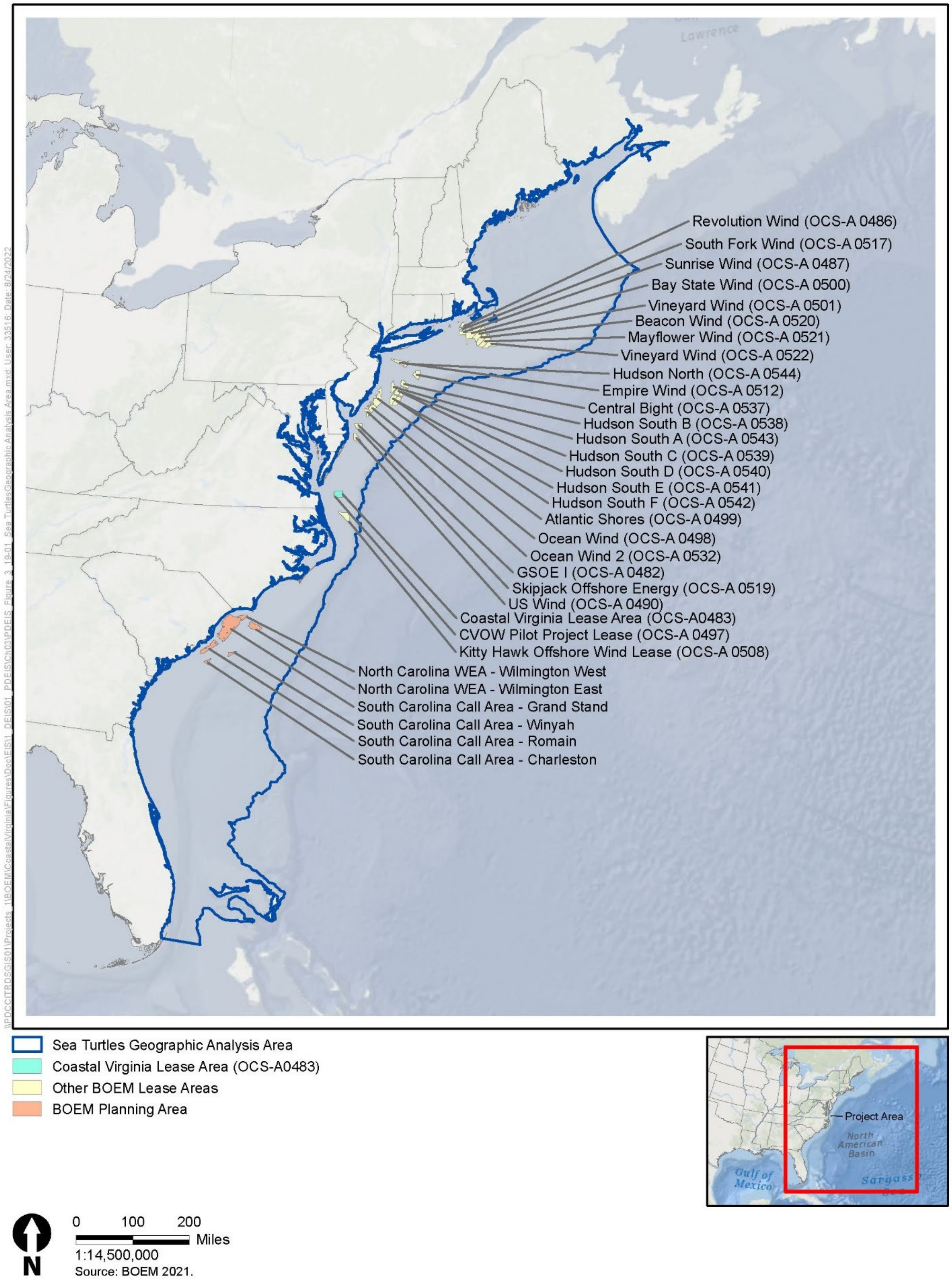


Figure 3.19-1 Sea Turtles Geographic Analysis Area

Sea turtle species distribution and presence in the Project area are summarized in Table 3.19-1 based on a review of protected species observer data, the NMFS sea turtle directory, Ocean Biodiversity Information System data (OBIS 2021), USFWS information for planning and consultation (USFWS 2021), VDWR (2021b) information, the Virginia Natural Heritage Data Explorer (Virginia Department of Conservation and Recreation 2021), and other available reports and literature.

The species most likely to occur in the Project area are loggerhead, Kemp's ridley, leatherback sea turtles, and green sea turtles. Visual survey and PSO sightings data indicate loggerhead and leatherback sea turtles are expected to be most common in waters offshore Virginia, while Kemp's ridley and green, though seen regularly, are observed in lower numbers offshore (COP, Section 4.2.6.1; Dominion Energy 2023; OBIS 2021; Virginia Institute of Marine Science 2021). Only two records of hawksbill sea turtles have been reported offshore Virginia since 1979 and they were considered an extralimital occurrence (Virginia Institute of Marine Science 2021). Hawksbill sea turtles typically prefers tropical habitats and occurrence in Virginia's offshore waters is considered extralimital (COP, Section 4.2.6.1, Dominion Energy 2023; OBIS 2021; Virginia Institute of Marine Science 2021).

There is no designated sea turtle critical habitat offshore Virginia (NMFS 2021), although sargassum critical habitat for loggerhead sea turtles extends into oceanic waters east of Virginia, beyond the OCS. Loggerhead sea turtles are commonly documented nesting in Virginia (Parker 2020), but there have been documented records of green sea turtles nesting in Croatan Beach in July 2021 just south of Virginia Beach (Croatan Civic League 2021), and records of green and Kemp's ridley sea turtles nesting or attempting to nest on Dam Neck Annex Beach just south of Virginia Beach starting around 2015 (Wright 2015; Wollam 2023). In cooler months when sea turtles face the risk of colder water temperatures decreasing their overall body temperature, sea turtles will spend significant time basking at the water surface to counteract this effect (Sapsford and van der Riet 1979; Dodge et al. 2014; Freitas et al. 2019). Lower water temperatures can also result in cold stunning of turtles, which causes them to become lethargic and float to the surface, making them more vulnerable to predators, anthropogenic effects, and strandings (NMFS 2021). Although these cold stunning events typically occur in coastal and inshore waters, temperature conditions anywhere in the Project area may affect sea turtle surface activities. Therefore, during cooler sea temperatures in the temperate ocean conditions offshore Virginia, sea turtles can raise their body temperatures by basking at the water surface, which may make them more vulnerable to vessel strikes. However, there is limited published data regarding basking behavior in all species of sea turtles in relation to sea temperatures or air temperatures. Published data that are available show more surface basking behavior off Nova Scotia than in Massachusetts (Dodge et al. 2014), inferring potentially more frequent or longer surface periods with increasing latitude. This suggests that while sea turtles may be more available for vessel strike in northern waters during cold conditions, this may not hold true for more temperate waters off Virginia.

Sea turtles are wide-ranging and long-lived, making population estimates difficult; population abundance estimation and visual survey methods vary depending on species and location (TEWG 2007; NMFS and USFWS 2013, 2015, 2019). Nesting data are widely used to estimate abundance, though nesting data may lag significantly in representing population increases or decreases. Leatherback sea turtle regional nesting trends were negative across three different temporal scenarios and became more negative as the time series became shorter (Northwest Atlantic Leatherback Working Group 2018).

Table 3.19-1 Presence, Distribution, and Population Status of Sea Turtle Species Known to Occur in Coastal and Offshore Waters of Virginia Around the Project Area

Common Name	Scientific Name	Distinct Population Segment	Estimated Population Abundance	Distribution Around Project Area	Relative Occurrence in Project Area[1]	Seasonality	Federal Population Status	Virginia Population Status
Loggerhead sea turtle	*Caretta caretta*	Northwestern Atlantic	588,000	Throughout; offshore and nearshore	Common	Year-round	Threatened	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	N/A	65,000	Predominantly offshore	Common	Year-round	Endangered	Endangered
Green sea turtle	*Chelonia mydas*	North Atlantic	215,000	Predominantly nearshore	Uncommon	Year-round	Threatened	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	N/A	284,300	Predominantly nearshore	Common	Year-round	Endangered	Endangered
Hawksbill sea turtle	*Eretmochelys imbricata*	N/A	19,000	Extralimital	Extralimital	Spring/Summer	Endangered	Endangered

N/A = not applicable to species.
[1] Relative occurrence defined as:

- Common: Project area within typical range of the species, and species sightings are regularly documented.
- Uncommon: Project area within typical range of the species, but species sightings are only occasionally documented.
- Extralimital: Project area considered outside the typical range of the species, and few species sightings have been documented.

For loggerhead sea turtle, progress toward recovery has been made since publication of the *2008 Loggerhead Sea Turtle Recovery Plan*, but recovery units have not met most of the critical benchmark recovery criteria (NMFS and USFWS 2019). Recent models indicate a persistent reduction in survival, recruitment, or both to the nesting population of Kemp's ridley sea turtle, suggesting that the population is not recovering to historical levels (NMFS and USFWS 2015). The most recent status review for the North Atlantic distinct population segment of green sea turtle estimates that nesting trends are generally increasing (Seminoff et al. 2015). However, a study by Ceriani et al. (2019) has indicated that using nest counts as a direct proxy for adult female population status can be misleading and is not evidence of a strong population recovery.

In addition to the complexity relating nesting trends to population trends, sea turtles can also have large geographic ranges that may vary by life stage or season; therefore, trends in one region may not fully reflect species distribution or occurrence within the specific Project area. The current conditions and trends of sea turtle populations are affected by factors present in the geographic analysis area, but key details about sea turtle foraging and nesting that are important to assessing sea turtle impacts within the specific Project area include the following:

- Loggerhead sea turtle:
  - Predominantly carnivores that feed on a variety of floating prey during their open ocean life phase as hatchlings and young juveniles; they feed mainly on benthic species such as whelks, other mollusks, horseshoe crabs, and decapod crabs during their late juvenile and adult phases when they have migrated to nearshore coastal habitats (NMFS 2021).
  - Primary nesting habitats in the United States are in Florida, Georgia, South Carolina, and North Carolina, but nests have been observed on beaches in Virginia, Maryland, and Delaware (Bies 2018; Parker 2020; Pomeroy 2020).
  - No critical habitat has been designated for this species in or near the Project area, but their *Sargassum* critical habitat occurs beyond the OCS from Florida to New Jersey over deeper waters of the continental slope, migratory critical habitat has been identified off the coast of North Carolina, overwintering critical habitat has been identified in offshore southern North Carolina, breeding critical habitat has been identified in offshore Florida, and there are areas of nearshore reproductive critical habitat extending from Florida to North Carolina (NMFS 2021).
- Kemp's ridley sea turtle:
  - Hatchlings inhabit the open ocean where they use *Sargassum* algae as a refuge to rest and forage on small animals and plants; adults travel to nearshore coastal areas where their preferred prey are crab species (NMFS 2021).
  - The main nesting habitat for this species is in the Gulf of Mexico; however, they have also been observed nesting in coastal areas of Georgia, South Carolina, and North Carolina, as well as the Atlantic coast of Florida (NMFS 2021). Though rare, there have been a few Kemp's ridley nests reported in Virginia since 2012 (Virginia State Parks 2012; USFWS 2012; Wright 2015; Wollam 2023).
  - The Chesapeake Bay estuary system supports one of the largest non-nesting populations of Kemp's ridley sea turtle in the world during summer months (VIMS 2023).
  - No critical habitat has been designated for this species.
- Leatherback sea turtle:
  - Preferred prey include soft-bodied animals such as jellyfish and salps (NMFS 2021).

  - In the western Atlantic, leatherbacks nest from North Carolina to Brazil. In the U.S., leatherbacks nest almost exclusively on the east coast of Florida (Florida Fish and Wildlife Commission 2023).
  - Critical habitat has been designated for this species around their main nesting habitat in the U.S. Virgin Islands (NMFS 2021).
- Green sea turtle:
  - Green sea turtles are the only herbivorous species feeding mainly on seagrass, although they will occasionally feed on sponges and invertebrates (NMFS 2021).
  - The primary nesting habitats for green sea turtles are in Costa Rica, Mexico, Cuba, and the Southeast U.S. including Florida, Georgia, South Carolina, and North Carolina (NMFS 2021). Though rare, there have been reports of green sea turtles nesting in Virginia (Croatan Civic League 2021; Wollam 2023).
  - Critical habitat has been designated for this species off Puerto Rico outside the Project area (NMFS 2021).
- Hawksbill sea turtle:
  - Hawksbills are omnivorous foragers whose preferred prey in most habitats are sponges, but they will also prey on marine algae, bivalves, and crustaceans (NMFS 2021).
  - Primary nesting habitats are in the Caribbean; nesting events for this species in the U.S. are rare and have been limited to southeast Florida and the Florida Keys (NMFS 2021).
  - Critical habitat has been designated for this species off Puerto Rico outside the Project area (NMFS 2021).

Risks to sea turtle populations include fisheries bycatch, marine debris, habitat loss, vessel traffic, underwater noise, EMFs, and artificial lighting, but fisheries bycatch, marine debris, and vessel traffic are the three IPFs that are most likely to affect population viability (NMFS 2021; NMFS and USFWS 2013, 2014, 2015, 2019). Globally, entanglement in and ingestion of human-made debris is a substantial threat to sea turtles and it is believed that entanglements are underestimated (i.e., not all are reported) (Duncan et al. 2017). Research by Duncan et al. (2017) estimated that globally, over 1,200 entangled sea turtles are encountered per year with just over a 90 percent mortality rate. Commercial fisheries operating in the geographic analysis area include bottom trawl, midwater trawl, dredge, gillnet, longline, and pots and traps. Commercial vessel traffic in the region is variable depending on location and vessel type.

3.19.2 Environmental Consequences

3.19.2.1 Impact Level Definitions for Sea Turtles

Definitions of impact levels are provided in Table 3.19-2.

Table 3.19-2 Impact Level Definitions 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.

Impact Level	Impact Type	Definition
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 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 that would likely be recoverable and would not affect the continued existence of any population or DPS.
	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.

3.19.3 Impacts of the No Action Alternative on Sea Turtles

When analyzing the impacts of the No Action Alternative on sea turtles, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore 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 F.

3.19.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for sea turtles described in Section 3.19.1, *Description of the Affected Environment for Sea Turtles*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned non-offshore wind activities. The primary IPFs for sea turtles within the geographic analysis area are generally associated with noise and vessel strikes, the presence of structures, and ongoing climate change. Fuel spills and releases of trash and debris have lesser potential impact on sea turtles due to their low probability of occurrence and relatively limited spatial impact. Land use and coastal development affect sea turtles mostly through habitat loss from development near sea turtle nesting areas, which occur outside of the Project area. Specific non-offshore wind activities that may affect sea turtles include commercial fisheries bycatch; ingestion of or entanglement in marine debris; marine transportation (vessel strikes); military use; oil and gas activities; undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; dredging and port improvement; marine mineral use and ocean dredged material disposal; and global climate change (see Appendix F, Section F.2, for a complete description of ongoing and planned activities). Most of these activities would only likely result in temporary displacement and behavioral changes; however, vessel strikes and entanglement in marine debris could result in potential injury or mortality of individuals. Global climate change could also result in population-level impacts on sea turtle species by displacement of prey species, changes in sea temperatures and circulations, changes in *Sargassum* abundance or distribution, fisheries displacement, and changes to sex determination ratios on nesting beaches, all of which may alter population dynamics and mortality rates.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include:

- Continued O&M of the Block Island 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 construction and O&M of the Block Island and CVOW-Pilot 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 traffic that are described in detail in Section 3.5.3.2 for planned offshore wind activities, but the risk of impacts would cover a smaller spatial and temporal scale given the relative number of ongoing projects compared to the planned offshore wind projects.

3.19.3.2 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).

Under the No Action Alternative, BOEM would not approve Dominion Energy's COP and impacts from IPFs during construction, operation, and maintenance directly associated with the Project would not occur. Existing environmental trends within the geographic analysis area would continue, potentially influenced by the development of planned future activities on the OCS and associated coastal areas over the coming decade. These include other offshore wind and renewable energy projects, and potential port improvements to support the development of this industry regionwide (see Appendix F).

BOEM expects future offshore wind activities to affect sea turtles through the following primary IPFs: accidental releases, discharges, EMFs, new cable emplacement/maintenance, noise, port utilization, the presence of structures, and vessel traffic. Offshore wind activities have the potential to produce impacts from site characterization studies, site assessment data collection activities that involve installation of meteorological towers or buoys, and installation and operation of turbine structures.

This section provides a general description of the IPF mechanisms resulting from future offshore wind development within the sea turtle geographic analysis area. However, the extent and significance of potential effects on cumulative conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed or permitted. Where appropriate, potential effects resulting from future offshore wind development activities are characterized through comparison to effects resulting from the Proposed Action that are likely to be similar in nature or significance. The intent of this section is to provide a general overview of how future activities might influence future environmental conditions. Should any or all of the future activities described in Appendix F proceed, each would be subject to independent NEPA analyses of environmental effects and regulatory approvals.

Accidental releases: Trash and debris or water quality contaminants could be accidentally released as a result of increased human activity associated with future offshore wind development activities. All species of sea turtles have been documented ingesting plastic debris (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016), as well as a variety of other anthropogenic waste (Tomás et al. 2002), likely mistaking debris for potential prey items (Schyuler et al. 2014). Ingesting trash or exposure to aquatic contaminants could result in lethal or sublethal effects including depressed immune system function; poor body condition; and reduced growth rates, fecundity, and reproductive success (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Additionally, entanglement in lost fishing gear and other marine debris is the primary anthropogenic cause of mortality in both juvenile and adult sea turtles (NMFS 2023a; National Research Council 1990 as cited in Shigenaka et al. 2010). Furthermore, accidental releases of contaminants may indirectly affect sea turtles through effects on prey species (see Section 3.13.1.1 for more details). Recognizing these risks, all vessels associated with offshore wind development projects would comply with USCG regulations and BOEM regulations designed to avoid and minimize accidental release of trash, debris, or other contaminants. Therefore, the release of solid trash or other debris into offshore waters would be extremely rare, and potential impacts from released trash and debris, though possibly injurious on an individual level, would not affect species on the population level. Each project would also be expected to have its own oil spill response plan to implement in the case of accidental releases. Therefore, potential accidental release volumes would not appreciably contribute to adverse impacts on sea turtles, and no population-level impacts are expected for any species.

Electromagnetic fields: Under the No Action Alternative, the future development of planned offshore wind projects would result in up to 5,595 miles (9,004 kilometers) of new submarine electrical transmission cables in the geographic analysis area for sea turtles (Appendix F, Table F2-1). Each cable would generate EMF potentially detectable by sea turtles in the immediate area around the cable (Klimley et al. 2021). Sea turtles are known to be geomagnetic-sensitive, but not electrosensitive (Normandeau et al. 2011). Sea turtles use their magneto-sensitivity for orientation, navigation, and migration; they use the Earth's magnetic fields for directional (compass-type) information to maintain a heading in a particular direction and for positional (map-type) information to assess a position relative to a specific geographical destination (Lohmann et al. 1997). Additional non-magnetic cues are also likely used by sea turtles during navigation and migration. Multiple studies have demonstrated magneto-sensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 µT for loggerhead turtles and 29.3 to 200 µT for green turtles (Normandeau et al. 2011). However, based on a review by Normandeau et al. (2011), sea turtles are unlikely to detect alternating current magnetic fields below 50 mG (5 µT) due to their magnetite-based detection mechanism. Hatchling sea turtles are known to use the Earth's magnetic field (and other cues) to orient and navigate from their natal beaches to their offshore habitat (Lohmann et al. 1997). Juvenile and adult sea turtles may detect EMFs when foraging on benthic prey or resting on the bottom in relatively close proximity to cables. Confounding EMF effects on sea turtles could range from trivial changes in swim direction to more significant migration alterations; the extent and magnitude of these potential effects are unclear, however, and may be compensated against to some degree by sea turtle's use of non-magnetic spatial cues. Overall, potential EMF effects would be reduced by cable shielding and burial to an appropriate depth, and new submarine cables would be installed to maintain a minimum separation of at least 330 feet (101 meters) from other known cables to avoid damaging existing infrastructure during installation. This separation distance would avoid additive EMF effects from adjacent cables. While artificial EMF effects on sea turtles are not well studied, current construction and mitigation methods would limit projected EMF effects to below levels that are expected to cause measurable biological effects. Short-term displacement of individual turtles from the Project area or deviations in their migrations would be small and would not be expected to substantially affect energy expenditure in sea turtles.

Light: Nighttime lighting associated with offshore structures and vessels could represent a source of attraction, avoidance, or other behavioral responses in sea turtles. Although responses to light have been studied in various species and life stages of sea turtles, the effects are expected to be negligible (BOEM 2019). Shoreline development is the predominant existing artificial lighting source in the nearshore component of the geographic analysis area while vessels, mainly fishing vessels, are the predominant source of artificial lighting offshore. Future wind energy development would contribute additional light sources to the offshore component of the geographic analysis area; onshore components of offshore wind projects are not expected to produce a substantial amount of light or be present in areas where sea turtles are expected. Offshore sources of light consist of short-term lighting from vessels used during construction and the long-term use of navigational lighting on new WTGs and OSSs. Over 3,287 structures are forecasted for construction in the geographic analysis area. Each structure would have minimal yellow flashing navigational lighting, as well as red flashing Federal Aviation Administration hazard lights in accordance with BOEM (2019) lighting and marking guidelines. Artificial light in coastal environments is an established stressor for juvenile sea turtles, which use light to aid in navigation and dispersal and can become disoriented when exposed to artificial lighting sources; however the significance of artificial light in offshore environments is less clear (Gless et al. 2008). Data from oil and gas platform operation in the Gulf of Mexico, which can have considerably more lighting than offshore WTGs, have not resulted in any known impacts on sea turtles (BOEM 2019) and no long-term or population-level impacts from offshore lighting produced by offshore wind projects is expected.

New cable emplacement/maintenance: Future offshore wind projects could disturb over 177,718[1] acres (719 square kilometers) of seabed while installing associated undersea cables, causing an increase in suspended sediment and seafloor disturbance (Appendix F, Table F2-2). This disturbance would be localized and temporary. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, although elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be limited in extent, short term in duration, and likely too small to be detected (NOAA 2021). Seafloor disturbance during construction of future offshore wind projects may affect sea turtle foraging success or prey species distribution; however, impacts would be temporary and generally localized to the cable corridor. Traditional dredging methods (e.g., trailing suction hopper dredgers) are not anticipated during installation of offshore wind projects; therefore, no significant entrainment risk to sea turtles is expected from cable emplacement activities (Ramirez et al. 2017). Given the likelihood of this activity occurring and the small time and spatial scale over which these activities would occur, no population-level effects on sea turtles would be expected.

Noise: Human activities would continue to generate underwater noise with potential to affect sea turtles. Several wind energy projects could be developed between 2023 and 2030 with overlapping construction periods that add several new sources of underwater noise to the ambient soundscape through pile driving and vessel traffic (Appendix F, Table F-3). As discussed in Appendix F, some projects could be constructed concurrently at multiple locations on the OCS, which could result in larger or overlapping areas of increased underwater anthropogenic noise.

A description of sea turtle hearing anatomy and perception of underwater sound is provided in Appendix J, Section J.2.6.2. Potential impacts on sea turtles from underwater noise include PTS, TTS, and behavioral disturbances, and the potential for the type of impacts would vary by phase and activity. Acoustic thresholds, which represent the estimated sound level at which the onset of a particular effect may occur, that are recommended by Finneran et al. (2017) for all sea turtle species by impact are listed in Table 3.19-3. Data are currently only available for sea turtle behavioral responses to impulsive sound sources (described in Section 3.15.1.1, *Future Offshore Wind Activities [without Proposed Action]*), so these thresholds are assumed to apply to all noise categories.

[1] Kitty Hawk Wind South has three export cables (57 miles [92 kilometers] to Virginia, 200 miles [322 kilometers] to North Carolina, and an additional 96 miles [154 kilometers] of inshore export cable to North Carolina) for a total of 352.9 miles (568 kilometers). Corridor widths range from the 1,520-mile-wide (2,414-kilometer-wide) corridor to Virginia and the 1,000-mile-wide (1,609-kilometer-wide) corridors to North Carolina to allow for optimal routing of the cables.

Table 3.19-3 Acoustic Thresholds for Sea Turtles for Each Type of Impact and Noise Category

Impact	Impulsive Noise Threshold	Non-impulsive Noise Thresholds
PTS	$L_{p,pk}$ 232 dB re 1 μPa	$L_{E,24hr}$: 220 dB re 1 μPa^2 s
	$L_{E,24hr}$: 204 dB re 1 μPa^2 s	
TTS	$L_{p,pk}$: 226 dB re 1 μPa	$L_{E,24hr}$: 200 dB re 1 μPa^2 s
	$L_{E,24hr}$: 189 dB re 1 μPa^2 s	
Behavioral disturbance	L_P: 175 dB re 1 μPa	

Source: Finneran et al. 2017.
μPa = micropascal; μPa^2 s = micropascal square second; dB = decibel; $L_{E,24hr}$ = sound exposure level over 24 hours; $L_{p,pk}$ = peak sound pressure level; L_P = root-mean-square sound pressure level.

There are few studies reporting sound production in sea turtles, despite their ability to hear sounds in both air and water. While the general importance of sound to the ecology of sea turtles is not well understood, there is a growing body of knowledge suggesting that sea turtles may use sound in a multitude of ways. Sea turtle embryos and hatchlings have been reported to make airborne sounds, thought to be produced for synchronizing hatching and nest emergence (Montiero et al. 2019; Ferrara et al. 2014a, 2014b, 2019; McKenna et al. 2019). Charrier et al. (2022) noted the production of 10 different underwater sounds in juvenile green sea turtles, including those within and above the frequency range of hearing reported for this species. A more comprehensive understanding of sound production and hearing is needed in sea turtles; however, the limited but growing information available suggests environmental acoustic cues are likely to be important to these animals.

3.19.3.2.1 HRG Surveys

The active acoustic sources used in site characterization surveys introduce noise into the water during site investigations. See Appendix J for a physical description of these sounds. Only a subset of geophysical sources (e.g., boomers, sparkers) are likely to be audible by sea turtles, given the frequency range of the sounds and the hearing range of turtles. Given the right context, these sounds may cause short-term behavioral disturbance, avoidance, or stress (NSF and USGS 2011). Recently, BOEM and USGS characterized underwater sounds produced by high-resolution geophysical sources and their potential to affect marine animals, including sea turtles (Ruppel et al. 2022). In addition to frequency range, other characteristics of the sources like the source level, duty cycle, and beamwidth make it very unlikely that these sources would result in behavioral disturbance of sea turtles, even without mitigation (Ruppel et al. 2022). Given the intensity of noise generated by this equipment (Crocker and Frantantonio 2016; Crocker et al. 2019) and short duration of proposed surveys, it is unlikely that PTS or TTS will occur in any turtle species as a result of being exposed to HRG survey noise. Although temporary displacement or behavioral responses may occur, they would not result in biologically notable consequences; impacts on sea turtles would be minor and would have no stock or population-level effects. Likewise, geotechnical surveys may introduce low-level, intermittent, broadband noise into the marine environment, though these sounds are unlikely to result in behavioral disturbance, given their low source levels and intermittent use.

3.19.3.2.2 Impact and Vibratory Pile Driving

Impulsive noise from impact pile driving during planned offshore wind development represents the highest risk of noise exposure and potential for adverse auditory effects on sea turtles in the geographic analysis area due to the anticipated frequency of pile driving activities and the spatial extent of effect. While these potential effects are acknowledged, their biological significance is unclear because sea turtle sensitivity and behavioral responses to pile-driving noise are not well known based on available studies. However, several studies conducted on responses to seismic airguns, an impulsive signal that can serve as a general proxy to other high intensity impulsive sources like pile driving, have shown that a range of behavioral effects are possible (McCauley et al. 2000; U.S. Department of the Navy 2018). In some seismic studies, observations of caged and free-swimming sea turtles exposed to airgun operations were reported as reacting to the sounds by initiating a startle dive (Weir 2007; DeRuiter and Doukara 2012), rising to the surface (Lenhardt 1994), and altering swimming patterns (McCauley et al. 2000). In other studies, sea turtles avoided the airgun source initially, but authors suggested that animals likely habituated to the source over time (Moein et al. 1994; Lenhardt 2002; Hazel et al. 2007). This type of noise habituation has been demonstrated even when the repeated exposures were separated by several days (Bartol and Bartol 2012; U.S. Department of the Navy 2018). The accumulated stress and energetic costs of avoiding repeated exposures to pile-driving noise over a season or life stage could have long-term effects on survival and fitness (U.S. Department of the Navy 2018).

Vibratory pile driving may be used prior to impact pile driving to reduce the risk of pile run for some offshore wind projects and during export cable installation and port facility construction. The term pile run refers to the quick penetration of a pile into the seabed as a result of its high self-weight and low resistance from the seabed. A physical description of vibratory pile-driving noise can be found in Appendix J. Typical noise levels generated by vibratory pile driving are lower than noise levels produced by impact pile driving. Available measurements indicate the SPL was, on average, 165 dB re 1 µPa at 33 feet (10 meters) and decreased to 140 dB re 1 µPa when measured 656 feet (200 meters) away (Illingworth and Rodkin 2017). These measurements are based on smaller piles in shallower water locations, appropriate for export cable installation activities, and it is expected that vibratory pile driving conducted for the foundations prior to impact pile driving will produce a greater area of ensonification. However, based on these sound levels, it is still not expected that the PTS thresholds (Finneran et al. 2017) would be exceeded more than 328 feet (100 meters) from the pile, even in deeper water environments. Ranges to the behavioral disturbance threshold for sea turtles (Finneran et al. 2017) may extend further; however, the behavioral disturbance threshold is an SPL of 175 dB re 1 µPa and would not be exceeded beyond 1,640 feet (500 meters) from the source. Additionally, vibratory pile driving activities would be relatively short-term, occurring over approximately 4 hours per pile for the foundations, and over several days for export cable installation.

Sea turtles that are exposed to pile driving noise have the potential to experience auditory impacts such as TTS or PTS. Reduced hearing sensitivity could limit the ability to detect predators, prey, or suitable habitat and reduce the survival and fitness of affected individuals; however, the role and importance of auditory cues in these biological functions for sea turtles remains poorly understood (Lavender et al. 2014).

Based on the available information provided above and in Appendix J, impacts on sea turtles from construction-related pile driving noise would be limited to effects on a small number of individuals. Auditory threshold shifts (TTS, PTS) are not likely to occur due to the short exposure times expected during piling; however, the risk of TTS and PTS cannot be fully eliminated. Therefore, given the number of projects anticipated within the geographic analysis area (Appendix D), impact pile driving would have minor impacts on sea turtles due to the potential for severe effects on individuals but no effects on population viability for any species. Vibratory pile driving is expected to have a reduced impact for sea turtles and would result in detectable impacts that are minor and would not result in population-level effects.

3.19.3.2.3 Vessel Noise

Vessel noise associated with non-offshore wind activities is likely to be present throughout the sea turtle geographical analysis area at a nearly continuous rate due to the prevalence of commercial shipping, fishing, and recreational boating activities that are ongoing and would be expected to continue in the geographic analysis area. During both the construction and operational phases of planned offshore wind projects, several types of vessels would be used to transport crew and supplies, and, during construction, dynamic positioning systems may be used to keep the pile-driving vessel in place. A description of the physical qualities of vessel noise can be found in Appendix J. Construction and operational vessel noises are the most broadly distributed sources of non-impulsive noise associated with offshore wind projects. Sea turtle exposure to underwater vessel noise would incrementally increase as a result of ongoing and planned offshore wind projects, especially during construction periods (Appendix F). Sea turtles are less sensitive to sound as compared to faunal groups like marine mammals, as evidenced by the higher auditory threshold criteria (NMFS 2023b). No injury or behavioral effects from vessel noise are anticipated for planned offshore wind projects. It is unlikely that received levels of underwater noise from vessel activities would exceed PTS thresholds for sea turtles, as the PTS threshold for non-impulsive sources is an SEL_{24h} of 200 dB re 1 µPa^2 s (NMFS 2023b), which is comparable to the maximum source level reported for large shipping vessels (Appendix J). Hazel et al. (2007) demonstrated that sea turtles only appear to respond behaviorally to vessels at approximately 33 feet (10 meters) or closer.

Vessel noise effects for planned offshore wind projects are expected to be broadly similar to noise levels from existing vessel traffic in the region. Nonetheless, periodic localized, short-term behavioral impacts on sea turtles could occur; however, sea turtle behavioral disturbances are anticipated only to occur within a relatively small area around the vessels and are expected to return to normal when the vessel moves away. Therefore, the effects of vessel noise from planned offshore wind activities would be minor. No population-level effects are expected to occur.

3.19.3.2.4 Cable Laying and Trenching

Preparing a lease area for turbine installation and cable-laying may require jetting, plowing, or removal of soft sediments, as well as the excavation of rock and other material through various cable emplacement methods. 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 relation to dredging, trenching, and cable-laying activities. A description of the physical qualities of these sound sources can be found in Appendix J. Given the estimated source levels (Appendix J) and transitory nature of these sources, exceedance of PTS and TTS sound levels are not likely for sea turtles (Heinis et al. 2013), and behavioral disturbances would likely be low-intensity, localized, and result in negligible impacts on sea turtles.

3.19.3.2.5 WTG Operations

No biologically notable effects on sea turtles are anticipated from noise produced by WTG operation. Noise associated with operational WTGs would be expected to attenuate below ambient levels at a relatively short distance from WTG foundations (Miller and Potty 2017; Thomsen et al. 2015; Tougaard et al. 2009). Maximum anticipated noise levels produced by operational WTGs are estimated to be between 125 and 130 dB re 1 µPa m (Lindeboom et al. 2011; Tougaard et al. 2009). HDR (2019) measured SPL below 120 dB re 1 µPa at 164 feet (50 meters) from operating turbines at the Block Island Wind Farm, which are below the sound level thresholds expected to cause sea turtle PTS, TTS, and behavioral disturbance (NMFS 2023b). Additionally, current generation WTGs use direct drive motors that could result in a sound decrease of approximately 10 dB from WTG using gear boxes that were considered in prior studies (Stöber and Thomsen 2021). However, a review of published literature also identified an increase in underwater source levels (up to 177 dB re 1 µPa) with increasing power size with a nominal 10 MW WTG (Stöber and Thomsen 2021). Given the number of foundations expected within the sea turtle geographic analysis area (Appendix F), the presence of WTG operational noise would be a persistent presence throughout the sea turtle geographic analysis area. Impacts on sea turtles would, therefore, be minor as the behavioral responses would be detectable but would not be expected to result in any population-level effects.

Port utilization: Port expansions could increase the total amount of disturbed benthic habitat and result in impacts on some sea turtle prey species. However, given that port expansions would likely occur in subprime areas for foraging and the disturbance would be relatively small in comparison to the overall sea turtle foraging areas in the geographic analysis area, port expansions are not expected to affect sea turtles. Dredging for port facility improvement could lead to additional impacts on turtles from incidental entrainment, impingement, or capture. Dredging impacts on sea turtles are relatively uncommon; most observed injury and mortality events in the U.S. were associated with hopper dredging in and around core habitat areas in the southern portion of the geographic analysis area and in the Gulf of Mexico outside the geographic analysis area (Michel et al. 2013; USACE 2020). Ongoing maintenance dredging of these facilities may incrementally increase related risks to individual turtles over the lifetime of the facilities; however, typical mitigation measures such as timing restrictions should minimize this potential. Additionally, the size, scope, and location of the dredging activities conducted for offshore wind projects would be less than that identified for other projects such as beach nourishment or port deepening, and the type of equipment used reduces the risk of entrainment or impingement. Compared to the dredging activities for planned offshore wind projects, navigation dredging projects, which occur primarily in channels close to shore, generally pose a greater risk of entrainment of sea turtles because of their tendency to concentrate in channels (Ramirez et al. 2017). For example, the number of sea turtles entrained by hopper dredging in BOEM offshore borrow areas has historically been relatively low when compared to navigation channel dredging (Ramirez et al. 2017). Between 1995 and 2015, there were 69 reported sea turtle takes in the North Atlantic (i.e., north of North Carolina) by trailing suction hopper dredges, versus approximately 260 taken in hopper dredges operating in the South Atlantic. The takes per project across the entire South Atlantic were estimated to be 0.96 (the North Atlantic was not analyzed). Therefore, given the extent of and location of navigation projects using hopper dredges, the limited amount of dredging conducted as part of the Proposed Action is not expected to result in population effects as few to no takes of sea turtles would reasonably be expected. The risk of injury or mortality to individual sea turtles resulting from dredging associated with future offshore wind projects exclusive of the Proposed Action is low and population-level effects are unlikely to occur.

Presence of structures: The addition of over 3,287 new offshore structures (WTGs, OSSs, and meteorological tower) in the geographic analysis area could increase sea turtle prey availability through the creation of new hard-bottom habitat, increasing pelagic productivity in local areas, or promoting fish aggregations at foundations (Bailey et al. 2014 cited in English et al. 2017). Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, discusses reef creation and the potential for anthropogenic structures to attract fish. Fish aggregations around new wind farm structures can provide additional foraging opportunities for sea turtles that may result in negligible or minor beneficial impacts given the broad geographic range of species during their annual foraging migrations. However, the presence of structures may indirectly concentrate recreational fishing around foundations, which could indirectly increase the potential for sea turtle entanglement in both lines and nets and result in minor adverse impacts on sea turtles given their proclivity for entanglement in lost fishing gear (Nelms et al. 2016; Gall and Thompson 2015; Shigenaka et al. 2010).

Human-made structures, especially tall vertical structures like WTG and OSS foundations, alter local water flow at a fine scale and could result in localized impacts on sea turtle prey distribution and abundance. A discussion of the effects of altered water flow can be found in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*. The presence of many WTG structures could affect oceanographic and atmospheric conditions in ways that alter local environments and potentially increasing primary productivity in the vicinity of these structures (Carpenter et al. 2016; Schultze et al. 2020). However, this may not translate to a beneficial increase in sea turtle prey abundance if the increase in primary productivity is consumed by filter feeders (e.g., mussels) that colonize the surface of the structures (Slavik et al. 2019).

The long-term effects of offshore structure development on ocean productivity and sea turtle prey species; therefore, sea turtles are difficult to predict with certainty because they are expected to vary by location, season, and year depending on broader ecosystem dynamics. For example, the presence of new hard surfaces could increase the abundance of associated organisms (e.g., mussels, crustaceans) on and around the structures, providing a prey resource for sea turtles. Increased primary and secondary productivity in proximity to hard-bottom structures could increase the abundance of prey species like jellyfish (English et al. 2017). Additionally, hard-bottom (scour control, cable protection) and vertical structures (WTG and OSS foundations) in a soft-bottom habitat can create a 3-dimensional artificial reef structure, thus inducing the “reef effect” and resulting in higher densities and biomass of mollusks, fish, and decapod crustaceans (Causon and Gill 2018; Taormina et al. 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, sea turtles, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019) indicating that offshore wind facilities can generate beneficial long-term impacts on local ecosystems, translating to increased foraging opportunities for sea turtle species. Sea turtles may also use vertical structures for shelter from strong currents to conserve energy and for cleaning their shells (Barnette 2017). In contrast, increased fish biomass around the structures could attract commercial and recreational fishing activity, creating an increased risk of injury or mortality from gear entanglement and ingestion of debris (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014).

Some level of displacement of sea turtles from future wind farm lease areas into areas with a higher potential for interactions with ships or fishing gear could occur. However, the addition of structures could locally increase pelagic productivity and prey availability for sea turtles and decrease the likelihood of long-term displacement from the wind farm lease areas. While the effect would be present long term throughout the life of future offshore wind projects, the overall impact of displacement on sea turtles is not expected to be biologically notable.

Vessel traffic: Vessel strikes are a concern for sea turtles. The percentage of loggerhead sea turtles with reported strandings due to vessel strikes increased from approximately 10 percent in the 1980s to 20.5 percent in 2004 (NMFS and USFWS 2007). Sea turtle strandings reported to have vessel strike injuries have been reported to be as high as 25 percent in Chesapeake Bay, Virginia (Barco et al. 2016), and Foley et al. (2019) reported that roughly one-third of stranded sea turtles in Florida had injuries indicative of a vessel strike. Sea turtles are expected to be most susceptible to vessel strikes in shelf waters where they forage (Barkaszi et al. 2021). Furthermore, they cannot reliably avoid being struck by vessels traveling in excess of 2 knots (Hazel et al. 2007); typical vessel speeds in the geographic analysis area may exceed 10 knots. Up to 207 vessels associated with offshore wind development may be operating in the geographic analysis area during the peak construction period in 2025 (BOEM 2019) (Appendix F, Table F1-14). Increased vessel traffic could result in a higher number of vessel strikes, resulting in injury or mortality of individual sea turtles. However, despite the potential for individual fatalities, potential impacts are localized and no population-level impacts on sea turtles are expected. It is expected that planned offshore wind projects will adhere to vessel speed restrictions and visual monitoring, which, while geared primarily towards marine mammals, will help reduce the risk of a strike occurring that results in a serious injury or mortality. PSO sightings data indicate sighting rates for sea turtles during vessel operations were approximately 13 sea turtle detections per 100 hours of vessel effort (Marine Ventures International, Inc. 2022; RPS 2021). These detection rates are relatively high, and even with these high detection rates there were only 18 vessel strike mitigation actions required (2.8 percent of all sea turtle detections) and no strikes reported. However, there are limited measures that have been proven to be effective at reducing collisions between sea turtles and vessels (Schoeman et al. 2020). The relatively small size of sea turtles makes detection very difficult when turtles are at the surface, during which time only a small portion of their body (e.g., head, top of carapace) is visible for detection at any distance that is reasonable for avoidance measures to be taken. Avoidance of vessels by sea turtles is not well documented but is expected to be initiated visually rather than acoustically (Hazel et al. 2007) and vessel strike probability increases significantly for vessels traveling greater than 4 knots (Hazel et al. 2007). Therefore, implementation of mitigation would not fully eliminate the risk of vessel strikes on sea turtles, but could help reduce it, and the seasonal patterns of sea turtles in the region would result in a reduction in risk during the early spring and winter months when sea turtle abundances in the area are expected to be lower (Section 3.19.1, *Description of the Affected Environment for Sea Turtles*). Vessel strikes are particularly lethal for sea turtles due to their size, and mortality risk increases with size and speed of the vessel. Therefore, the risk of vessel strikes on individuals cannot be discounted, and impacts are not expected to have population-level effects and so they are classified as minor.

Fishing gear utilization (biological/fisheries monitoring surveys): A primary threat to sea turtles is their unintended capture in fishing gear, which can result in drowning or cause injuries that lead to injury and mortality (e.g., swallowing hooks). For example, trawl fishing is among the greatest continuing primary threats to the loggerhead turtle (NMFS and USFWS 2019), and sea turtles are also caught as bycatch in other fishing gear including longlines, gillnets, hook and line, pound nets, pot/traps, and dredge fisheries. A substantial impact of commercial fishing on sea turtles is the entrapment or entanglement that occurs with a variety of fishing gear. Although the requirement for the use of bycatch mitigation measures—such as requirements for “turtle excluder devices” in trawl fishing gear in the southeastern U.S. shrimp fisheries (NMFS 2023c)—has reduced sea turtle bycatch, Finkbeiner et al. (2011) compiled data on sea turtle bycatch in U.S. fisheries and found that in the Atlantic, a mean estimate of 137,700 interactions, 4,500 of which were lethal, occurred annually since implementation of bycatch mitigation measures. The impacts of gear use associated with fisheries on sea turtles may result in the injury or mortality of individual sea turtles of any species that may occur within sampled area(s). These impacts are expected to be localized and short term in duration (limited to active sampling periods only). Loss or injuries of individual turtles resulting from these activities are not expected to result in population-level effects on any species and are, therefore, expected to be minor. A reduction of sea turtle interactions with fisheries is a priority for sea turtle recovery.

Climate change: Global climate change is an ongoing potential risk to sea turtles, although the associated impact mechanisms are complex, not fully understood, and difficult to predict with certainty. Possible impacts on sea turtles due to climate change include increased storm severity and frequency; increased erosion and sediment deposition; increased disease frequency; ocean acidification; and altered habitat, prey availability, ecology, and migration patterns. Over time, climate change, in combination with coastal development, would alter existing nearshore and coastal (nesting beach) habitats and render some areas unsuitable for some species and more suitable for others. Furthermore, regarding the effects of temperature on nesting sea turtles, termed ‘temperature-dependent sex determination' or TSD, increased temperatures could result in skewed and even lethal incubation conditions, which would result in impacts on turtle species, hatchling success (the proportion of eggs that produce viable hatchlings), hatchling size and locomotory performance, the prevalence of scute abnormalities, and possibly infectious disease outbreaks (National Ocean Service 2023; Laloë and Hays 2023; Patrício et al. 2021). However, the introduction of planned offshore wind projects would be expected to help slow the progression of climate change. Therefore, these activities would not contribute to the risks of climate change faced by sea turtles and may result in beneficial changes for sea turtles through operations of planned offshore wind projects. Beneficial effects may be offset by derelict or abandoned fishing gear or fishing line.

3.19.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, sea turtle species would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on sea turtles. These effects are primarily driven by offshore construction and operation impact, presence of structures, noise, and traffic.

BOEM expects ongoing activities and future offshore wind activities to have continuing temporary to permanent impacts on sea turtles, primarily through construction-related lighting, noise, habitat alteration, risk of vessel strikes, and artificial reef effect. In addition to ongoing activities, planned activities other than offshore wind development include increasing vessel traffic, new submarine cables and pipelines, maintenance dredging, channel-deepening activities, military activities, biological/fisheries monitoring surveys, and the installation of new towers, buoys, and piers (Appendix F).

Potential impacts on sea turtles from ongoing activities, particularly the risk of accidental releases of trash and debris and vessel strikes, would be **minor** for sea turtles. Additionally, impacts on sea turtles could occur from planned actions from non-offshore wind activities, which would likely incrementally increase the number of vessels in the water and may, therefore, increase the risk of accidental releases and vessel strikes. However, the incremental increase would not result in population-level impacts on sea turtles; therefore, impacts would remain **minor**. The combination of ongoing activities and reasonably foreseeable non-offshore wind activities would result in **minor** impacts on sea turtles in the geographic analysis area.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and sea turtles would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on sea turtles due to habitat loss from increased offshore construction and operations.

Considering all IPFs collectively, future offshore wind activities in the geographic analysis area would result in **minor adverse** impacts overall, particularly from pile driving, vessel strike risk, or entanglement risk posed by the presence of structures. They would also result in **minor beneficial** impacts throughout the life of the projects due to ‘reef effect’ associated with the presence of the structures. Beneficial effects may be offset by the risk of entanglement due to derelict or abandoned fishing gear or fishing line. Most of the structures in the geographic analysis area would be attributable to offshore wind development. Sea turtles present in these project areas during construction would be exposed to increased underwater noise levels during pile driving of new WTG and OSS foundations and would be at risk of vessel strikes from project vessels used throughout all phases of development. These impacts are expected to be localized to the project area of a given wind farm project, and impacts would not be biologically notable on the regional population or species level.

3.19.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 primary PDE parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*) that would influence the magnitude of the impacts on sea turtles:

- Noise associated with the construction of Project structures (e.g., pile driving and construction vessels), which could have behavioral and physiological effects or cause auditory injury to sea turtles;
- Vessel traffic, which could increase collision risk to sea turtles due to increased recreational fishing vessels and vessels transiting to and from the Wind Farm Area during construction, operations, and decommissioning; and
- The presence of structures, which could cause both beneficial and adverse impacts on sea turtles through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement.

Variability of the proposed Project design exists as outlined in Appendix E. The following is a summary of potential variances in impacts:

- **Foundation type:** The potential acoustic impacts on sea turtles differ among the foundation types that the Project would use, which is up to 3 piled jacket foundations or monopile foundations for OSS and up to 98 monopile foundations for WTGs. Construction of the jacket-type foundation would have a higher acoustic impact than construction of the monopile foundation due to the increased risk of exposure because of the longer time required to install more piles (up to four 9.8-foot [3-meter] pin piles per jacket).
- **Monopile diameter:** The potential acoustic impacts on sea turtles differ among the WTG monopile diameters that may be used. The Project would use monopiles with a maximum diameter between 25 feet (8 meters) and 34 feet (11 meters). The acoustic modeling associated with construction of a monopile with a diameter of 34 feet (10.3 meters) differs from the acoustic modeling associated with construction of a monopile with a diameter of 30 feet (9 meters).
- **The WTG number:** All potential impacts would be lessened with a decrease in number of WTGs built.
- **Onshore export cable routes:** The route chosen (including variants within the general route) would determine the amount of habitat affected. Sections 3.19.3 through 3.19.6 detail the pertinent differences among the options with respect to sea turtles.
- **Season of construction:** Sea turtles may occur in Virginia waters year-round, but highest abundances occur from May through November (DiMatteo et al. 2023). Construction outside of the May–November window would have a lesser impact on sea turtles compared to construction during peak abundance periods.

Although some variation is expected in the design parameters, the impact assessment on sea turtles in this section analyzes the maximum-case scenario.

3.19.5 Impacts of the Proposed Action on Sea Turtles

Accidental releases: During construction, operation, and conceptual decommissioning of the Project there could be a short-term risk of sanitary and other waste fluids or fuels and other petrochemicals accidentally entering the water from vessels operating during Project activities. If sea turtles were exposed to an oil spill or discharge of waste material, potential impacts would be the same as those discussed in Section 3.19.3.2, *Cumulative Impacts of the No Action Alternative*. Any non-routine spills or accidental releases that could result in negligible and short-term impacts on surface water resources would be avoided or minimized through the implementation of the Project Oil Spill Response Plan and other environmental protection measures (COP, Section 4.2.6.3, Table 4.2-51; Dominion Energy 2023). Impacts on sea turtles from accidental spills or pollutant releases are considered minor because of the low probability of accidents and mitigation measures that will be implemented. Trash and debris from Project-related vessels that enter the water also represents a risk factor to sea turtles because they could ingest or become entangled in debris, causing lethal or injurious impacts. Plastic materials (e.g., plastic bags) are often mistaken for prey (e.g., jellyfish, salps) and ingested, which can block the turtles' intestinal tracts, causing injury or mortality. Personnel working offshore would receive training on sea turtle awareness and marine debris awareness (COP, Section 4.2.6.3, Table 4.2-51; Dominion Energy 2023). Other proposed measures that would be implemented include strict adherence to regulations specified in separate Annexes of MARPOL (the International Convention for the Prevention of Pollution from Ships), which would lower the probability of such a risk (USCG 2023). Therefore, impacts from accidental releases on sea turtles are expected to be negligible for the Proposed Action.

Electromagnetic fields: EMFs would be produced by the inter-array and offshore export cables throughout the life of the Project. These effects would be most intense directly above the cables at locations where they could not be buried to the full proposed burial depth and are laid on the seafloor beneath stone or concrete mattresses. Approximately 300 miles (484 kilometers) of inter-array cable and 417 miles (671 kilometers) of export cable in the offshore portion of the preferred cable route would be installed (COP, Table 1.2-1; Dominion Energy 2023). Estimated EMF levels modeled by Exponent for the COP (Appendix AA; Dominion Energy 2023) predict a maximum magnetic field from the inter-array cable of 68 milligauss, and 112 milligauss from the export cable at the seabed. However, the magnetic field is reduced to 5.2 and 8.7 milligauss for the inter-array and export cable, respectively, at 3 feet (1 meter) above the seafloor; similar reductions are expected at increasing horizontal distance from the cables (COP, Appendix AA; Dominion Energy 2023). BOEM has conducted literature reviews and analyses of potential EMF effects from offshore renewable energy projects on indigenous fauna (CSA Ocean Sciences and Exponent 2019; Normandeau et al. 2011). These and other available reviews and studies (Gill et al. 2005; Kilfoyle et al. 2018) suggest that most marine species cannot sense very low intensity electric or magnetic fields at the typical AC power transmission frequencies associated with offshore renewable energy projects. As discussed in Section 3.19.3.2, sea turtles are likely magnetosensitive and orient to Earth's magnetic field for navigation, but they are unlikely to detect magnetic fields below 50 milligauss (Normandeau et al. 2011). The transmission cables used during Project operations may exceed 50 milligauss at locations where full burial is not possible, but these areas would be limited (i.e., the magnetic field above 50 milligauss would be limited to the area immediately above the cables) (COP, Appendix AA; Dominion Energy 2023). This indicates that sea turtles would only be able to detect induced magnetic fields within a few meters of the exposed cables or immediately above buried cables. Given the lack of sensitive life stages of sea turtles present in the Project area, the limited extent of detectable magnetic field levels, and limited potential for sea turtles to encounter field levels above detectable levels for extended periods of time, the effects of Project-related EMF exposure on sea turtles would be negligible for the Proposed Action.

Light: Lights would be required on vessels and heavy equipment during construction and conceptual decommissioning, and would also include a variety of operational lighting, including navigational lighting for mariners, obstruction lighting for aviators, and vessel/work lighting for maintenance and operations. As discussed in Section 3.19.3.2, behavioral responses to artificial lighting of offshore structures and vessels have been observed in sea turtles; however, none of these responses are expected to result in long-term or biologically notable impacts. Additionally, typical migrating or foraging behavior of sea turtles (i.e., remaining predominantly submerged) limits their exposure to operational lighting, and lighting would be limited to the minimum required for by regulation for safety. Based on available information and Project design parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*), it is expected the impact of Project-related lighting on sea turtles would be negligible for the Proposed Action.

New cable emplacement/maintenance: Sea turtles in or near the Project area would likely be foraging or migrating between foraging and nesting habitats. Prey items within the Project area could include benthic species that could be affected by seabed disturbance associated with installation of the offshore export cables and inter-array cables. This disturbance would be short-term and prey species would be expected to return to the area once the cables are installed (Section 3.13.3). Similar levels of impact would be realized during cable maintenance. While trailing hopper suction dredgers are being considered for use for the Proposed Action, it is not definite and potential risks of sea turtle entrainment would be low as discussed in Section 3.19.3.2. Because impacts during cable installation or maintenance would be temporary and localized, the impact of Project activities on sea turtles would be negligible for the Proposed Action.

Noise: A short-term increase in underwater noise is the most likely IPF that could affect sea turtles, predominantly during installation of the WTG and OSS foundations, cofferdams, and nearshore structures during Project construction. The Project PDE includes both impact and vibratory pile driving as an option for installation of the WTG monopile foundations and OSS jacket foundations, as well as vibratory pile driving, which would be used to install the cofferdams and impact pile driving of the goal post piles (COP, Appendix Z; Dominion Energy 2023). All these activities have potential to produce noise above recommended sea turtle acoustic thresholds (Table 3.19-3). Underwater acoustic modeling was conducted for the COP (Appendix Z; Dominion Energy 2023) for both activities, and the results are summarized in Table 3.19-4. For the purposes of this assessment, the deep modeling location using the maximum hammer energy with the noise attenuation proposed for each activity based on the LOA application (Tetra Tech 2022) is provided for each modeled scenario.

Table 3.19-4 Summary of Underwater Acoustic Modeling Conducted for the Coastal Virginia Offshore Wind Project Construction and Operations Plan

Scenario	Noise Attenuation (dB)	Distance (m) to PTS Threshold ($L_{p,pk}$)	Distance (m) to PTS Threshold ($L_{E,24hr}$)	Distance (m) to TTS Threshold ($L_{p,pk}$)	Distance (m) to TTS Threshold ($L_{E,24hr}$)	Distance (m) to Behavioral Threshold (L_P)
Standard Driving Installation – Impact Pile Driving	10	10	1,044	67	3,575	2,146
Standard Driving Installation – Vibratory Pile Driving	10	N/A	6	NA	179	82
Hard-to-Drive Installation – Impact Pile Driving	10	10	1,142	67	3,902	2,146
Hard-to-Drive Installation – Vibratory Pile Driving	10	N/A	0	NA	132	82
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	10	10	1,410	67	4,812	2,146
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	10	N/A	8	NA	200	82
OSS Piled Jacket – Impact Pile Driving	10	0	653	0	2,303	742
OSS Piled Jacket – Vibratory Pile Driving	10	N/A	0	NA	94	7
Cofferdam Installation – Vibratory Pile Driving	0	N/A	0	NA	NA	0

Scenario	Noise Attenuation (dB)	Distance (m) to PTS Threshold ($L_{p,pk}$)	Distance (m) to PTS Threshold ($L_{E,24hr}$)	Distance (m) to TTS Threshold ($L_{p,pk}$)	Distance (m) to TTS Threshold ($L_{E,24hr}$)	Distance (m) to Behavioral Threshold (L_P)
Goal Post Pile Installation – Impact Pile Driving	0	0	0	NA	NA	0

Source: Tetra Tech 2022.

As discussed in Section 3.19.3.2, the low-frequency noise associated with impact and vibratory pile driving during installation of the WTG and OSS foundations is within the estimated hearing range of sea turtles. Results of the modeling show there is some risk of exposure to noise above the PTS threshold during impact pile driving given the maximum range to the threshold may extend to 0.9 mile (1.4 kilometers) with 10 dB noise attenuation (Table 3.19-4). However, the PTS threshold is represented as a sound exposure level over 24 hours ($L_{E,24hr}$) indicating that the duration of the exposure is just as important as the level of the noise an animal is exposed to. The $L_{E,24hr}$ assumes an individual is exposed to noise at or above the threshold for the entire duration of the pile installation for the onset of PTS to occur, so if an animal moves away from the noise before accumulating enough sound to meet the threshold they are not likely to develop PTS. It is expected that sea turtles will swim away from the ensonified area during construction, which reduces the risk of PTS occurring. Additionally, mitigation measures such as soft start, pre-clearance, and shutdown procedures, while geared primarily towards marine mammals, will help ensure that the amount of time the Project area is ensonified above the thresholds and the amount of time an animal is present within the ensonified area is reduced, further reducing the risk of PTS being realized. The modeled behavioral threshold isopleths, with 10 dB noise mitigation, for sea turtles resulting from impact pile driving range from 2,434 to 7,041 feet (742 to 2,146 meters); the modeled TTS threshold isopleths with 10 dB noise mitigation range from 7,555 to 15,787 feet (2,303 to 4,812 meters). The behavioral threshold ranges use the SPL metric, which is based on the acoustic energy produced by a single hammer strike on the pile, while the TTS ranges are based on the $L_{E,24hr}$ metric, which requires accumulation of acoustic energy for the full duration of the pile installation. Therefore, while it appears animals would reach TTS thresholds prior to reaching behavioral thresholds, the time consideration in the TTS metric renders these ranges not fully comparable to the SPL ranges since the approach used assumes any given animal would be stationary for the full pile installation period, which is not representative of how an animal would be expected to behave in the wild. A shorter modeled time exposure, a single strike exposure for TTS, or modeled TTS exposure ranges that account for animal movement and behavior may provide more comparable results; however, these are not available in the modeling report and would not be expected to change the effects determinations. As discussed previously, TTS is a form of auditory fatigue that, unlike PTS, is non-permanent and reversible. As mentioned previously, very little is known about the onset of TTS in sea turtles and this metric is rarely used to assess potential impacts from impact pile driving beyond a few hammer strikes at the highest hammer energy. This metric is more often applied to sources such as underwater explosions where exposure to high sound energy could result in TTS when behavioral responses are unlikely to occur. Additionally, as discussed for behavioral responses, onset of TTS does not equate to an individual being removed from a population or facing any long-term restrictions on critical behaviors, as TTS is recoverable. As discussed for PTS, the proposed mitigation measures will help reduce the overall duration sea turtles may be exposed to above-threshold noise. If sea turtles avoid the ensonified area during pile driving that may represent a loss of foraging habitat during the construction period; however, this would not be expected to be a long-term behavioral disturbance as sea turtles would regain access to this habitat after pile driving, and there are likely to be ample foraging opportunities outside the Project area, so no impacts that would affect the viability of any sea turtle population are expected. Because of the risk of PTS for potentially large numbers of sea turtles of all species known to occur within the Project area, as well as temporary avoidance of these animals from the ensonified area, minor impacts on sea turtles are expected to result from the Proposed Action.

Vibratory pile driving during installation of the cofferdams is not expected to exceed PTS or behavioral thresholds at any distance (Table 3.19-4). Therefore, vibratory pile driving associated with cofferdam installation is expected to result in a negligible impact on sea turtles from the Proposed Action; it is more likely sea turtles would respond to noise from construction vessels staging on site prior to vibratory pile driving.

Impact pile driving during installation of the goal post piles used to support trenchless installation of the export cable is similarly not expected to result in any PTS-onset or behavioral disturbances. Though impact pile driving produces louder noise than vibratory pile driving, the size of the piles, location of the activity, and duration of the pile driving for the goal posts make this less likely to produce above-threshold noise for sea turtles. Modeling shows that PTS and behavioral thresholds will not be met or exceeded at any distance from the source (Table 3.19-4), and impacts on sea turtles during goal post installation under the Proposed Action would, therefore, result in negligible impacts.

Underwater noise levels produced by construction, maintenance, and decommissioning vessels throughout the life of the Project are not expected to exceed PTS thresholds for sea turtles. The main frequency range of vessels (10 to 1,000 Hz) overlaps with the frequency range of sea turtle hearing (100 to 1,200 Hz) (Ketten and Bartol 2006; Lavender et al. 2014); sea turtles can detect vessel noise and could respond with a startle or temporary stress response (NSF and USCG 2011). However, sea turtles may also habituate to vessel traffic associated with the Project as they inhabit areas that experience regular marine traffic (Hazel et al. 2007). A conservative assumption is that Project construction and support vessels could elicit behavioral changes in individual sea turtles present in the Project area during vessel operations, but these changes would be limited to evasive maneuvers such as diving, changes in swimming direction, or changes in swimming speed. These changes are not expected to be biologically notable and impacts on sea turtles from Project vessel noise would, therefore, be negligible for the Proposed Action.

The most likely cable burial methods being considered as part of the Proposed Action include jet plow, jet trenching, hydroplow (simultaneous lay and burial), and mechanical plowing (simultaneous lay and burial) (COP Section 3.4, Dominion Energy 2023), which produce low sound levels, as discussed in 3.15.3.2, *Cumulative Impacts of the No Action Alternative*. Potential impacts would be limited to behavioral disturbances that are short term and localized around the immediate area surrounding the cable installation activities and would, therefore, be negligible for sea turtles.

HRG survey equipment would likely be used during pre-construction surveys to support design finalization. This equipment produces noise in the 1.1 to 200 kHz frequency range at sound levels that may exceed sea turtle behavioral thresholds. No injurious impacts are expected for sea turtles from any HRG survey equipment (Baker and Howsen 2021). Behavioral disturbances may occur up to 295 feet (90 meters) from impulsive sources and up to 7 feet (2 meters) from non-impulsive sources assuming equipment are operating at the highest power settings (Baker and Howsen 2021). However, as discussed in Section 3.19.3.2, the assessment conducted by Ruppel et al. (2022) indicated that, even without mitigation, behavioral disturbances were unlikely to occur for sea turtles during operation of most HRG equipment, given the source levels and frequency range of the sources. Some low-level behavioral disturbances could potentially occur during Project-related HRG surveys; however, implementation of mitigation measures (Appendix H, *Mitigation and Monitoring*) and the relatively short duration of these surveys would reduce the risk of exposure. Impacts from HRG surveys on sea turtles are, therefore, expected to be negligible for the Proposed Action.

Sea turtles would likely be able to hear the continuous underwater noise of operational WTGs throughout the life of the proposed Project. Sea turtle hearing (frequencies less than 1,200 Hz) is within the frequency range for operational WTG (less than 500 Hz) (Popper et al. 2014; Thomsen et al. 2006; Tougaard et al. 2009, 2020). Thus, it is possible that WTG noise may influence sea turtle behavior. Potential responses to WTG noise generated during normal operations may be behavioral and include avoidance of the noise source, disorientation, and disturbance of normal behaviors such as feeding (MMS 2007). Noise generated during normal operations might affect many individuals and for a much longer time period (MMS 2007). As discussed previously for marine mammals in Section 3.15.3, operational WTGs can produce L_P ranging from 92 to 137 dB referenced to 1 micropascal at distances of 65 to 656 feet (20 to 200 meters) from the source (Tougaard et al. 2020). However, though WTG noise may exceed ambient sound levels present within the Project area, they are not expected to exceed noise produced by vessel traffic out to 0.6 mile (1 kilometer) (Tougaard et al. 2020) and impacts would, therefore, be similar to those described for vessel noise under *Cumulative Impacts of the No Action Alternative* and would be expected to be negligible.

Port utilization: No dredging activities related to port modifications are directly proposed under the Proposed Action, so sea turtles in the Project area would not be exposed to dredging activities under the Proposed Action. Additionally, most sea turtle nesting locations in this area are north of the Project switching station in military reserves and national wildlife refuges, outside the area of effect (Section 3.19.1). Therefore, dredging impacts on sea turtles from port utilization during Project construction would be negligible for the Proposed Action.

Presence of structures: The Proposed Action would alter approximately 203.3 acres (0.82 square kilometer) of seafloor, with 202 WTG and up to three OSS foundations with associated scour protection and over the life of the Project (COP, Table 4.2-17; Dominion Energy 2023). The alteration of the seafloor under the Proposed Action would result in a long-term conversion of existing benthic habitat to new, stable, hard structures. The presence of the foundations poses a potential risk for sea turtle displacement which would result in lost foraging opportunities or reduced access to foraging and breeding habitat. However, there is no designated critical habitat for any sea turtles in the Project area so there is not expected to be any substantial loss of foraging opportunities that could have population-level effects. Based on the best available information, negligible impacts, if any, are anticipated for the Proposed Action. Sea turtles would be expected to use habitat in between the WTGs, as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if benthic communities develop on and around foundations. Although migrating sea turtles could make temporary stops to rest and feed during migrations, the presence of structures is not expected to result in noticeable changes to overall migratory patterns in sea turtles. However, presence of these structures is also expected to attract fishing activity, which may increase the risk of accidental releases of trash and debris or entanglement in fishing gear. Interactions with lost fishing gear, such as hook and line or gill net gear around WTG foundations is another potential long-term risk and may result in hooking, entanglement, ingestion, injury, and death of individual turtles (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Given sea turtle proclivity for using anthropogenic structures and documented effects of discarded fishing gear on sea turtles (Barnette 2017), it is likely that impacts from entanglement associated with the Proposed Action on sea turtles would be minor, as impacts would be detectable and measurable. These impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.

Once construction is complete, these surfaces would be available for colonization by sessile organisms and would draw other species that are typically attracted to hard-bottom habitats (Causon and Gill 2018; Langhamer 2012). This phenomenon is known as the reef effect as discussed in Section 3.19.3.2. Additional information about the reef effect on sea turtle prey species can be found in Section 3.13.3. The Project foundations could result in localized increased primary production and zooplankton abundance, which could serve as food for some sea turtle species, as well as some sea turtle prey species. This may result in minor beneficial impacts from the presence of foundations for the Proposed Action.

Within the context of other available habitats along the OCS and expected future offshore wind projects (Appendix F, *Planned Activities Scenario*), habitat availability due to presence of WTG and OSS foundations, including the Proposed Action, would result in minor adverse impacts on sea turtles. The presence of structures, which would attract fish, may attract fishing vessels around the wind farms, which increases the risk of lost gear being present where sea turtles are foraging or migrating. However, the increased fish presence and potential primary productivity rates around these structures would also provide additional foraging opportunities, and the structures themselves provide shelter for sea turtles which may result in minor beneficial effects on sea turtles. However, it must be noted that these minor beneficial effects may be offset due to the risk of entanglement due to derelict or abandoned fishing gear or fishing line.

Vessel traffic: Vessels associated with Project construction, O&M, and conceptual decommissioning during the Proposed Action would result in a nominal increase in vessel traffic relative to the overall existing volume of vessel traffic offshore Virginia and within the OCS in general (Appendix F, Table F1-14). Larger vessels used during construction would largely transit to the Project work site and remain there for most of the construction period. Smaller support vessels are expected to make more frequent trips between Project ports and the work site to deliver supplies and crew members. Regular trips would also be made by Project vessels throughout operations and maintenance for routine maintenance of Project components. Increased vessel traffic from Project activities presents a vessel strike risk to individual sea turtles of the species identified as potentially occurring in the Project area, all of which are listed as threatened or endangered under the Endangered Species Act; a strike that results in serious injury or mortality could have severe consequences. Sea turtle stranding data reported that stranded sea turtles with evidence of vessel strike injury were as high as 25 percent in the Chesapeake Bay, Virginia (Barco et al. 2016). Similarly, Foley et al. (2019) reported that roughly one-third of stranded loggerhead, leatherback, and green sea turtles in Florida had injuries indicative of a vessel strike. However, all Project vessels would implement mitigation measures outlined in the COP (Section 4.2.6.3, Table 4.2-63; Dominion Energy 2023) following guidance from both NOAA and BOEM to reduce the likelihood of vessel strike on sea turtles. Mitigation measures such as vessel speed restrictions and protected species monitoring, while geared towards marine mammals, will subsequently benefit sea turtles by reducing the risk of a vessel strike occurring. PSOs for offshore wind site investigation surveys have reported sightings of sea turtles during vessel transits and survey operations (Marine Ventures International, Inc. 2022; RPS 2021). RPS (2021) recorded 75 leatherback sea turtles, 470 loggerhead sea turtles, and 83 unidentified turtles over a 2-year period totaling roughly 4,893 observation hours, which equates to approximately 13 sea turtle detections per 100 hours of survey and vessel effort. These detection rates are relatively high, and even with these high detection rates there were only 18 vessel strike mitigation actions required (2.8 percent of all sea turtle detections) and no strikes reported. Therefore, with the implementation of vessel strike avoidance measures such as visual monitoring, impacts from vessel traffic on sea turtles would be minor under the Proposed Action, including conceptual decommissioning.

Fishing gear utilization (biological/fisheries monitoring surveys): Under the Proposed Action, fisheries monitoring surveys would be conducted for whelk, black sea bass, and Atlantic surf clam (Appendix H, Table H-2). These survey activities would include use of trap/pot fishing gear for the welk and black sea bass and dredging for the Atlantic surf clam which would post a risk of entrainment or unintended capture for sea turtles. However, the Proposed Action also includes a number of mitigation and monitoring measures, such as removing all sampling gear from the water at least once every 30 days; recovering lost survey gear; having at least one onboard staff member who has completed the Northeast Fisheries Observer Program observer training (within the last 5 years) or other training in protected species identification and safe handling; and having adequate disentanglement equipment (i.e., knife and boathook) onboard vessels deploying fixed gear (Appendix H). Given the limited duration and spatial extent of all fisheries monitoring survey efforts and the implementation of the monitoring and mitigation measures (Appendix H), the effects from monitoring surveys (e.g., entanglement, reductions in prey) on sea turtles are considered extremely unlikely to occur and though they would be detectable and measurable, would not lead to population-level effects. The impact of survey gear utilization on sea turtles as a result of the Proposed Action, therefore, is expected to be minor.

3.19.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to cumulative impacts on sea turtles include but are not limited to various coastal development projects. As the Proposed Action would account for about 9.6 percent (up to 202 of 3,287) of the new WTGs on the OCS, a majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action.

Accidental releases: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, and conceptual decommissioning activities would be minor. Entanglement in lost fishing gear is the primary anthropogenic cause of mortality in both juvenile and adult sea turtles (National Research Council 1990 as cited in Shigenaka et al. 2010) and is expected to be the primary source of risk to sea turtles from accidental releases of trash and debris from ongoing and planned activities.

Electromagnetic fields: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be negligible. New subsea cable installation would be predominantly attributed to future offshore wind development, which would result in up to 5,595 miles (9,004 kilometers) of export cables and 5,554 miles (8,938 kilometers) of inter-array cables installed between 2023 and 2030, within which the Proposed Action comprises a relatively small portion of the overall length of the cables (Appendix F, Table F2-1). While each cable would generate EMF effects in the immediate surrounding area, only sea turtles at or directly above the seafloor near the cables would likely be able to detect it, and impacts would be limited to negligible, short-term behavioral responses.

Light: The expected negligible impact of the Proposed Action alone would not noticeably increase the overall impacts of light beyond the impacts described under the No Action Alternative (Section 3.19.3). Under the expanded planned action scenario, over 3,287 offshore structures would have lights, and these would be incrementally added over time beginning in 2023 and continuing through 2030 (Appendix F, Table F2-1). Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021) guidance. In the context of reasonably foreseeable environmental trends, combined lighting impacts on sea turtles from ongoing and planned actions, including the Proposed Action would be expected to have negligible, non-measurable impacts on sea turtles. Ongoing and future non-offshore wind activities are not expected to cause permanent impacts, primarily driven by light from offshore structures and short-term and localized impacts from vessel lights.

New cable emplacement/maintenance: The expected negligible incremental impact of the Proposed Action or combined with ongoing and planned actions would result in seafloor disturbance from the offshore export cable and inter-array cables. In the context of reasonably foreseeable environmental trends, the combined cable emplacement impacts from ongoing and planned actions, including the Proposed Action, could occur if impacts are in close temporal and spatial proximity. However, these impacts from cable emplacement would be expected to be negligible and would not be expected to be biologically notable.

Noise: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be minor for sea turtles. The main activity that would result in adverse effects on sea turtles is impact pile driving during installation of WTG and OSS foundations. The expected minor incremental impact of the impact pile driving under the Proposed Action, combined with future offshore wind activities, would result in increased underwater noise levels during construction starting in 2023 and continuing through 2030, but the effects of this activity would cease once pile driving stopped (Appendix F, Table F2-1). All other noise-producing activities under the Proposed Action, including conceptual decommissioning, are expected to result in negligible impacts on sea turtles, and combined impacts with ongoing and planned actions would similarly be negligible. Impacts from other noise producing activities are lower in intensity relative to impact pile driving, and impacts would be localized, temporary, and not biologically notable for sea turtle populations.

Port utilization: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be negligible.

Presence of structures: The Proposed Action would contribute to the cumulative impacts of structures on sea turtles, which are expected to minor.

Vessel traffic: In the context of reasonably foreseeable environmental trends, the combined vessel traffic impacts from ongoing and planned actions, including the Proposed Action, and conceptual decommissioning, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be minor.

Fishing gear utilization (biological/fisheries monitoring surveys): In the context of reasonably foreseeable environmental trends, the combined fishing gear utilization impacts from ongoing and planned actions, including the Proposed Action, and conceptual decommissioning, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be minor.

3.19.5.2 Conclusions

Impacts of the Proposed Action. Project construction, operations and maintenance, and conceptual decommissioning would likely result in habitat disturbance, underwater noise, vessel traffic, artificial lighting, and potential accidental discharges or spills and trash. BOEM anticipates the impacts resulting from the Proposed Action would range from **negligible** to **minor**. Therefore, the overall impacts on sea turtles are expected to be **minor**, as the overall effect would be notable, but the resource is expected to recover completely with remedial or mitigating action.

Cumulative impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action, would range from **negligible** to **minor**. The Proposed Action could also result in **minor beneficial** impacts that may be offset by the risk of entanglement in derelict or abandoned fishing gear or fishing line. Considering all the IPFs collectively, impacts from ongoing and planned actions, including the Proposed Action, would result in **minor** impacts on sea turtles in the geographic analysis area. The main driver for this impact rating is underwater noise from impact pile driving (rated as a minor impact). Considering the fact that all sea turtle species in the region are currently listed as endangered or threatened under the ESA, the overall rating reflects this highest, or most severe rating from individual IPFs. The Proposed Action would contribute to the overall impact rating primarily through additional impact pile driving, vessel traffic, and WTG/OSS structures that would be present in the region during Project construction and operations and maintenance. Therefore, overall impacts on sea turtles are expected to be **minor** because a measurable impact is anticipated, but the resource would likely recover completely when activities cease or remedial or mitigating actions are taken.

3.19.6 Impacts of Alternatives B and C on Sea Turtles

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. Alternatives B and C would reduce the number of proposed WTGs but would lead to the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. However, Alternatives B and C would remove 29 and 33 turbines, respectively; therefore, there would be a smaller area of seabed disturbance and water column disturbance and a shorter duration of noise impacts. The area of seabed disturbed by Alternatives B and C would be decreased by approximately 14 percent and 17 percent compared to the Proposed Action, respectively. Although this would decrease the overall duration of impact pile driving expected during the construction period, the noise produced per pile would be expected to be similar to that described under the Proposed Action and impacts on sea turtles would be expected to remain minor.

Operational impacts of reduced WTGs on sea turtles under Alternatives B and C would be minimally decreased compared to the Proposed Action due to the fewer number of WTGs and subsequent smaller area of impact. Less habitat would be altered and affected by WTG operational noise, artificial lighting, and EMF from the inter-array cable. However, in the vicinity of the Project, effects would not be measurably different from those of the Proposed Action.

If Alternative B or Alternative C were approved, associated risks to sea turtles, particularly related to pile-driving noise, would be less than those expected under the Proposed Action.

Cumulative impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternatives B and C, would be similar to those described under the Proposed Action.

3.19.6.1 Conclusions

Impacts of Alternatives B and C. Although Alternatives B and C would decrease the number of WTGs and their associated inter-array cables, BOEM expects that the impacts resulting from Alternatives B and C alone would be similar to those of the Proposed Action and would range from **negligible** to **minor**.

Cumulative impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternatives B and C, would be similar to those described under the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts, and with the potential for **minor beneficial** impacts to be offset by the risk of entanglement in derelict or abandoned fishing gear or fishing line. While Alternatives B and C may result in a slightly lower risk of impacts on sea turtles than described under the Proposed Action, the overall impacts of Alternatives B and C on sea turtles would be the same as under the Proposed Action and would remain **minor**. This impact rating is determined primarily by ongoing activities such as those that produce underwater noise and vessel activities. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.19.7 Impacts of Alternative D on Sea Turtles

Impacts of Alternative D. Alternative D would result in the same types of impacts on sea turtles from construction, O&M, and decommissioning as the Proposed Action. The scope of construction and installation activities and their associated IPFs under Alternative D are designed to reduce the impact on onshore habitats but, as described in Section 3.19.1, sea turtles around the Project area are primarily expected to remain offshore in the Project area. Loggerhead sea turtles, green sea turtles, and Kemp's ridley sea turtles have been documented nesting in Virginia (USFWS 2005; Wright 2015; Parker 2020; Wollam 2023) but, given the availability of nest beaches relative to the proposed onshore cable construction footprint, no biologically relevant impacts on breeding for this population are expected under Alternative D. The primary IPFs that would affect sea turtles are underwater noise and vessel traffic, which would not differ from that described under the Proposed Action, and impacts on sea turtles would be expected to remain negligible to minor.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternative D, would be the same as those described under the Proposed Action.

3.19.7.1 Conclusions

Impacts of Alternative D. Although Alternative D would minimize impacts on onshore habitats, this is not expected to result in a notable benefit for sea turtles in this region, and overall potential impacts would be the same as under the Proposed Action and would range from **negligible** to **minor**.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternative D, would be the same as those described under the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts, and would also result in **minor beneficial** impacts. However, it is important to note that these benefits may be offset by the risk of entanglement in derelict fishing gear. While Alternative D is designed to minimize impacts on onshore habitats, the overall impacts of Alternative D on sea turtles would be the same as under the Proposed Action and would remain **minor**. This impact rating is determined primarily by ongoing activities, such as those that produce underwater noise and vessel activities. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.19.8 Agency-Required Mitigation Measures

The mitigation measures listed in Table 3.19-5 are recommended for inclusion in the preferred alternative. If one or more of the measures analyzed below are adopted, the risk for some adverse impacts could be further reduced. There are no additional agency-required mitigation measures identified as relevant for sea turtles (Appendix H, Table H-3).

Table 3.19-5 Measures Resulting from Consultations[1]

Measure	Description	Effect
Vessel strike avoidance procedures	Applicant proposed measures plus: • As part of vessel strike avoidance, a training program will be implemented. The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet.	This measure would ensure effective monitoring and separation distances from sea turtles, which will reduce potential interactions between

Measure	Description	Effect
	Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event. Vessel operators and crew must maintain a vigilant watch for marine mammals and sea turtles by slowing down or stopping their vessels to avoid striking these protected species. Vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures.	Project-related vessels and sea turtles.
BOEM PDCs and BMPs	BOEM will require Dominion Energy comply with all the Project Design Criteria and BMP for Protected Species at https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf, that implement the integrated requirements for threatened and endangered species resulting from the June 29, 2021, programmatic consultation under the ESA, revised September 1, 2021. This requirement also applies to non-ESA-listed marine mammals that are found in that document. Consultation conditions occurring in State waters outside of BOEM jurisdiction may apply to co-action agencies issuing permits and authorizations under this consultation	Compliance with PDCs and BMPs for protected species would minimize risk to sea turtles during site characterization and site assessment surveys.
Look out for sea turtles and reporting	a. For all vessels operating north of the Virginia/North Carolina border, between June 1 and November 30, Dominion Energy would have a trained lookout posted on all vessel transits during all phases of the project to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements in I below can be implemented. b. For all vessels operating south of the Virginia/North Carolina border, year-round, Dominion Energy would have a trained lookout posted on all vessel transits during all phases of the project to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements II below can be implemented. This requirement is in place year-round for any vessels transiting south of Virginia, as sea turtles are present year-round in those waters. c. The trained lookout would monitor https://seaturtlesightings.org/ prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day. d. If a sea turtle is sighted within 330 feet (100 meters) or less of the operating vessel's forward path, the vessel operator would slow down to 4	Maintains safe operating distances to minimize vessel interactions with sea turtles. This measure would further clarify the distance at which vessels would divert their path and the distance at which vessels would reduce speed and shift to neutral.

Measure	Description	Effect
	knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 330 feet (100 meters), at which time the vessel may resume normal operations. If a sea turtle is sighted within 164 feet (50 meters) of the forward path of the operating vessel, the vessel operator would shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots. The vessel may resume normal operations once it has passed the turtle. e. Vessel captains/operators would avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots while transiting through such areas. f. All vessel crew members would be briefed in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. Reference materials would be available aboard all project vessels for identification of sea turtles. The expectation and process for reporting of sea turtles (including live, entangled, and dead individuals) would be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so. g. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements on an emergency basis. If any such incidents occur, they would be reported to NMFS within 24 hours. h. If a vessel is carrying a PSO or trained lookout for the purposes of maintaining watch for NARWs, an additional lookout is not required and this PSO or trained lookout would maintain watch for marine mammals and sea turtles. Vessel transits to and from the Offshore Project area, that require PSOs will maintain a speed commensurate with weather conditions and effectively detecting sea turtles prior to reaching the 330 feet (100 meters) avoidance measure.	
Marine debris awareness training	Dominion Energy would ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their	Marine debris and trash awareness training would minimize the risk of sea turtle ingestion of or entanglement in marine debris.

Measure	Description	Effect
	commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities would continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are in fact trained. The training process would include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and • Record keeping and the availability of records for inspection by DOI. By January 31 of each year, Dominion Energy would submit to DOI an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. Dominion Energy would send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).	
BOEM/NMFS meeting requirements for sea turtle take documentation	To facilitate monitoring of the incidental take exemption for sea turtles, through the first year of operations, BOEM and NMFS would meet twice annually to review sea turtle observation records. These meetings/conference calls would be bi-annually) and would use the best available information on sea turtle presence, distribution, and abundance, project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to project operations. These meetings would continue on an annual basis following year one of operations. Upon mutual agreement of NMFS and BOEM, the frequency of these meetings can be changed.	Reporting requirements to document take would improve accountability for documenting and reviewing sea turtle take associated with the Proposed Action.
Data Collection BA BMPs	BOEM would ensure that all PDC and BMPs 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 Dominion Energy project as applicable.	Compliance with PDCs and BMPs for protected species would minimize risk to sea turtles during site characterization and site assessment surveys during all Project phases.

Measure	Description	Effect
BOEM COP PDCs and BMPs	Use standard underwater cables that have electrical shielding to control the intensity of electromagnetic fields (EMF).	This measure would decrease the area and intensity of EMF effects.
BOEM COP PDCs and BMPs	Vessels related to project planning, construction, and operation should travel at reduced speeds when assemblages of cetaceans are observed. Vessels also should maintain a reasonable distance from whales, small cetaceans, and sea turtles, and these should be determined during site-specific consultations.	This measure would minimize the potential of vessel strikes for sea turtles from Project-related vessels.
BOEM COP PDCs and BMPs	Lessees and grantees should minimize potential vessel effects on marine mammals and sea turtles by having project-related vessels follow the NMFS Regional Viewing Guidelines while in transit. Operators should undergo training on applicable vessel guidelines.	This measure would minimize the potential of vessel strikes for sea turtles from Project-related vessels.
BOEM COP PDCs and BMPs	Lessees and grantees should take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	This measure would minimize the potential and severity of noise-related effects.
BOEM COP PDCs and BMPs	Lessees and grantees should avoid and minimize effects on marine species and habitats in the Action Area by posting a qualified observer on site during construction activities. This observer should be approved by BOEM and NMFS.	This measure would increase accountability and ensure the effectiveness of mitigation and monitoring measures
Periodic Underwater Surveys, Reporting of Monofilament and Other Fishing Gear Around WTG Foundations	Dominion Energy must monitor indirect effects associated with charter and recreational fishing gear lost from expected increases in fishing around WTG foundations by surveying at least 10 of the WTGs located closest to shore in the Dominion Energy Lease Area (OCS-A 0483) annually. Survey design and effort may be modified with review and concurrence by DOI. Dominion Energy may conduct surveys by remotely operated vehicles, divers, or other means to determine the frequency and locations of marine debris. Dominion Energy must report the results of the surveys to BOEM (at renewable_reporting@boem.gov) and BSEE (at marinedebris@bsee.gov) in an annual report, submitted by April 30, for the preceding calendar year. Annual reports must be submitted in Word format. Photographic and videographic materials must be provided on a portable drive in a lossless format such as TIFF or Motion JPEG 2000. Annual reports must include survey reports that include: the survey date; contact information of the operator; the location and pile identification number; photographic, video documentation, or both of the survey and debris encountered; any animals sighted; and the disposition of any located debris (i.e., removed or left in place).	This measure would establish requirement for monitoring and reporting of lost monofilament and other fishing gear around WTGs, which would reduce the risk of entanglement associated with the presence of structures.

Measure	Description	Effect
	Annual reports must also include claim data attributable to the Project from Dominion Energy corporate gear loss compensation policy and procedures. Required data and reports may be archived, analyzed, published, and disseminated by BOEM.	
PAM Plan	BOEM and USACE would ensure that Dominion Energy prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. This plan would be submitted to NMFS and BOEM for review and concurrence at least 120 days prior to the planned start of activities requiring PAM.	This measure would ensure the efficacy of PAM placement for appropriate monitoring.
Pile driving monitoring plan	BOEM would ensure that Dominion Energy prepare and submit a Pile Driving Monitoring Plan to BOEM, BSEE, and NMFS for review and concurrence at least 90 days before start of pile driving. The plan would detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan would also describe how BOEM and Dominion Energy would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Dominion Energy would obtain NMFS' concurrence with this plan prior to starting any pile driving.	This measure would ensure adequate monitoring and mitigation is in place during pile driving, which would minimize the potential for Level A or Level B exposures to marine mammals during foundation installation.
PSO Coverage	BOEM and USACE would ensure that PSO coverage is sufficient to reliably detect marine mammals and sea turtles at the surface in the identified clearance and shutdown zones to execute any pile driving delays or shutdown requirements during foundation installation. This will include a PSO/ PAM team on the construction vessel and two additional PSO vessels each with a visual monitoring team. The following equipment and personnel will be on each associated vessel: ***Construction Vessel:*** • 2, visual PSOs on watch • 2, (7x) or (10x) reticle binoculars calibrated for observer height off the water. • 2 (25x or similar) mounted "big eye" binoculars if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1, PAM operator on duty • 1, mounted thermal/IR camera system • 2, (25x or similar) "big eye" binoculars mounted 180 deg apart	This measure ensures adequate monitoring of zones during foundation installation to reduce risk to sea turtles.

Measure	Description	Effect
	• 1, monitoring station for real-time PAM system • 2, handheld or wearable NVDs with IR spotlights • 1, Data collection software system • 2, PSO-dedicated VHF radios • 1, digital single lens reflex camera equipped with a 300-mm lens **Each Additional PSO Vessels (2):** • 2, visual PSOs on watch • 2, (7x) or (10x) reticle binoculars calibrated for observer height off the water. • 1, (25x or similar) mounted "big eye" binoculars if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1, mounted thermal/IR camera system • 1, handheld or wearable NVD with IR spotlight • 1, Data collection software system • 2, PSO-dedicated VHF radios • 1, digital single lens reflex camera equipped with a 300-mm lens If, at any point prior to or during construction, the PSO coverage that is included as part of the Proposed Action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs, platforms, or both would be deployed. Determinations prior to construction would be based on review of the Pile Driving Monitoring Plan. Determinations during construction would be based on review of the weekly pile driving reports and other information, as appropriate.	
Sound Field Verification Plan	BOEM would require Dominion Energy to develop an operational sound field verification plan to determine the operational noises emitted from the Offshore Project area. The plan would be reviewed and approved by BOEM and NMFS. The plan will include measurement procedures and results reporting that meet ISO standard 18406:2017 (Underwater acoustics – Measurement of radiated underwater sound from percussive pile driving)	This measure would establish requirements for operational noise monitoring.
Sound field verification	Applicant proposed measures plus: BOEM and USACE would ensure that if the clearance, shutdown zones, or both are expanded due to the verification of sound fields from Project activities, PSO coverage is sufficient to reliably monitor the expanded clearance, shutdown zones, or both. Additional observers would be deployed on additional platforms for every 4,921 feet (1,500 meters) that a clearance or shutdown zone is	This measure would ensure adequate monitoring of clearance zones in order to minimize noise-related effects on sea turtles.

Measure	Description	Effect
	expanded beyond the distances modeled prior to verification.	
Adaptive shutdown zones	BOEM and USACE may consider reductions in the shutdown zones for sei, fin or sperm whales based on sound field verification of a minimum of 3 piles; however, BOEM/USACE would ensure that the shutdown zone for sei whales, fin whales, blue whales, and sperm whales is not reduced to less than 3,280 feet (1,000 meters), or 1,640 feet (500 meters) for sea turtles. No reductions in the clearance or shutdown zones for NARWs would be considered regardless of the results of sound field verification of a minimum of three piles.	This measure would ensure that shut down zones are sufficiently conservative in order to minimize noise-related effects on sea turtles.
Minimum visibility requirement	• In order to commence pile driving at foundations, PSOs must be able to visually monitor a 5,741-foot (1,750-meter) radius from their observation points for at least 60 minutes immediately prior to piling commencement. • In order to commence pile driving at trenchless installation sites, PSOs must be able to visually monitor a 3,280-foot (1,000-meter) from their observation points for at least 30 minutes immediately prior to piling commencement. Acceptable visibility will be determined by the Lead PSO.	This measure would ensure adequate monitoring of zones, which would minimize noise-related effects on sea turtles.
Monitoring zone for sea turtles	Applicant proposed measures plus: BOEM and USACE would ensure that Dominion Energy monitors the full extent of the area where noise would exceed the root-mean-square sound pressure level (SPL) 175 dB re 1 μPa behavioral disturbance threshold for 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.	This measure would ensure accurate monitoring of sea turtle take in order to ensure that all take that occurs is documented.
Alternative Monitoring Plan (AMP) for Pile Driving	Dominion Energy must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevent visual monitoring of the full extent of the clearance and shutdown zones. • Dominion Energy must submit an AMP to BOEM and NMFS for review and approval at least 6 months prior to the planned start of pile-driving. This plan may include deploying additional observers, alternative monitoring technologies such as night vision, thermal, and infrared technologies, or use of PAM and must demonstrate the ability and effectiveness to maintain all clearance and shutdown zones during daytime as outlined below in Part 1 and nighttime as outlined in Part 2 to BOEM's and NMFS's satisfaction.	This measure would establish requirements for nighttime and low-visibility impact pile driving approval, which would serve to decrease the potential for noise-related impacts to occur during those conditions.

Measure	Description	Effect
	• The AMP must include two stand-alone components as described below: o Part 1 – Daytime when lighting or weather (e.g., fog, rain, sea state) conditions prevent visual monitoring of the full extent of the clearance and shutdown zones. Daytime being defined as 1 hour after civil sunrise to 1.5 hours before civil sunset. o Part 2 – Nighttime inclusive of weather conditions (e.g., fog, rain, sea state). Nighttime being defined as 1.5 hours before civil sunset to 1 hour after civil sunrise. • If a protected marine mammal or sea turtle is observed entering or found within the shutdown zones after impact pile-driving has commenced, Dominion Energy would follow the shutdown procedures outlined in Table 1-7 of the NMFS Biological Assessment. Dominion Energy would notify BOEM and NMFS of any shutdown occurrence during piling driving operations with 24 hours of the occurrence unless otherwise authorized by BOEM and NMFS. • The AMP should include, but is not limited to the following information: o Identification of night vision devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable NVDs, infrared spotlights), if proposed for use to detect protected marine mammal and sea turtle species. o The AMP must demonstrate (through empirical evidence) the capability of the proposed monitoring methodology to detect marine mammals and sea turtles within the full extent of the established clearance and shutdown zones (i.e., species can be detected at the same distances and with similar confidence) with the same effectiveness as daytime visual monitoring (i.e., same detection probability). Only devices and methods demonstrated as being capable of detecting marine mammals and sea turtles to the maximum extent of the clearance and shutdown zones will be acceptable. o Evidence and discussion of the efficacy (range and accuracy) of each device proposed for low visibility monitoring must include an assessment of the results of field studies (e.g., Thayer Mahan demonstration), as well as supporting documentation regarding the efficacy of all proposed alternative monitoring methods (e.g., best scientific data available).	

Measure	Description	Effect
	○ Reporting procedures, contacts and timeframes. BOEM may request additional information, when appropriate, to assess the efficacy of the AMP.	
Sampling gear	All sampling gear would be hauled at least once every 30 days, and all gear would 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 for sea turtles.
Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in the surveys would be uniquely marked to distinguish it from other commercial or recreational gear. Using black and yellow striped duct tape, place a 3-foot-long mark within 2 fathoms of a buoy. In addition, using black and white paint or duct tape, place 3 additional marks on the top, middle and bottom of the line. These gear marking colors are proposed as they are not gear markings used in other fisheries and are, therefore, distinct. Any changes in marking would not be made without notification and approval from NMFS.	Gear identification would improve accountability in the case of gear loss and distinguish survey gear from other commercial or recreational gear.
Lost survey gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS (mailto:nmfs.gar.incidental-take@noaa.gov) within 24 hours of the documented time of missing or lost gear. This report would include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	This measure would promote the recovery of lost gear, which would reduce risk of entanglement for sea turtles.
Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) would have adequate disentanglement equipment (i.e., knife and boathook) onboard. Any disentanglement would occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).	This measure would promote safe handling and release of sea turtles, which would improve survivability of entangled and released individuals.
Sea turtle/ESA-fish identification and data collection	Any sea turtles or ESA-fish caught, retrieved, or both in any fisheries survey gear would first be identified to species or species group. Each ESA-listed species caught, retrieved, or both would then be properly documented using appropriate equipment and data collection forms. Biological data, samples, and tagging would occur as outlined below. Live, uninjured animals should be returned to the water as quickly as possible after completing the required handling and documentation. • The Sturgeon and Sea Turtle Take Standard Operating Procedures would be followed	This measure would require standard data collection and documentation of any sea turtles caught during surveys.

Measure	Description	Effect
	(download at: https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). • Survey vessels would have a passive integrated transponder (PIT) tag reader onboard capable of reading 134.2 kHz and 125 kHz encrypted tags (e.g., Biomark GPR Plus Handheld PIT Tag Reader) and this reader be used to scan any captured sea turtles and sturgeon for tags. Any recorded tags would be recorded on the take reporting form (see below). • Genetic samples would be taken from all captured ESA-fish (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This would be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (download at: https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). ○ Fin clips would be sent to a NMFS approved laboratory capable of performing genetic analysis and assignment to DPS of origin. To the extent authorized by law, BOEM is responsible for the cost of the genetic analysis. Arrangements would be made for shipping and analysis in advance of submission of any samples; these arrangements would be confirmed in writing to NMFS within 60 days of the receipt of this ITS. Results of genetic analysis, including assigned DPS of origin would be submitted to NMFS within 6 months of the sample collection. ○ Subsamples of all fin clips and accompanying metadata forms would be held and submitted to a tissue repository (e.g., the Atlantic Coast Sturgeon Tissue Research Repository) on a quarterly basis. The Sturgeon Genetic Sample Submission Form is available for download at: https://media.fisheries.noaa.gov/2021-02/Sturgeon%20Genetic%20Sample%20Submission%20sheet%20for%20S7_v1.1_Form%20to%20Use.xlsx?null. All captured sea turtles and ESA-fish would be documented with required measurements and photographs. The animal's condition and any marks or injuries would be described. This information would be entered as part of the record for each incidental take. A NMFS Take Report Form would be filled out for each individual sturgeon and sea turtle (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null)	

Measure	Description	Effect
	and submitted to NMFS as described below.	
Sea turtle/ESA-fish handling and resuscitation guidelines	Any sea turtles or ESA-fish caught and retrieved in gear used in fisheries surveys would be handled and resuscitated (if unresponsive) according to established protocols and whenever at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically: • Priority would be given to the handling and resuscitation of any sea turtles or ESA-fish that are captured in the gear being used, if conditions at sea are safe to do so. Handling times for these species should be minimized (i.e., kept to 15 minutes or less) to limit the amount of stress placed on the animals. • All survey vessels would have copies of the sea turtle handling and resuscitation requirements found at 50 CFR 223.206(d)(1) prior to the commencement of any on-water activity (download at: https://media.fisheries.noaa.gov/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures would be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during the Proposed Actions. • If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff would immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-6622 for further instructions and guidance on handling the animal, and potential coordination of transfer to a rehabilitation facility. If unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held on board for up to 24 hours following handling instructions provided by the Hotline, prior to transfer to a rehabilitation facility. • Attempts would be made to resuscitate any ESA-fish that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (download at: https://media.fisheries.noaa.gov/dam-migration/sturgeon_resuscitation_card_06122020_508.pdf). • Provided that appropriate cold storage facilities are available on the survey vessel, following the report of a dead sea turtle or sturgeon to NMFS, and if NMFS requests, any dead sea turtle or ESA-fish would be retained on board the survey vessel for transfer to an appropriately permitted partner or	This measure would promote safe handling and release of sea turtles, which would improve survivability of entangled and released individuals.

Measure	Description	Effect
	facility on shore as safe to do so. Any live sea turtles or ESA-fish caught and retrieved in gear used in any fisheries survey would ultimately be released according to established protocols and whenever at-sea conditions are safe for those releasing the animal(s) to do so.	
Take notification	GARFO PRD would be notified as soon as possible of all observed takes of sea turtles and ESA-fish occurring as a result of any fisheries survey. Specifically: • GARFO PRD would be notified within 24 hours of any interaction with a sea turtle or ESA-fish (nmfs.gar.incidental-take@noaa.gov). The report would include at a minimum (1) survey name and applicable information (e.g., vessel name, station number); (2) GPS coordinates describing the location of the interaction (in decimal degrees); (3) gear type involved (e.g., bottom trawl, gillnet, longline); (4) soak time, gear configuration and any other pertinent gear information; (5) time and date of the interaction; and (6) identification of the animal to the species level. Additionally, the email would transmit a copy of the NMFS Take Report Form (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports would be submitted as soon as possible; late reports would be submitted with an explanation for the delay. At the end of each survey season, a report would be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report would also contain information on all survey activities that took place during the season including location of gear set, duration of soak/trawl, and total effort. The report on survey activities would be comprehensive of all activities, regardless of whether ESA-listed species were observed.	Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action.
Monthly/annual reporting	Applicant proposed measures plus: BOEM would ensure that Dominion Energy implements the following reporting requirements necessary to document the amount or extent of take that occurs during all phases of the Proposed Action: • All reports would be sent to: nmfs.gar.incidental-take@noaa.gov.	Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action.

Measure	Description	Effect
	• During the construction phase and for the first year of operations, Dominion Energy would compile and submit monthly reports that include a summary of all project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), and piles installed, and all observations of ESA-listed species. Monthly reports are due on the 15th of the month for the previous month. Beginning in year two of operations, Dominion Energy would compile and submit annual reports that include a summary of all project activities carried out in the previous year, including vessel transits (number, type of vessel, and route), repair and maintenance activities, survey activities, and all observations of ESA-listed species. These reports are due by April 1 of each year (i.e., the 2026 report is due by April 1, 2027). Upon mutual agreement of NMFS and BOEM, the frequency of reports can be changed.	
Reporting	Dominion Energy will report to BOEM and BSEE within 24 hours of confirmation any incidental take of an endangered or threatened species.	Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action.

[1] Also Identified in Appendix H, Table H-2.
BMP = best management practice; BOEM = Bureau of Ocean Energy Management; BSEE = Bureau of Safety and Environmental Enforcement; COP = Construction and Operations Plan; DMA = Dynamic Management Area; DOI = Department of the Interior; DPS = distinct population segment; ESA = Endangered Species Act; GARFO PRD = Greater Atlantic Regional Fisheries Office Protected Resources Division; IR = infrared; ITS = incidental take statement; NARW = North Atlantic right whale; NMFS = National Marine Fisheries Service; NVD = night vision device; O&M = operations and maintenance; PAM = passive acoustic monitoring; PDC = project design criteria; PSO = protected species observer; SMA = Seasonal Management Area; USACE = U.S. Army Corps of Engineers; VHF = very high-frequency; WTG = wind turbine generator.

3.19.8.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.19-5 and Appendix H, Table H-2 are incorporated into the preferred alternative. There are no additional agency-required mitigation measures identified as relevant for sea turtles (Appendix H, Table H-3). These measures, if adopted, would serve to reduce impacts on sea turtles and are broadly categorized as follows.

- **Vessel strike avoidance and look out for sea turtles and reporting:** Measures to minimize vessel interactions would reduce the 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.
- **BOEM PDCs and BMPs for data collection activities:** Compliance with project design criteria and BMPs for protected species would minimize risk to sea turtles during site characterization and site assessment activities. While adoption of this measure would decrease risk to sea turtles under the Proposed Action, it would not alter the impact determination.
- **BOEM COP PDCs and BMPs to minimize vessel interactions and EMF, noise, and habitat effects:** Compliance with project design criteria to minimize vessel interactions would reduce the risk

of vessel strike. Compliance with project design criteria to minimize EMF, noise, and habitat effects would minimize the potential and severity of effects for sea turtles. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determinations.

- **Marine debris awareness training:** 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.
- Passive Acoustic Monitoring Plan, Pile-Driving Monitoring Plan, adaptive shutdown zones, minimum visibility requirements, Alternative Monitoring Plan, protected species observer coverage, sound field verification, shutdown zones, and monitoring zones for sea turtles: The development of an Alternative Monitoring Plan, adaptive shutdown zones, minimum visibility requirements, protected species observer coverage, shutdown zones, and monitoring zones for sea turtles would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. The development of a Pile-Driving Monitoring Plan and sound field verification would increase the accountability of underwater noise mitigation during pile driving. While adoption of these measures would decrease risk to sea turtles during impact pile driving or increase accountability during this construction activity under the Proposed Action, it would not alter the impact determination.
- **Operational Sound Field Verification Plan:** The development of an Operational Sound Field Verification Plan would allow BOEM to confirm that impacts of operating WTG noise 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.
- **Periodic underwater surveys, and reporting of monofilament and other fishing gear around WTG foundations:** 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.
- **Sampling gear, gear identification, lost survey gear, survey training, sea turtle disentanglement, sea turtle identification and data collection, sea turtle handling and resuscitation guidelines, and take notification:** The regular hauling of sampling gear, survey staff training, sea turtle disentanglement, and handling and resuscitation guidelines would reduce risk of entanglement or effects of entanglement in fisheries survey gear. Gear identification and lost survey gear would improve accountability in the case of gear loss. Sea turtle identification and data collection and take notification would improve accountability for documenting take associated with fisheries surveys. While adoption of these measures would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination.
- **Incidental take, monthly, and annual reporting requirements and meeting requirements for sea turtle take documentation:** Reporting requirements and meeting requirements to document take would improve accountability for documenting take associated with the Proposed Action. While adoption of these measures would improve accountability, it would not alter the overall impact determinations.

3.20 Scenic and Visual Resources

This section discusses potential impacts on seascape and landscape character and views 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 2016).

The analysis of scenic and visual resources is made up of two separate but linked parts: seascape, open ocean, and landscape impact assessment (SLIA) and visual impact assessment (VIA). SLIA analyzes and evaluates impacts on both the physical elements and the aesthetic, perceptual, and experiential aspects that make the landscape, seascape, or open ocean distinctive. These impacts affect the “feel” or “character” of the landscape, seascape, or open ocean, rather than the composition of a view from a particular place. In SLIA, the impact receptors (the entities that are potentially affected by the proposed Project) are the seascape/open ocean/landscape itself defined by its physical features and distinctive character.

VIA analyzes and evaluates the impacts of the proposed development on people. VIA evaluates the composition changes of selected views and assesses how the people who are likely to be at that viewpoint may be affected by the change. The inclusion of both SLIA and VIA in the BOEM seascape, landscape, and visual impact assessment (SLVIA) methodology is consistent with NEPA’s objective of providing Americans with aesthetically and culturally pleasing surroundings and its requirement to consider all potentially significant impacts of development.

This section is a summary of the SLIA and VIA analysis and findings. A detailed description of methodology and analysis can be found in Appendix M, *Seascape, Landscape, and Visual Impact Assessment*.

BOEM utilized viewsheds, context photographs, and visual simulations from select viewing locations as tools for this analysis. These resources can be found in the attachments to COP, Appendix I-1, *Offshore Visual Impact Assessment* and Appendix I-2, *Onshore Visual Impact Assessment* (Dominion Energy 2023). The visual simulations represent the diverse weather conditions found along coastal Virginia and North Carolina; however, the NEPA analysis is based on clear sky views and numeric calculations, regardless of the weather represented in the photographs. For a more complete discussion of methods and analysis of offshore wind structures’ potential impact on seascape and landscape character, please refer to Appendix M.

The PDE parameters reviewed for potential visual effects are summarized in Table I-1-1 of COP, Appendix I-1, and include a general layout of up to 202 WTGs, up to 3 OSSs, their respective foundations, and preferred and maximum capacity WTGs (14–16 MW). The 40-mile (64.4-kilometer) Offshore Visual Study Area shown on Figure I-1-9 of COP, Appendix I-1 extends approximately 14.9 miles (24.1 kilometers) inland and includes the coastline and offshore areas associated with the Delmarva Peninsula, Virginia Beach, and the northern tip of North Carolina to incorporate potential views of the Project, as indicated by the WTG potential visibility areas (Figure 3.20-1). Offshore visual effects are analyzed for the maximum parameters in the PDE. Sensitive historic resources mapped in Figure 3.20-1 include adversely affected historic properties and districts as determined by BOEM through Section 106 consultation. Please see Section 3.10, *Cultural Resources*, and Appendix O, *Finding of Adverse Effect for the Coastal Virginia Offshore Wind Commercial Construction and Operations Plan*, for more detail.

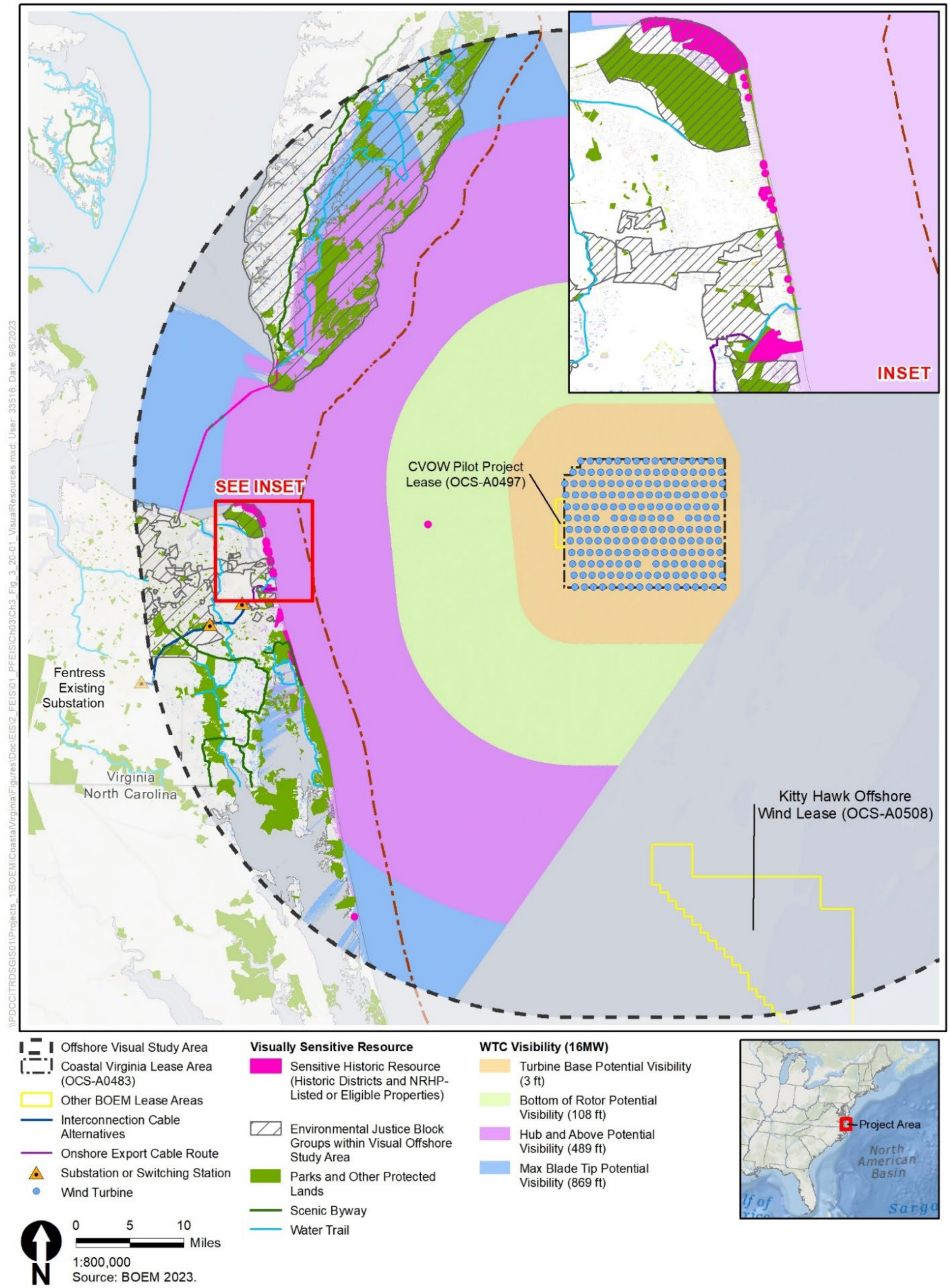


Figure 3.20-1 Scenic and Visual Resources Geographic Analysis Area

The onshore geographic analysis area encompasses a 5-mile (8-kilometer) perimeter for the following Onshore Project components.

- Cable Landing Location at the Virginia State Military Reservation.
- Underground transmission line connecting it to a point north of Harpers Road in Virginia Beach, known as the Onshore Cable Route Corridor.
- Harpers Switching Station.
- Fentress Substation.
- Chicory Switching Station proposed for the Hybrid Route.
- One overhead transmission line route and one underground/overhead hybrid transmission line route, known as IC Route 1 and Route 6.

The PDE parameters reviewed for potential visual effects from onshore components are summarized in COP, Appendix I-2 (Dominion Energy 2023). Onshore visual effects are analyzed for the above components and include foreground to background views except where vegetation and structures prevent view of these facilities; refer to Appendix M for detailed analysis.

3.20.1 Description of the Affected Environment for Scenic and Visual Resources

This section summarizes the coastal zone management; seascape, open ocean, and landscape baseline conditions; and viewer baseline conditions as described in the VIA (Appendix I of the COP; Dominion Energy 2023).

3.20.1.1 Coastal Zone Management

NOAA approved the Virginia Coastal Management Program in 1986, and the Virginia Department of Environmental Quality serves as the lead agency. Authorized by a commonwealth executive order, the coastal management program is structured as a network of agencies that have authority for implementing policies covering wetlands, fisheries, water quality, dunes and beaches, subaqueous lands, and other coastal resources in the Virginia coastal zone. The North Carolina Coastal Management Program, approved by NOAA in 1978, is administered by the Division of Coastal Management within the North Carolina Department of Environment and Natural Resources. The primary authority for the coastal management program is the Coastal Area Management Act (1974). Specific state and local land use plans and guidance that address scenic and visual resources are summarized in Appendix M, Section M.1.1, and are described in detail in COP, Appendix I-2 (Dominion Energy 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 is based on the juxtaposition of apparent seacoast and landward landscape elements, including topography, water (bays and estuaries), vegetation, and structures.

3.20.1.2 Seascape, Open Ocean, and Landscape Baseline Conditions

This subsection provides the baseline information for analyzing the seascape, open ocean, and landscape visual impacts as described in the BOEM 2021 SLVIA guidelines (BOEM 2021). The geographic analysis area is classified by broadly defined physiographic areas and more specific character areas. Lands and water areas are based on major differences in landscape structure that define the physical character of the geographic analysis area and include open ocean, shoreline, coast, marsh and bay, and inland areas. Each area is subdivided into character areas that are defined by similar land use patterns, topography, ecological characteristics, and proximity to the ocean. Character areas provide a more specific description of the existing landscape and provide a framework to systematically analyze potential visual effects throughout the geographic analysis area (COP, Appendix I-1, Section 4.3.1.3; Dominion Energy 2023). Table 3.20-1 summarizes the land and water areas and corresponding character areas, used in this analysis.

Table 3.20-1 Land and Water Areas

Land and Water Areas	Character Areas	Examples of Character Areas
Atlantic Ocean	Open Ocean	Chesapeake Light Station
Seascape, Shoreline, and Coastal Features	Beach	Broad sandy areas sloping gently toward the Atlantic Ocean and adjacent dunes with unobstructed views over the ocean
	Beachfront Residential	Residential properties on the oceanfront (North End Beach and Croatan Beach); single-family homes parallel to shore with ocean views and beach access
	Rural Coastal Plain	Delmarva Peninsula and rural residential areas of North Carolina
	Industrial/Military	Large military complexes: Joint Expeditionary Base Little Creek-Fort Story, Dam Neck Naval Base, and State Military Reservation with shoreline views
	Virginia Beach/Tourism	Virginia Beach city center and dense urbanized mixed development within 0.5 mile (0.8 kilometer) of the shoreline
	Recreation	Natural conservation areas, public open spaces, and golf courses. First Landing State Park, False Cape State Park, and Bodie Island
	Historic Resources and Disadvantaged Communities	Cape Henry Lighthouse, Currituck Beach Lighthouse, neighborhoods along Virginia Beach Boardwalk at 17th and 16th Streets
	Transportation Corridor/Scenic Byways	Major interstates and state highways paralleling the coastline (US 60, US 58, and I-264)
	Streets and Highways	Local roads and streets adjacent to the shoreline
Marsh and Bay Features	Inland Bay	Non-ocean open water and inland lakes: Chesapeake Bay, Lynnhaven Bay, Broad Bay, Back Bay, Smith Island Bay, Magothy Bay, Currituck Sound, Coinjack Bay, Sanders Bay, Lake Rudee, Lake Wesley, and Lake Christine
	Lower Coastal Plain/Tide Water	Saltmarsh and brackish open water bays: Smith Island, Mink Island, Myrtle Island, National Wildlife Refuges, coastal reserves, and state wildlife management areas
Inland Landscape (Land, Water, and Surface Features)	High Density/Apartment District	Two- to four-story multi-family housing
	Low Density Residential	Single-family residential areas inland and near coastline, some with oceanfront views
	Agriculture and/or Open, Undeveloped Lands[1]	Working agricultural fields, primarily inland
	Commercial and Developed – Commercial[1]	Retail, commercial, shopping areas, and parking lots located inland

Land and Water Areas	Character Areas	Examples of Character Areas
	Developed – Rural Residential[1]	Single-family homes on large lots surrounded by varied landscape patterns
	Developed – Industrial[1]	Low-lying buildings for production and storage with minimal landscaping and substantial parking
	Developed – Suburban Residential[1]	Single-family homes, planned communities, and subdivisions
	Industrial/Military	Joint Expeditionary Base Little Creek-Fort Story and Oceana Naval Air Station
	Developed Recreation Areas[1]	Playgrounds, picnic areas, and athletic fields
	Forested[1]	Upland forests and forested wetlands
	Open Water[1]	Inland lakes and rivers including water trails
	Streets and Highways	Local roads and streets inland

[1] Seascape character area/landscape character area identified in the Onshore VIA COP.

The geographic analysis area's landforms, water, vegetation, and built environment structures contain common and distinctive landscape features as outlined in Table 3.20-2.

Table 3.20-2 Landform, Water, Vegetation, and Structures

Category	Landscape Features
Landform	Flat shorelines to gently sloping beaches, dunes, barrier islands, and inland topography including gently rolling hills
Water	Ocean, bay, estuary, tidal river, tidal and brackish wetlands, lagoons, marshes, ponds, river, and stream water patterns
Vegetation	Level IV ecoregions of Virginia and North Carolina include the following: • Virginian Barrier Islands and Coastal Marshes: Northern Cordgrass Prairie, Oak-Hickory-Pine Forest on upland sites, and Atlantic Coastal Plain Maritime Forest • Chesapeake-Pamlico Lowlands and Tidal Marshes: Oak-Hickory-Pine forests on drier ground, with dominant species being hickory, longleaf pine, shortleaf pine, and loblolly pine, white oak, and post oak; there are also southern floodplain forests and northern cordgrass prairies; this region also includes nonriverine wet hardwood forests dominated by swamp chestnut oak, cherry bark oak, laurel oak, and water oak • Delmarva Uplands: original forests have been cleared and converted to agriculture including corn, soybeans, fruits, and assorted truck crops
Structures	Buildings, plazas, signage, walks, parking, roads, trails, seawalls, jetties, public art, and infrastructure

Existing scenic resources in the geographic analysis area—including parks and preserves, historic properties, national and state conservation areas, scenic byways, and other resources—are mapped on Figure 3.20-2.

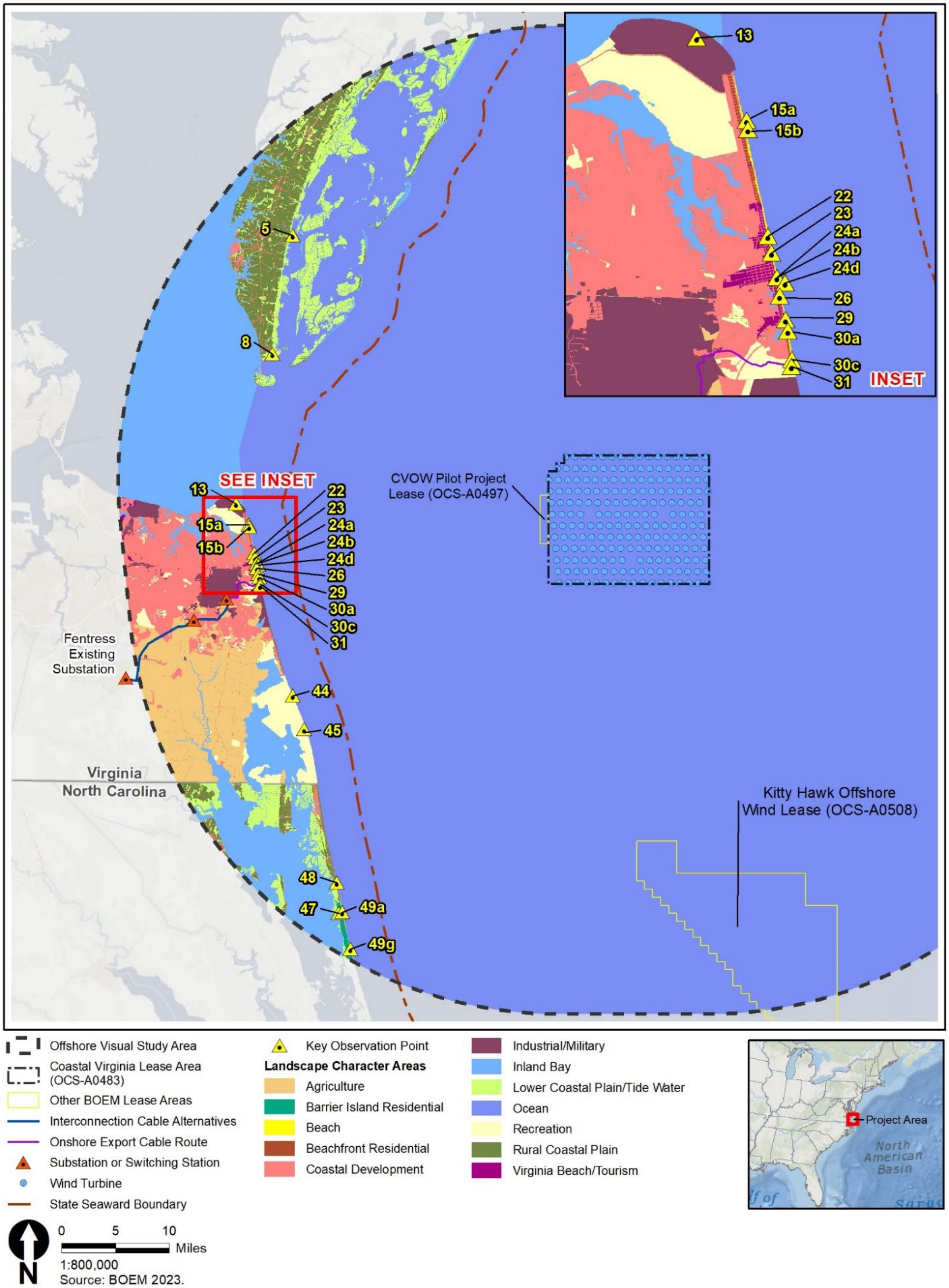


Figure 3.20-2 Scenic Resources and Key Observation Points

The visual characteristics of the seascape, open ocean, and landscape conditions in the geographic analysis area, including surroundings of the Wind Farm Area, landfall sites, offshore and onshore export cable corridors, and onshore substation areas, contain both locally common and regionally distinctive physical features, characters, and experiential views (Table 3.20-3).

Table 3.20-3 Seascape, Open Ocean, and Landscape Conditions

Category	Visual Characteristics
Seascape	
Experiential Views	Intervisibility within coastal and adjacent marine areas (3.45 miles [5.6 kilometers]) within the 40-mile (64.4-kilometer) geographic analysis area by pedestrians and boaters.
Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, and whitecaps.
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	
Experiential Views	Intervisibility within the open ocean (beyond the 3.45-mile [5.5-kilometer] seascape area) within the 40-mile (64.4-kilometer) geographic analysis area from seagoing vessels, including recreational cruising and fishing, commercial "cruise ship" routes, commercial fishing activities, tankers, and cargo vessels; and air traffic over and near the WTG array and cable routes.
Features	Physical features range from flat water to ripples, waves, swells, surf, foam, chop, and whitecaps.
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	
Experiential Views	Intervisibility within ocean, coastal, and adjacent inland areas; 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.
Features	Natural elements: barrier islands, bays, beaches, dunes, 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, and moderate to high-density residences, and high-rise hotels.
Character	Experiential characteristics range from tranquil and pristine, to vibrant and ordered, to chaotic and disordered.

Category	Visual Characteristics
Public Designated Places	
Designated National, State, and Local Parks, Preserves, and Parkways	24th Street Park, Atlantic Wildfowl Heritage Museum, Barbour Hill Campground, Bayville Farms Park, Boardwalk at Lake Holly, Briarwood, Boy Scout Field, Buck Bay National Wildlife Refuge and Visitor Center, Cape Charles Lighthouse, Cape Henry Lighthouse, Cape Henry Memorial Park, Carova Beach, Chris's Beach, Chesapeake Bay Bridge Tunnel Scenic Overlook Trail, Corolla Adventure Park, Croatan Beach, Currituck County Courthouse, Currituck Beach Lighthouse, Currituck National Wildlife Refuge, E Beach, Eastern Shore of Virginia National Wildlife Refuge, False Cape State Park, First Landing State Park Beach and Campground, Fisherman Island National Wildlife Refuge, Great Neck Park, Grommet Island Park Boardwalk, Horn Point, Kendall Grove Historic District, Kiptopeke State Park, Lynnhaven Beach and Boat Ramp, MacKay Island National Wildlife Refuge, Magothy Bay Natural Area Preserve, Marshview Park, Munden Point Park, Mockhorn Island Wildlife Management Area, Museum of Contemporary Art, Myrtle Island Beach, Naval Aviation Monument Park, Neptunes Park, North End Beaches, Ocean View Beach, Oceanfront Beach Park, Old Dam Neck Park, Pine Meadows Park, Princess Anne Memorial Park, Redwing Golf Course, Resort Beach, Sandridge Beach, Sandridge Fishing Pier, Seatack Park, Smith Island Beach, South Beach Trail, Surf Cabana Club, The Narrows, Virginia Aquarium and Marine Science Center, Virginia Beach Boardwalk, Virginia Beach Fishing Pier, Virginia National Wildlife Refuge, Walsh Woods Environmental Center, Wreck Island Natural Area Preserve.

The geographic analysis area's seascape character areas, open ocean character area, and landscape character areas were broadly defined based on like physiographic characteristics (e.g., landform, water, vegetation and land use patters) (COP, Appendix I-1, Dominion Energy 2023). National Land Cover Data, local zoning classifications, and recent aerial imagery were mapped using ArcGIS software and reviewed to identify character 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. The extents of seascape character areas, open ocean character area, and landscape character areas used in this analysis are summarized in Table 3.20-4.

Table 3.20-4. Seascape, Open Ocean, and Landscape Character Types in the Offshore Project Area Viewsheds

Character Area	Total Area in Visual Study Area in Square Miles (square kilometers)	Area in the Zone of Potential Visual Influence (Refined Viewshed)	Percentage of Character Area in the Zone of Potential Visual Influence
Open Ocean Character Area			
Open Ocean[1]	6,302.55 (16,323.5)	2,540.79 (6,580.6)	100[1]
Seascape Character Area			
Lower Coastal Plain/Tide Water	113.73 (294.5)	60.86 (157.6)	53.5
Inland Bay	405.87 (1,051.2)	215.46 (558.0)	53.1
Virginia Beach/Tourism	1.45 (3.75)	0.28 (0.73)	19.3
Beach[2]	0.42 (1.1)	0.42 (1.1)	100
Beachfront Residential[3]	0.69 (1.8)	0.55 (1.4)	79.7
Barrier Island Residential	5.92 (15.3)	4.93 (12.8)	83.3
Industrial/Military[3]	23.58 (61.1)	3.4 (8.8)	14.4

Character Area	Total Area in Visual Study Area in Square Miles (square kilometers)	Area in the Zone of Potential Visual Influence (Refined Viewshed)	Percentage of Character Area in the Zone of Potential Visual Influence
Recreation[3]	38.13 (98.7)	10.68 (27.7)	28.0
Landscape Character Areas			
Agriculture	126.65 (328.1)	9.24 (23.9)	7.3
Coastal Development	114.88 (375.2)	6.17 (16.0)	5.4
Rural Coastal Plain	89.16 (231.0)	11.29 (29.2)	12.7
Important Designated Areas			
NRHP-listed Historic Districts	8.12 (21.0)	1.49 (3.9)	18.3
Designated Environmental Justice Communities	700.97 (1,815.5)	391.12 (1,013.0)	55.8

Source: COP, Appendix I-1, Table I-1-4 (Dominion Energy 2023).
[1] The Open Ocean character area within the zone of potential visual influence as described in the COP includes only the landward facing ocean area as shown in COP, Appendix I-1, Figure I-1-3. The area of open ocean analyzed in this EIS includes the 360 degree viewshed around the Lease Area; therefore, the area of open ocean is the total area within the viewshed.
[2] The Beach character area calculation (described and illustrated in COP, Appendix I-1, Attachment I-3) includes approximately 13 linear miles of beach from the southern boundary of Fort Story to Croatan Beach in Virginia and the beach paralleling the Barrier Island Residential character area in the Corolla area of South Carolina. Additional description is provided in Appendix M, Section.3.1.1.2.4, *Beach*.
[3] These character types are not differentiated between Seascape and Landscape character areas in the COP. They are listed under Seascape character area here because most of the area within the zone of potential influence is within the seascape. These character types also include their adjacent beaches.

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 GIS visibility studies and include the Project's affected resources' extents, verified and augmented by expert onsite analysis (COP, Appendix I; Dominion Energy 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. A higher rating prevails over a lower rating.

Open ocean sensitivity ratings for open ocean character areas 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 have minimal scenic value.

The sensitivity of the geographic analysis area's seascape character is defined by its innate features and elements, its susceptibility to the Project, and its value to residents and visitors. Seascape sensitivity rating criteria are high, medium, or low defined as follows.

- **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 low value to residents and visitors.

Landscape character sensitivity is defined by its innate features, its susceptibility to the Project, and its value to residents and visitors. Landscape sensitivity ratings high, medium, and low are defined as follows.

- **High:** Landscape characteristics are highly susceptible to the Project and highly valued by residents and visitors, or within a designated scenic or historic landscape.
- **Medium:** Landscape characteristics have medium susceptibility to the Project and are of medium value to residents and visitors.
- **Low:** Landscape characteristics are unlikely to be affected by the type of change proposed and are of low value to residents and visitors.

Table 3.20-5 lists the susceptibility, value, and sensitivity ratings within the open ocean, seascape, and landscape character areas.

Table 3.20-5 Seascape, Open Ocean, and Landscape Sensitivity

Settings	Conditions
High-Sensitivity Seascape[1]	Ocean shoreline areas, beach, and dune areas, and ocean areas within 3.45 statute miles (5.5 kilometers) of the shoreline (Table 3.20-2). Seascapes with national, state, or local designations: 24th Street Park, Barbour Hill Campground, Back Bay National Wildlife Refuge (NWR) and Visitor Center, Cape Charles Lighthouse, Cape Henry Lighthouse, Cape Henry Memorial Park, Carova Beach, Chris's Beach, Coast Guard Station Cobb Island Public Boat Ramp, Croatan Beach, Currituck Beach Lighthouse, Currituck NWR, Dam Neck Naval Base, E Beach, Eastern Shore of Virginia NWR, False Cape State Park, First Landing State Park Beach and Campground, Fisherman Island NWR, Grommet Island Park Boardwalk, Horn Point, Little Island Park, Lynnhaven Beach and Boat Ramp, MacKay Island NWR, Magothy Bay NAP, Marshview Park, Munden Point Park, Mockhorn Island Wildlife Management Area, Myrtle Island Beach, Neptunes Park, North End Beaches, Ocean View Beach, Oceanfront Beach Park, Resort Beach, Sandridge Beach, Sandridge Fishing Pier, Seatack Park, Sandbridge Beach, Sandbridge Fishing Pier, Smith Island Beach, South Beach Trail, Surf Cabana Club, Virginia Beach Boardwalk, Virginia Beach Fishing Pier, Virginia NWR, Wreck Island Natural Area Preserve Beaches, Atlantic Wildfowl Heritage Museum, Navy Seal Monument, Virginia Legends Park. Beaches seaward boardwalks, jetties, and piers.
High-Sensitivity Open Ocean	Ocean areas within the geographic analysis area.
Moderate-Sensitivity Open Ocean	Ocean areas within the visual setting and vicinity of the Chesapeake Light Station.
High-Sensitivity Landscape[2]	Landward portions of scenic and medium to high resident and visitor use volume coastal areas and bays, sounds, and adjoining estuaries (Table 3.20-2). Cemeteries, churches, historic sites, lighthouses, scenic overlooks, schools, town halls, and residential areas within the geographic analysis area. Landscapes with national, state, or local designations.

Settings	Conditions
	Landscapes with national, state, or local designations: Linkhorn Bay, Little Neck Creek, Broad Bay, First Landing State Park, Pleasure Point Natural Area, Owl Creek, Lake Rudee, Lake Wesley, Lake Christine, Lake Redwing, Lake Tecumseh, Kiptopeke State Park, Lake Holly Boardwalk, North Landing River Natural Area Preserve, Pungo Ferry Road Virginia Scenic Byway, North Landing River Scenic River.
Medium-Sensitivity Landscape	Inland landscapes with moderately distinctive areas of medium scenic value and/or low resident or visitor use volume beaches, coastal areas and bays, sounds, adjoining estuaries, and inland areas with national, state, or local designations. Fentress Naval Air Landing Field, Great Neck Park, Military Aviation Museum, Mount Trashmore Park, Munden Point Park, Pine Meadows Park, Old Dam Neck Park, Princess Anne Memorial Park, Etheridge Lakes Park, Princess Anne Athletic Complex, Kempsville, Redwing Park, Bayville Farms Park, Cessford, Dr. John Masure Miller House, Eastville Shops/James Brown Dry Good Store.
Low-Sensitivity Landscape	Indistinctive areas with low scenic value and limited-to-absent resident or visitor use volume.

[1] Locations also listed under Landscape extend to both Seascape and Landscape.
[2] Locations also listed under Seascape extend to both Landscape and Seascape.

Seascape character susceptibility is defined by both the susceptibility to impacts from the Project and its visual resources' rarity and scenic value. Seascape susceptibility rating criteria include the following.

- **High:** Seascape characteristics are highly vulnerable to the proposed changes, distinctive, and highly valued by residents and visitors.
- **Medium:** Seascape characteristics are reasonably resilient to the proposed changes, moderately distinctive, and moderately valued by residents and visitors.
- **Low:** Seascape characteristics are unlikely to be affected by the proposed changes, common, and unimportant to residents and visitors.

Open ocean susceptibility is defined by both the susceptibility to impacts from the Project and its visual resources' rarity and scenic value. Open ocean susceptibility rating criteria include the following.

- **High:** Open ocean characteristics are highly vulnerable to the proposed changes, distinctive, and highly valued by residents and visitors.
- **Medium:** Open ocean characteristics are reasonably resilient to the proposed changes, moderately distinctive, and moderately valued by residents and visitors.
- **Low:** Open ocean characteristics are unlikely to be affected by the proposed changes, common, and unimportant to residents and visitors.

Landscape susceptibility is defined by both the vulnerability to impact from the Project, and the visual resources' rarity and scenic value. Landscape susceptibility ratings include the following.

- **High:** Landscape characteristics are highly vulnerable to proposed changes, distinctive, highly valued by residents and visitors, or within a designated scenic or historic landscape.
- **Medium:** Landscape characteristics are reasonably resilient to the type of change proposed, moderately distinctive, and within a landscape of locally valued scenic quality.
- **Low:** Landscape characteristics are unlikely to be affected by the proposed changes, common, or within a landscape of minimal scenic value.

Table 3.20-6 summarizes the conditions within open ocean, seascape, and landscape settings with high, medium, and low susceptibility.

Table 3.20-6 Seascape, Open Ocean, and Landscape Susceptibility

Settings	Conditions
High-Susceptibility Seascape	Ocean shoreline, beach, and dune areas (Table 3.20-2). Seaward boardwalks, jetties, and piers. Seascapes with national, state, or local designations: 24th Street Park, Back Bay NWR, Cape Charles Lighthouse, Cape Henry Lighthouse, Cape Henry Memorial Park, Carova Beach, Chris's Beach, Coast Guard Station Cobb Island Public Boat Ramp, Croatan Beach, Currituck Beach Lighthouse, Currituck NWR, Dam Neck Naval Base, E Beach, Eastern Shore of Virginia NWR, False Cape State Park, First Landing State Park Beach, Fisherman Island NWR, Grommet Island Park Boardwalk, Little Island Park, Lynnhaven Beach, MacKay Island NWR, Magothy Bay Natural Area Preserve, Marshview Park, Munden Point Park, Mockhorn Island Wildlife Management Area, Myrtle Island Beach, Neptunes Park, North End Beaches, Ocean View Beach, Oceanfront Beach Park, Resort Beach, Sandridge Beach, Sandridge Fishing Pier, Seatack Park, Sandbridge Beach, Sandbridge Fishing Pier, Smith Island Beach, South Beach Trail, Surf Cabana Club, Virginia Beach Boardwalk, Virginia Beach Fishing Pier, Virginia NWR, Wreck Island Natural Area Preserve Beaches, Virginia Legends Park.
Medium-Susceptibility Seascape	Highly developed tourism areas, coastal roads, and scenic byways.
High-Susceptibility Open Ocean	Open ocean within the geographic analysis area.
Medium-Susceptibility Open Ocean	Open ocean within the visual setting and visibility of the Chesapeake Light Station.
High-Susceptibility Landscape	Landward portions of coastal areas and bays, sounds, and adjoining estuaries and rivers, and forested lands (Table 3.20-2). Landscapes with national, state, or local designations or valued places: Atlantic Intracoastal Waterway, Albemarle and Chesapeake Canal, Linkhorn Bay, Little Neck Creek, Broad Bay, First Landing State Park, Pleasure Point Natural Area, Owl Creek, Lake Rudee, Lake Wesley, Lake Christine, Lake Redwing, Lake Tecumseh, Kiptopeke State Park, Lake Holly Boardwalk, North Landing River Natural Area Preserve, Pungo Ferry Road Virginia Scenic Byway, National Aviation Monument, North Landing River Scenic River, Stumpy Lake Natural Area, Pocaty River, Princess Anne (and Guard Shore) Wildlife Management Area.
Medium-Susceptibility Landscape	Inland landscapes including suburban and military residential areas, active recreation, agriculture and commercial areas: Fentress Naval Air Landing Field, Great Neck Park, Military Aviation Museum, Mount Trashmore Park, Munden Point Park, Pleasure House Point Natural Area, Pine Meadows Park, Old Dam Neck Park, Princess Anne Memorial Park, Etheridge Lakes Park, Princess Anne Athletic Complex, Kempsville, Redwing Park, Bayville Farms Park, Cessford, Seatack Park, Ocean Lakes Park, Red Mill Farms Park.
Low-Susceptibility Landscape	Inland areas including high density residential, industrial/military areas, streets and highways, and other developed lands with limited to no visibility of the Project.

Table 3.20-7 lists the jurisdictions and City of Virginia Beach neighborhoods with ocean beach views and their view distance susceptibility to the PDE. The nearest and most distant mainland view conditions, Little Island Park - Back Bay NWR (KOP-44, 26.8 miles [43.1 kilometers]) and Whale Head Bay

Albacore Street Entrance (KOP-49g, 39.1 miles [62.9 kilometers]), are portrayed on Figure 3.20-3 and Figure 3.20-4, respectively. View distances from the Project's WTGs to Myrtle Island Beach, the nearest beach, range from 23.7 miles (38.14 kilometers) at the northwestern-most WTG to 42 miles (67.5 kilometers) at the southeastern-most WTG. The farthest view conditions are found along Parramore Island, Virginia, north of the PDE and Corolla Beach, North Carolina, south of the PDE (COP, Appendix I; Dominion Energy 2023). The barrier island beaches of Myrtle and Parramore Island are only accessible by boat.

Table 3.20-7 Jurisdictions with Ocean Beach Views and Distance-Based Susceptibility

Susceptibility and Distance in Miles (Kilometers)	Jurisdiction
High 24.1 to 28 (38.8 to 45.1)	City of Virginia Beach, Sandbridge, Dam Neck, Croatan, Rudee Heights, Lake Holly area, Little Island, Pine Meadows Place
Medium 28 to 31 (45.1 to 49.9)	Highgate Greens, Ocean Lakes North, Oceana Gardens East, Redwing, Northend Beaches, Kiptoeke, Capeville, Fairview, North Virginia Beach, Crystal Lake neighborhoods, Wadsworth Shores, Lago Mar, Carova
Low 31 to 40 (49.9 to 64.4)	City of Norfolk Ocean View Beach, Bayville, Great Neck, Munden Point, Cape Charles, Indiantown, Brownsville Farm, Cheriton, Oyster, Beverly, Northwest, Pungo

Figure 3.20-3 Little Island Park/Back Bay National Wildlife Refuge – Seascape

Figure 3.20-4 Whale Head Bay Albacore Street Entrance – Seascape

3.20.1.3 VIA Affected Environment

The VIA assesses how the proposed development impacts viewers as seen from selected representative sensitive viewpoints and as seen by different viewer groups. The following presents baseline conditions for understanding impacts on people.

Key Observation Points (KOPs) are locations that represent where individuals or groups of people visit, work, live, and gather who may be affected by changes in views and visual amenity. Based on higher viewer sensitivity, viewer exposure, and context photography, 39 designated KOPs provide the locational bases for detailed analyses of the geographic analysis area's seascape, landscape, and viewer experiences, as shown on Figure 3.20-2 (COP, Appendix I; Dominion Energy 2023). Sensitive receptors in the vicinity of the Harpers Switching Station, interconnection cable corridors, Fentress Substation, and onshore export cable corridors are identified in COP, Appendix I-2 (Dominion Energy 2023). KOPs and their view contexts are summarized in Table 3.20-8.

Table 3.20-8 Representative View Receptor Contexts and Key Observation Points

View Context	Key Observation Points
Vantage Point	KOP-13 Cape Henry Lighthouse/Fort Story Military Base[1] KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-31 Picnic Views at SMR[2] KOP-47 Currituck Beach Lighthouse *Onshore Components* KOP-10 (IC Routes 1 and 6) KOP-11 (IC Route 1 and 6) KOP-13 (IC Routes 1 and 6)
Linear Receptor	KOP-5 Oyster Village Horse Island Trail KOP-15a North End Beach Residential View 1—Daytime KOP-15b North End Beach Residential View 1—Nighttime KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24a Virginia Beach Boardwalk – 16th Street Entrance Nighttime KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance - Elevated Representative KOP-50 Cruise Ship Shipping Lanes *Onshore Components* KOP-3 (IC Route 1) KOP-5 (IC Route 1) KOP-12 (IC Routes 1 and 6) KOP-14a (IC Routes 1 and 6) KOP-14b (IC Routes 1 and 6) KOP-17 (IC Routes 1 and 6)
Scenic Area	KOP-8 Eastern Shore of Virginia National Wildlife Refuge KOP-44 Little Island Park/Back Bay National Wildlife Refuge KOP-45 False Cape State Park KOP-48 Currituck National Wildlife Refuge Representative KOP-51 Recreational Fishing, Pleasure, and Tour Boat Area
Substation/ Switching Station Area	*Onshore Components* KOP-3 Harpers Switching Station KOP-10 Fentress Substation KOP-18 Chicory Switching Station

[1] The Fort Story Military Base in the VIA refers to the Joint Expeditionary Base Little Creek-Fort Story, of which the Fort Story Historic District is a part.
[2] The SMR beachfront is not exclusively recreational in use. The SMR beachfront platform is also an observation point, as the beachfront and oceanfront environment are also used for training activities at the SMR.

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, Appendix I, Dominion Energy 2023). It is important to note that in some instances there may be a high number of viewers, but few individuals notice or are focused on the view (i.e., a scenic roadway). In other instances, there may be few viewers, but their sensitivity to change is very high (i.e., wilderness areas or remote stretches of beach).

Table 3.20-9 lists the sensitivity issues identified for the SLIA and the VIA, as well as the indicators and criteria used to assess impacts for the Final EIS.

Table 3.20-9 View Receptor Sensitivity Ranking Criteria

Sensitivity Rating	Sensitivity Criteria	Value Attached to Views
High	Residents with views of the 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 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.	Heavily visited and widely recognized viewpoints; viewpoints designated as scenic, scenic roadways or rivers designated at the national, state, or local level; association with a historic or culturally important site, especially within a designated area; appearances in guidebooks, tourist maps, web sites, online photo collections, and social media; references to the views in literature or art; public facilities to promote enjoyment of views including parking areas, restrooms, benches, interpretive panels, and telescopes; areas identified in consultation with residents, visitor bureaus, tourism service providers, and other local entities.
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; people at their places of livelihood, commerce, and personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, and where the seascape and landscape setting is not important to the quality of their activity; and, generally, those commuters and other travelers traversing routes that are dominated by non-scenic developments.	Moderately visited viewpoints; viewpoints with modest visual distractions or that are slightly lacking harmony; limited appearances in guidebooks, tourist maps, websites, online photo collections, and social media references; with limited access and support facilities that encourage visitation.
Low	People who regard the visual environment as an unvalued asset.	Infrequently visited viewpoints, with an incongruous setting, discordant features, no official designations, and no support facilities.

Judgements regarding offshore KOP viewer sensitivity ratings are informed by the VIA (COP, Appendix I; Dominion Energy 2023). Table 3.20-10 lists onshore KOP viewer sensitivity ratings.

Table 3.20-10 Project Area Key Observation Point Viewer Sensitivity Ratings

Key Observation Points	Susceptibility	Value	Sensitivity
High			
KOP-5 Oyster Village Horse Island Trail	High	High	High
KOP-8 Eastern Shore of Virginia National Wildlife Refuge	High	High	High
KOP-13 Cape Henry Lighthouse/Fort Story Military Base	High	High	High
KOP-15a North End Beach Residential View 1—Daytime	High	High	High
KOP-15b North End Beach Residential View 1—Nighttime	High	High	High
KOP-23 Naval Aviation Monument Park	High	High	High
KOP-24a Virginia Beach Boardwalk – 17th Street Park	High	High	High
KOP-24a Virginia Beach Boardwalk – 16th Street Entrance Nighttime	High	High	High
KOP-24d Virginia Beach Boardwalk – Fishing Pier	High	High	High
KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime	High	High	High
KOP-26 Marriott Virginia Beach Oceanfront Hotel	High	High	High
KOP-30a Croatan Beach A	High	High	High
KOP-30b Croatan Beach C	High	High	High
KOP-31 Picnic Views on Beach	High	High	High
KOP-44 Little Island Park/Back Bay National Wildlife Refuge	High	High	High
KOP-47 Currituck Beach Lighthouse	High	High	High
KOP-48 Currituck National Wildlife Refuge	High	High	High
Representative KOP-50 Cruise Ship Shipping Lanes	High	High	High
Representative KOP-51 Recreational Fishing, Pleasure, and Tour Boat Area	High	High	High
Medium			
KOP-22 King Neptune Statue/Boardwalk	Medium	High	Medium
KOP-29 Grommet Island Park/Boardwalk	Medium	High	Medium
KOP-49a Whale Head Bay Residential View 4	Medium	High	Medium
KOP-49g Whale Head Bay Albacore Street Entrance – Elevated	Medium	High	Medium
Low			
None	--	--	--

Table 3.20-11 Onshore Project Area Key Observation Point Viewer Sensitivity Ratings

Context	Key Observation Points
High	None
Medium	KOP-3 Harpers Switching Station (HF Route 1) KOP-14a (IC Routes 1 and 6) KOP-14b (IC Routes 1 and 6) KOP-17 (IC Routes 1 and 6) KOP-18 Chicory Switching Station (IC Route 6)

Context	Key Observation Points
Low	KOP-10 Fentress Substation (IC Routes 1 and 6) KOP-11 (IC Route 1 and 6) KOP-12 (IC Routes 1 and 6) KOP-13 (IC Routes 1 and 6)

In addition to onshore viewers, the Project components would be visible to offshore viewers at sea and from the air from a variety of commercial and recreational watercraft and aircraft. The Chesapeake Bay and waters of coastal Virginia are heavily trafficked shipping lanes. Offshore viewing receptors include recreation and commercial fishing boats, recreation pleasure craft, cruise ships, and undefined watercraft. Overall, watercraft passage through the Lease Area is considered “light.” Commercial fishing tracks through the Lease Area are infrequent and broadly distributed, as shown in COP, Figures 4.4-22 through Figure 4.4-25 (COP, Sections 4.4.6, and 4.4.7; Dominion Energy 2023). In contrast, recreational fishing vessels and dive boats routinely transit within and through the Offshore Project area (COP, Section 4.4.6, Dominion Energy 2023). Daytime and nighttime views from all vessels range from immediate foreground to background distances.

Daytime and nighttime aircraft receptors, arriving and departing Norfolk International Airport and Oceana Naval Air Station traffic, and others traversing the Atlantic Coast, experience views ranging from foreground to background. Aircraft receptors are more frequently affected by view-limiting atmospheric conditions than are land and water receptors.

Typical meteorological conditions limit visibility of the Wind Farm Area from inland and the coast on 80 percent of days and provide clear visibility on 20 percent of days during daytime hours (approximately 1 of every 5 days are clear for a minimum of 50 percent of the day throughout the year, with visibility at 20 nautical miles [37 kilometers]) (COP, Appendix I-1; Dominion Energy 2023).

Views from nearer the shoreline are more limited by atmospheric conditions than views from inland areas. Many viewers, particularly recreational users, are more likely to be present on beaches, boardwalks, jetties, and piers on clearer days, when viewing conditions are better than on rainy, hazy, or foggy days. Therefore, the affected environment and VIAs of the Project are based on clear-day and clear-night visibility. Elevated boardwalks, piers, 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 glare of shorefront developments.

3.20.2 Environmental Consequences

3.20.2.1 Impact Level Definitions for Scenic and Visual Resources

Definitions of impact levels are provided in Table 3.20-12. There are no beneficial impacts on scenic and visual resources.

Table 3.20-12 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, the nature of the sensitivity is evaluated to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change but 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 key qualities. In areas affected by large magnitudes of change, the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Project would introduce a moderate to large level of change to the view's character; may have 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, the nature of the sensitivity is evaluated 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; 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, the nature of the sensitivity is evaluated 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, the nature of the sensitivity is evaluated to determine if lowering the impact to moderate is justified.

3.20.3 Impacts of the No Action Alternative 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 activities and ongoing offshore wind activities, on the baseline conditions for scenic 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 F, *Planned Activities Scenario*.

3.20.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for seascape, open ocean, landscape, and viewers described in Section 3.20.1, *Description of the Affected Environment for Scenic and Visual Resources*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing non-offshore wind activities within 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 COP, Section 4.4.11 (Dominion Energy 2023) for a description of ongoing and planned activities in the geographic analysis area. Ongoing and 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.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on scenic resources include continued O&M of the CVOW-Pilot Project (two WTGs) in Lease Area OCS-A 0497.

Ongoing O&M of the CVOW-Pilot Project would result in impacts on scenic resources through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, land disturbance, lighting, and presence of structures.

3.20.3.2 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).

BOEM expects future offshore wind development activities to affect seascape character, open ocean character, landscape character, and viewer experience through the following primary IPFs. Tables M-13 through M-16 in Appendix M consider effects on seascape, open ocean, landscape, and viewers of offshore wind development without the Proposed Action and in combination with the Proposed Action.

Presence of structures: Under the No Action Alternative, existing offshore wind development at the CVOW-Pilot Project consists of two 6-MW WTGs with a maximum rotor blade height of 620 feet (189 meters) above mean low low water and a maximum hub height of 364 feet (111 meters) above mean sea level. These smaller stature turbines contribute minimally to adverse scenic impacts. Other offshore wind development will add structures offshore including WTGs and OSSs. Two offshore wind projects, Kitty Hawk Wind North and Kitty Hawk Wind South, would be constructed in the geographic analysis area between 2024 and 2030. The placement of 190 WTGs (excluding the Proposed Action) within the geographic analysis area under the planned activities scenario (Appendix F, Table F2-1) would contribute to adverse impacts on scenic and visual resources. Appendix M provides simulations of offshore wind development without the Proposed Action from five KOPs with views to the southeast (Appendix M, Attachment M-2). The total number of WTGs that would be theoretically visible from any single KOP would likely be less than the 190 WTGs considered under the planned activities scenario, except in elevated conditions. For example, approximately 82 WTGs would be theoretically visible from KOP-26 Marriott Virginia Beach Oceanfront Hotel, 45 WTGs would be visible from KOP-45 False Cape State Park, and 190 WTGs would be visible from KOP-47 Currituck Beach Lighthouse (BOEM 2021). The presence of structures associated with future offshore wind development would affect seascape character, open ocean character, landscape character, and viewer experience, as simulated from sensitive onshore receptors (Appendix M). The seascape character and open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to moderate wind farm character by approximately 2030.

Lighting: Construction-related nighttime vessel lighting would be used if future 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 two future offshore wind projects within the geographic analysis area (excluding the Proposed Action). The impact of vessel lighting on scenic and visual resources during construction 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 within the geographic analysis area and would have impacts on scenic and visual resources. FAA hazard lighting systems (obstruction lights) would be in use for the duration of O&M for up to 190 WTGs in addition to the existing two CVOW-Pilot Project WTGs. The CVOW-Pilot Project WTGs have FAA L-864 medium density aeronautical lights with a flash rate of 20 flashes per minute atop each nacelle and USCG quick flashing amber lights located on the base tower not higher than 50 feet (15 meters) above the highest astronomical tide. 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 within the offshore wind lease areas would have long-term 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 clouds would influence visibility and perception of hazard lighting from sensitive viewing locations. Although the implementation of ADLS to activate the hazard lighting system when aircraft are detected would greatly reduce nighttime lighting impacts, the existing CVOW-Pilot Project has not implemented this system and the proposed Kitty Hawk Wind North and Kitty Hawk Wind South projects have not proposed implementing this system.

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.

Traffic (vessel): Current O&M vessel traffic on the two CVOW-Pilot Project WTGs is unknown, but because of the very small scale of this project the impact on scenic and visual resources is considered negligible. Future offshore wind project construction and decommissioning and, to a lesser extent, O&M would generate increased vessel traffic that could contribute to adverse impacts on scenic and visual resources within the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the future offshore wind construction areas. Vessel traffic for Kitty Hawk Wind South is not known but is anticipated to be similar to that of Kitty Hawk Wind North, which is projected to generate an average of 46 daily vessel trips between ports and offshore work areas over the entire construction phase and a maximum of 95 vessel trips daily during peak construction activity (COP, Section 3.4; Dominion Energy 2023). As shown in Appendix F, Table F-3, between 2024 and 2030 two offshore wind projects other than the Proposed Action, Kitty Hawk North and Kitty Hawk South, could be under construction simultaneously. Kitty Hawk North and Kitty Hawk South would have overlapping construction periods with CVOW-C between 2024 and 2027. During such periods, construction of offshore wind projects would generate an average of 92 vessel trips daily from Portsmouth, Virginia, ports to worksites in the geographic analysis area, with as many as 190 vessels present (either underway or at anchor) during times of peak construction. Stationary and moving vessels would slightly increase 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. O&M activities of future offshore wind projects are anticipated to generate an average of four vessel trips per week between a port and the Wind Farm Area. Vessel traffic would result in long-term, occasional 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 operating period of each project, with impacts like those described for construction.

Land disturbance: Ongoing and future offshore wind development would require installation of onshore export cables, onshore substations, 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 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 future offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases: Accidental releases during construction, O&M, and decommissioning of ongoing and future 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 decommissioning of future offshore wind projects, and would be lower but continuous during O&M.

3.20.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, visual and scenic resources would continue to be affected by existing environmental trends and ongoing activities. Ongoing non-offshore wind activities would have continued 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, that would have **minor** to **moderate** impacts on scenic and visual resources in the geographic analysis area.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and visual resources would continue to be affected by natural and human-caused IPFs.

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 190 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.

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. The No Action Alternative would result in **minor** impacts on scenic and visual resources from ongoing activities. The No Action Alternative combined with all other foreseeable planned activities (including other offshore wind activities) would result in **moderate** to **major** impacts on visual and scenic resources within the geographic analysis area due to addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.

3.20.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This 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 E, *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 and OSSs, and the design of lighting systems for structures.
- The number and type of vessels involved in construction, O&M, and decommissioning, and time of day that construction, 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 E. The following summarizes the 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.
- **Size, scale, and orientation of the project:** The larger the size and scale of the project and its proximity to shore the greater the impact to the scenic value of the open ocean, seascape, and landscape character areas.
- **Design and type of WTG lighting:** The design and type of WTG lighting would affect nighttime visibility of WTGs from shore. Implementation of ADLS technology would substantially reduce visual impacts.
- **Vessel lighting:** Nighttime construction, O&M, and decommissioning activities that involve nighttime lighting would increase visibility at night.
- **Location and scale of Onshore Project components:** Installation of larger-scale Onshore Project components closer to sensitive receptors would have greater impacts.

3.20.5 Impacts of the Proposed Action on Scenic and Visual Resources

This section addresses the impacts associated with construction, O&M, and decommissioning of the Proposed Action on seascape character, open ocean character, landscape character, and viewer experience in the geographic analysis area. The impact level is judged with reference to the sensitivity of the view receptor and the magnitude of impact, 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 by 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 character.
- 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 wind turbine area range from 23.7 miles (38.1 kilometers) to 40 miles (64.4 kilometers). At the 23.7-mile (38.1-kilometer) distance, the wind farm would occupy 26° (21 percent) of the typical human's 124° horizontal FOV and 0.4° (0.73 percent) of the typical 55° vertical FOV (measured from eye level). This vertical measure also indicates the perceived proportional size and relative height of the wind farm. 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 and OSS visibility would be variable throughout the day depending on specific factors, including view angle, sun angle, atmospheric conditions, and distance, which would affect the visibility and noticeability. Visual contrast of WTGs and OSSs would vary throughout the day depending on whether the WTGs and OSS 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 moderate to major visual effects while at other times of day would have minor or negligible effects.

KOP-3 through KOP-49g are representative of sensitive receptors (and their vicinities) in the shoreward (seascape and landscape) parts of the geographic analysis area, and two representative offshore (open ocean) KOPs (KOP-50 and KOP-51) are typical of views of the Lease Area from boats and cruise ships. KOP-15b North End Beach – Residential View 1—nighttime (28.1 miles, 45.2 kilometers to nearest WTG), KOP-24b Virginia Beach Boardwalk – 16th Street Entrance—nighttime (27.8 miles, 44.7 kilometers to nearest WTG), and KOP-24d Virginia Beach Boardwalk-Fishing Pier—nighttime (27.6 miles, 44.4 kilometers to nearest WTG) represents the nighttime assessment. COP, Appendices I-1 and I-2 (Dominion Energy 2023) present visual simulations from each of 38 onshore KOPs considered in this analysis. Cumulative visual simulations in Appendix M, Attachment M-2 portray future conditions of the Proposed Action alone and in combination with other future offshore wind development from five representative locations: KOP-26 Marriott Virginia Beach Oceanfront Hotel Rooftop; KOP-31 Picnic/Beach Views at State Military Reservation; KOP-45 False Cape State Park; KOP-47 Currituck Beach Lighthouse; and KOP-49a Whale Head Bay Residential Area. Table 3.20-13 lists the distance from each KOP to the nearest WTG by project.

Table 3.20-13 Distance from KOPs Considered to Nearest WTG, by Project

KOP	Camera Elevation – Feet (Meters)	CVOW-C Offshore Wind – Miles (Kilometers)	CVOW-Pilot Offshore Wind – Miles (Kilometers)	Kitty Hawk North – Miles (Kilometers)[1]
Virginia				
KOP-26 Marriott Virginia Beach Oceanfront Hotel	236 (72)	28 (45)	26.8 (43.2)	45 (72.4)
KOP-31 Picnic/Beach Views at State Military Reserve	14 (4.3)	27.6 (44.4)	26.8 (43)	43.0 (69.2)
KOP-45 False Cape State Park	15 (4.6)	27.1 (43.6)	28.5 (64.2)	33.3 (53.6)
North Carolina				
KOP-47 Currituck Beach Lighthouse	155 (47.2)	36.8 (59.2)	39.9 (64.2)	28.3 (45.5)
KOP-49a Whale Head Bay Residential Area	25 (7.6)	39.1 (62.9)	39.7 (63.8)	27.9 (44.9)

[1] Distances based on CVOW Cumulative Effects Simulations, Dominion Energy 2022.

Presence of structures: The Proposed Action would install 202 WTGs extending up to 869 feet (265 meters) above mean high water and 3 OSSs extending up to 220 feet (67 meters) above mean high water within the Lease Area. The WTGs would be painted RAL 7035 Light Grey, which would help reduce potential visibility against the horizon. Additionally, the lower sections of each WTG would be marked with high-visibility (RAL 1023) yellow paint from the water line to a minimum height of 50 feet (15.2 meters) above mean high water. Each WTG and OSS would be marked with a unique five-character alpha numeric identifier, which is easily visible in daylight as well as night, either with illumination or retro-reflecting material. The characters would be 3.28 to 8.20 feet (1–2.5 meters) in height on three sides of each tower and visible from any angle of approach. Characters would be painted black on a yellow background. 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 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, Appendix I, Attachment I-1-5 presents visual simulations from each of 20 onshore KOPs considered in this analysis (Dominion Energy 2023). The visual simulations reflect variables in weather, sun angle, cloud cover, and viewer height. The visual analyses consider the view at each KOP on a clear-day day. Table M-1 in Appendix M identifies visibility variables for selected KOP simulations.

Appendix M provides additional (cumulative effects) simulations of the Proposed Action from five KOPs with views to the southeast (Appendix M, Attachment M-2) and provides an assessment of the Proposed Action's noticeable elements, distance effects, FOV effects, foreground elements and influence, and contrast rating effects by seashore character unit, landscape character unit, and 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 and applicable distances (Appendix M, Table M-4); FOV extents (Table M-5 and M-6); form, line, color, and texture contrasts in the characteristic seascape, open ocean, and landscape (Table M-7); and open views versus view framing or intervening foregrounds (Table M-12). 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 3.20-14 considers the totality of the Proposed Action's level of impact by seascape character unit, open ocean character unit, landscape character unit, and offshore and onshore KOPs. Table 3.20-15 considers the impact of the Proposed Action on viewer experience.

Appendix M, Table M-14 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 3.20-14 Proposed Action Impact on Seascape Character, Open Ocean Character, and Landscape Character

Level of Impact	Seascape Character Units, Open Ocean Character Unit, Landscape Character Units	Overall Character Area in Square Miles (square kilometers)	Affected Character Area in Square Miles (square kilometers)
Major	**Open Ocean Character Unit[1]**	6,302.55 (16,323.5)	2,540.79 (6,580.6)[1]
	***Onshore* Landscape Character Units:**		
	Developed – Suburban, Open Water	No areas given	No areas given
Moderate	**Seascape Character Units:**		
	Beach[2]	0.42 (1.1)	0.42 (1.1)
	Beachfront Residential[2]	0.69 (1.8)	0.55 (1.4)
	Recreation[2, 3]	38.13 (98.7)	10.68 (27.7)
	Virginia Beach/Tourism	1.45 (3.75)	0.28 (0.73)
	***Onshore* Landscape Character Units:**		
	Developed – Rural Residential, Agricultural/Open Lands, Forested	No areas given	No areas given

Level of Impact	Seascape Character Units, Open Ocean Character Unit, Landscape Character Units	Overall Character Area in Square Miles (square kilometers)	Affected Character Area in Square Miles (square kilometers)
Minor	**Seascape Character Areas:**		
	Barrier Island Residential	5.92 (15.3)	4.93 (12.8)
	Historic Resources	8.12 (21.0)	1.49 (3.9)
	Disadvantaged Communities	700.97 (1,815.5)	391.12 (1,013.0)
	Industrial/Military[2,3]	23.58 (61.1)	3.4 (8.8)
	Landscape Character Areas:		
	Rural Coastal Plain	89.16 (231.0)	11.29 (29.2)
	***Onshore* Landscape Character Areas:**		
	Transportation Corridor, Developed Recreation, Developed - Industrial	No areas given	No areas given
Negligible	**Seascape Character Areas:**		
	Inland Bay	405.87 (1,051.2)	215.46 (558.0)
	Lower Coastal Plain/Tidewater	113.73 (294.5)	60.86 (157.6)
	Landscape Character Areas:		
	Agriculture	126.65 (328.1)	9.24 (23.9)
	Coastal Development	114.88 (375.2)	6.17 (16.0)
	***Onshore* Landscape Character Areas:**		
	Developed – Commercial	No areas given	No areas given

[1] The Open Ocean character area within the zone of potential visual influence as described in the COP includes only the landward facing ocean area and not the whole Open Ocean character area as shown in COP, Appendix I-1, Figure I-1-3. The area of open ocean analyzed in this EIS includes the 360° viewshed around the Lease Area; therefore, approximately 92.8% of open ocean is within the zone of potential visual influence.
[2] The Beach character area calculation as described and illustrated in COP, Appendix I-1, Attachment I-3 maps includes approximately 13 linear miles of beach from the southern boundary of Fort Story to Croatan Beach in Virginia and the beach paralleling the Barrier Island Residential character area in the Corolla area of South Carolina. See Appendix M, Section 3.1.1.2.4, *Beach*, for additional description. For the NEPA analysis, Beaches are considered as a whole character unit including all sandy shoreline areas in the study area.
[3] Combined area for seascape and landscape character areas. Areas within the seascape are considered a moderate impact because of their ocean-facing views. Areas within the landscape are considered minor to negligible because they fall outside of the WTG viewshed or have minor susceptibility.

Table 3.20-15 Proposed Action Impact on Viewer Experience

Level of Impact	Offshore and Onshore Key Observation Points
Major	VIA: KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area KOP-51 Commercial and Cruise Ship Shipping Lanes *Onshore Components* KOP-3 Harpers Switching Station (IC Route 1) KOP-5 (IC Route 1) KOP-10 Fentress Substation (IC Routes 1 and 6) KOP-17 (IC Routes 1 and 6) KOP-18 Chicory Switching Station (IC Route 6)

Level of Impact	Offshore and Onshore Key Observation Points
Moderate	VIA: KOP-13 Cape Henry Lighthouse/Fort Story Military Base KOP-15b North End Beach – Residential View – Nighttime KOP-24b Virginia Beach Boardwalk – 16th Street Entrance Nighttime KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-44 Little Island Park/Back Bay NWR *Onshore Components* KOP-11 (IC Routes 1 and 6) KOP-14a/b (IC Routes 1 and 6)
Minor	VIA: KOP-15a North End Beach – Residential View KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-31 Picnic Views at SMR KOP-48 Currituck Beach Lighthouse
Negligible	VIA: KOP-5 Oyster Village Horse Island Trail KOP-8 Eastern Shore of Virginia NWR KOP-47 Currituck National Wildlife Refuge KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance – Elevated *Onshore Components* KOP-12 (IC Routes 1 and 6) KOP-13 (IC Routes 1 and 6)

The Proposed Action would also add one onshore substation, Harpers Switching Station north of Harpers Road on Navy property in Virginia Beach and expand the existing Fentress Substation in the community of Chesapeake. The substation and switching stations should be painted U.S. Bureau of Land Management color Covert Green or Shadow Grey to mitigate contrast. Dark grey colors help incongruous structures recede into the background throughout the seasons. Additional landscaping should also be planted to screen views presented in the simulations as well as views that may not be captured in the simulations. Appendix H, Table H-1 describes the applicant's proposed mitigation measures to reduce visual impacts, including evaluating vegetative screening, designing lighting to reduce light pollution, and consulting with the U. S. Navy and local governments to evaluate color treatment and other visual impact mitigations for the switching station and onshore substation. Onshore export cable infrastructure would be underground for 4.4 miles (7.1 kilometers) and would not contribute to impacts on scenic and visual resources. Interconnection cables would be collocated to the extent feasible, along existing Dominion Energy transmission lines.

Light: Nighttime vessel lighting could result from construction, 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 decommissioning would be 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.

Marine aids to navigation lights would be installed on each WTG and OSS to ensure 360-degree visibility around each structure. Depending on the structure's location in the Lease Area, the synchronized flashing yellow marine lanterns would be energized when an incoming vessel is within a 5- to 2-nautical mile (9.3- to 3.7-kilometer) range. The height of the marine navigation lanterns would be 75.5 feet (23.0 meters) AMSL. Due to the Earth's curvature, from eye levels of 5 feet (1.5 meters), these lights would become invisible above the ocean surface beyond 13 miles (21 kilometers).

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 151 feet (46 meters) above sea level. Due to the Earth's curvature, from eye levels of 5 feet (1.5 meters), these lights would become invisible above the ocean surface beyond approximately 18 miles (28.9 kilometers). Lights of the three OSSs, when lit for maintenance, would not 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 40-mile (64.4-kilometer) geographic analysis area, depending on variable ocean surface and meteorological reflectivity.

Dominion Energy has committed to installing ADLS on WTGs, which activates the FAA hazard lighting system in response to detection of nearby aircraft (Dominion Energy 2023). The synchronized flashing of the aviation warning lights (obstruction lights) occurs only when aircraft are present, resulting in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The ADLS report (COP, Appendix T; Dominion Energy 2023) indicates that, based on historical air traffic data, flights passing through the light activation zone would activate obstruction lights for a total of 25 hours, 33 minutes, and 49 seconds over a 1-year period. March would have the highest proportion of ADLS night lighting activation and September would have the smallest proportion. It is anticipated 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, although ADLS would have major impacts on viewers when activated. The shorter-duration synchronized flashing of ADLS would substantially reduce visual impacts for beaches and coastlines within the geographic analysis area 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 negligible intermittent and long-term effects on sensitive onshore and offshore viewing locations based on viewer distance and angle of view, and assuming no obstructions.

Traffic (vessel): Construction, O&M, and decommissioning of the Proposed Action would generate increased vessel traffic that could contribute to adverse impacts on scenic and visual resources within the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the future offshore wind construction areas. Construction of the Proposed Action would generate an average of 46 vessels per day throughout the duration of construction operating in the Wind Farm Area or over the offshore export cable route at any given time from 2023 through 2027, with a minimum of 3 and a maximum of 95 vessel trips (COP, Table 3.4-5; Dominion Energy 2023). Although vessel traffic within the Lease Area is expected to decrease once the WTGs and OSSs are in place, O&M of the Proposed Action would result in the same types of vessel traffic and navigation impacts as those described during construction. O&M activities for the Proposed Action are anticipated to operate 365 days for the service operations vessels, with 26 annual round trips to port per vessel, and 365 operating days for each crew transfer vessel with 120 annual round trips to port per vessel (COP, Section 3.5.1; Dominion Energy

2023). Based on Table 1-5 in the CVOW BA prepared for NMFS (BOEM 2022), it is assumed there would be two of each vessel, for a total of 292 annual round trips to port.

Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action. As shown in Appendix F, Table F-3, between 2023 and 2027 one additional offshore wind project (excluding the Proposed Action) could be under construction simultaneously (Kitty Hawk North and Kitty Hawk South would have overlapping construction periods with CVOW-C between 2024 and 2027). During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 92 vessel trips daily from Atlantic Coast ports to worksites in the geographic analysis area, with as many as 190 vessels present (either underway or at anchor) during times of peak construction. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean characters 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 Proposed Action, O&M of two offshore wind projects (including the Proposed Action) would generate an estimated four vessel trips per week within the geographic analysis area. 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 assumed operating period of each project, with impacts similar to those described for construction. Maintenance activities would cause minor effects on seascape character and open ocean character due to increased O&M vessel traffic to and from the offshore wind lease areas. Increases in these vessel movements would be noticeable to onshore and offshore viewers but are likely to have a minor effect.

Land disturbance: Future 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 continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M.

Accidental releases: Accidental releases during construction, O&M, and decommissioning of future 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. Nearshore 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 decommissioning of offshore wind projects, and would be lower but continuous during O&M.

3.20.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

Presence of structures: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute 202 of a combined total of 392 WTGs (considering both Kitty Hawk North and Kitty Hawk South) that would be installed in the geographic analysis area between 2024 and 2030. The total number of WTGs that would be visible from any single KOP would be fewer than the 274 WTGs considered under the planned activities scenario in combination with the Proposed Action. For example, approximately 267 WTGs would be theoretically visible from KOP-26 Marriott Virginia Beach Oceanfront Hotel and approximately 92 WTGs would be theoretically visible from KOP-49g Whale Head Bay Albacore Street Entrance (BOEM 2021). Appendix M, Attachment M-2 provides simulations of the

Proposed Action in combination with other future offshore wind projects that would be theoretically visible within the same viewshed as the Project, including Kitty Hawk Wind North. The presence of structures associated with future offshore wind development in combination with the Proposed Action would have moderate seascape character, open ocean character, landscape character, and viewer experience impacts, as simulated from sensitive onshore receptors (Appendix M, Attachment M-2). The open ocean character would see a moderate level of change to its features and character from formerly undeveloped ocean to dominant wind farm character by approximately 2030.

Light: In context of reasonably foreseeable environmental trends, vessel lights could be active during nighttime hours for up to two offshore wind projects including the Proposed Action. Nighttime vessel lighting for the Proposed Action in combination with other future offshore wind development would moderately affect seascape character, open ocean character, nighttime viewer experience, and valued scenery. This impact would be localized and short term during construction and decommissioning and intermittent and long term during O&M.

In context of reasonably foreseeable environmental trends, FAA hazard lighting systems would be in use for the duration of O&M for up to 392 WTGs including the Proposed Action and other future offshore wind development. The cumulative effect of these WTGs and associated FAA hazard lighting (obstruction lighting) would have long-term 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 extent to which other future offshore wind projects would implement ADLS is unknown. Cumulative impacts from lighting would be reduced if ADLS is implemented across all future offshore wind projects in the geographic analysis area and would be more adverse if other projects do not commit to using ADLS. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations. Each future offshore wind project would also have at least one OSS that would be lit and marked in accordance with USCG and Occupational Safety and Health Administration lighting standards.

Due to variable distances from visually sensitive viewing locations and the unknown adoption of ADLS, other reasonably foreseeable offshore wind projects in combination with the Proposed Action would have moderate to major long-term cumulative effects on visually sensitive viewing areas.

Traffic (vessel): In context of reasonably foreseeable environmental trends, future offshore wind project construction, O&M, and decommissioning would increase vessel traffic in the geographic analysis area beyond what the Proposed Action would generate in isolation.

Land disturbance: The exact extent of impacts would depend on the locations of project infrastructure for future offshore wind energy projects; however, the Proposed Action in combination with other future offshore wind development would generally have localized, short-term impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases: The Proposed Action would contribute to the combined impacts on scenic and visual resources from ongoing and planned activities, including offshore wind, which would be moderate.

3.20.5.2 Conclusions

Impacts of the Proposed Action. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected during construction, 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 M. Project decommissioning effects would be similar to construction effects. Due to distance, extensive FOVs, strong contrasts, large scale of change, and visual prominence and predominantly undeveloped ocean views, the Proposed Action would have **major** effects on the open ocean character unit and viewer boating and cruise ship experiences. Due to view distances (effects ranges discussion in Appendix M), moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, Proposed Action effects on high- and moderate-sensitivity seascape and landscape character units, and viewer experience would be **moderate** to **negligible**. 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 would be an unavoidable presence in views from the coastline, with **moderate** to **minor** effects on seascape character and landscape character.

Onshore, temporary **moderate** effects would occur during construction 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 sites' surrounding industrial elements, strong visual contrast between the sites and the surrounding landscape, and the scale of change would be **major** to **moderate** as viewed from the KOPs. Incorporating vegetative screening to screen street views, designing lighting to reduce light pollution, and color treatment of the onshore substation and switching station would reduce visual impacts. The transmission lines collocated with existing transmission corridors would have a **moderate** impact, whereas new corridors would have a **major** impact on scenic and visual resources. Impacts of the onshore components on scenic and visual resources would be **moderate**.

Cumulative impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would be **moderate**. The Proposed Action would comprise approximately 65 percent of the affected viewshed because of the distance and obtuse angle of reasonably foreseeable projects. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.20.6 Impacts of Alternatives B and C on Scenic and Visual Resources

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, which is described in this section.

Impacts of Alternatives B and C. Alternative B involves revised layout of WTGs and OSSs to accommodate navigation and the Fish Haven area located along the northern boundary of the Lease Area and would result in 26 fewer WTGs than the Proposed Action. Alternative C, in addition to the accommodations in Alternative B, would also avoid sand ridge habitat through micrositing components and removal and relocation of WTGs and associated infrastructure in priority sand ridge habitats. As a result, Alternative C would consist of 30 fewer WTGs than the Proposed Action. Alternatives B and C would only use 14 MW WTGs. Therefore, the types of impacts under Alternatives B and C on scenic and visual resources would be the same as described for the Proposed Action but slightly reduced as fewer and shorter height WTGs would be installed. Impacts of Alternatives B and C related to the primary IPFs (presence of structures, lighting, vessel traffic, and accidental releases) would also be similar to the impacts described for the Proposed Action.

Cumulative impacts of Alternatives B and C. The contribution of Alternatives B and C to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action.

3.20.6.1 Conclusions

Impacts of Alternatives B and C. The effects of Alternatives B and C 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 B and C would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternatives B and C on high- and moderate-sensitivity seascape and landscape character units would be **moderate** to **minor**. The OSSs would not be visible from shore. The daytime presence of offshore WTGs, 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. In clear weather, the WTGs would be an unavoidable presence in views from the coastline, with **moderate** to **minor** effects on seascape and landscape character.

Considering all the IPFs together, BOEM anticipates that the contribution of Alternatives B and C to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

Cumulative impacts of Alternatives B and C. In context of other reasonably foreseeable environmental trends in the area, the contribution of Alternatives B and C to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action. Considering all the IPFs together, BOEM anticipates that the contribution of Alternatives B and C to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.20.7 Impacts of Alternative D on Scenic and Visual Resources

Impacts of Alternative D. Under Alternative D, including sub-alternatives D-1 and D-2, the construction, O&M, and eventual decommissioning of a wind energy facility would include the same offshore layout of Project components as described under the Proposed Action. Unlike the Proposed Action and Alternatives B and C, the construction of interconnection cables under Alternative D would follow either Interconnection Cable Route Option 1 or Interconnection Cable Route Option 6 (Hybrid Route). Both routes are approximately 14.3 miles (22.9 kilometers) from the cable landing location to the Fentress Substation. The onshore export cables from the proposed cable landing location to the Harpers Switching Station (4.4 miles [7.1 kilometers]) would be underground.

Alternative D-2 would involve the use of Interconnection Cable Route Option 6 (Hybrid Route). This interconnection cable route option would be approximately 14.3 miles (22.9 kilometers) long and mostly follow the same route as Interconnection Cable Route Option 1, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of underground and overhead construction methods. A proposed Chicory Switching Station would be built and used under this sub-alternative. No aboveground switching station would be built at Harpers Road (KOP-3 HF Route 1), instead the Chicory Switching Station would be constructed north of Princess Anne Road on a parcel that is currently forested and adjacent to a transportation corridor (Princess Anne Road) and a small residential subdivision (KOP-18). The Chicory Switching Station is only associated with Interconnection Cable Route Option 6 (Hybrid Route). From the Chicory Switching Station, Interconnection Cable Route 6 would continue as an overhead transmission line, aligned with Cable Route Option 1 for the remaining 9.7 miles to the Fentress Substation. Approximately 80 percent, or 7.8 miles (12.6 kilometers), of the aboveground transmission lines are collocated with existing transmission lines.

Under sub-alternative D-1, Interconnection Cable Route 1 would be constructed using an entirely overhead cable from the proposed Harpers Switching Station north of Harpers Road to the Fentress Substation. Approximately 68 percent, or 9.6 miles (15.4 kilometers), of the aboveground transmission lines are collocated with existing transmission lines.

Cumulative impacts of Alternative D. The contribution of Alternative D to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action.

3.20.7.1 Conclusions

Impacts of Alternative D. The effects of Alternative D, including subalternatives D-1 and D-2, 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, Alternative D would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternative D on high- and moderate-sensitivity seascape and landscape character units would be **moderate** to **minor**. The daytime presence of offshore WTGs, 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. The OSSs are not visible from shore. In clear weather, the WTGs would be an unavoidable presence in views from the coastline, with **moderate** to **minor** effects on seascape and landscape character.

Onshore, temporary **moderate** effects would occur during construction and decommissioning of the landfall and onshore export cables. Effects during O&M activities would involve temporary vehicular and personnel presence and would be **negligible**.

The onshore Chicory Switching Station associated with the Alternative D-2 site context of surrounding forest and transportation corridor elements, visual contrast between the site and the surrounding landscape, and the scale of change would be **major** to **moderate.** The Chicory Switching Station is not visible in the current KOPs; however, it would be visible in winter and from the surrounding homes. The buried transmission lines would avoid visual impacts on an area of suburban residential development (Castleton and Pine Ridge) at the eastern end of the route. The existing utility right-of-way would need to be expanded, but no new structures would be built in this area. The buried lines would have **moderate** temporary impact during construction and decommissioning and **negligible** impact during O&M. Transmission lines collocated with existing transmission corridors would have a **moderate** impact. Impacts of the onshore components on scenic and visual resources would be **moderate**.

The onshore components of Alternative D-1 include the Harpers Switching Station and 14.3 miles of overhead transmission lines, and in the context of agriculture, rural and suburban residential, and recreation land uses, the visual contrast and scale of change would be **major** to **moderate**. The Harpers Switching Station is in a semi-industrial area, but across from high density residential housing and would replace a wooded area adjacent to a golf course. Incorporating vegetative screening to screen street views, designing lighting to reduce light pollution, and color treatment of the switching station would reduce visual impacts. Transmission lines collocated with existing transmission corridors would have a **moderate** impact. Impacts of the onshore components on scenic and visual resources would be **moderate**.

Considering all the IPFs together, BOEM anticipates that the contribution of Alternative D to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

Cumulative impacts of Alternative D. In context of other reasonably foreseeable environmental trends in the area, the contribution of Alternative D to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative D to the impacts associated with ongoing and planned activities in combination with other future offshore wind development would be **moderate**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.20.8 Agency-Required Mitigation Measures

There are no mitigation measures resulting from consultations. The National Park Service has proposed measures to minimize impacts on scenic and visual resources (Appendix H, Table H-3). If the measures analyzed are adopted some adverse impacts could be further reduced.

Table 3.20-16 Additional Agency-Required Measures: Scenic and Visual Resources[1]

Measure	Description	Effect
Adopt sustainable lighting practices	Adopt NPS-recommended sustainable lighting practices for outdoor lighting at onshore facilities (e.g., onshore substation and O&M facility). Sustainable outdoor lighting specifications include use of LEDs in warm colors, recessed and fully shielded lights, fixtures that include timers, motion detectors, hue adaptors, and dimmers, reducing light intensity, and proper installation of lights (see https://www.nps.gov/subjects/nightskies/sustainable-outdoor-lighting.htm).	Implementation of this measure would reduce the visual impact contributed by lighting at onshore facilities. Implementation of this measure would not reduce the major impact of the Proposed Action because the major impact level is primarily associated with the presence of structures in the offshore environment, including WTGs and OSS that are lit according to BOEM's Lighting and Marking Guidelines and FAA and USCG lighting standards.

[1] Also Identified in Appendix H, Table H-3.
LED = light-emitting diode; NPS = National Park Service

3.20.8.1 Effect of Measures Incorporated into the Preferred Alternative

BOEM has identified the additional measure in Appendix H, Table 3.20-16 and Table H-3 as incorporated in the Preferred Alternative: adopt sustainable lighting practices. The effect of this measure, if adopted, would be to reduce the visual impact contributed by lighting at onshore facilities. However, implementation would not reduce the major impact associated with the presence of structures in the offshore environment, including WTGs and OSS that are lit according to BOEM's Lighting and Marking Guidelines and FAA and USCG lighting standards.

3.21. 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 described in Appendix F, *Planned Activities Scenario,* Table F-1 and shown on Figure 3.21-1, 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 that may be used by the Project. In addition, the geographic analysis area includes an onshore component that includes any subwatershed that is intersected by the Onshore Project area.

3.21.1 Description of the Affected Environment for Water Quality

The geographic analysis area includes onshore waterbodies, such as ponds, streams, and rivers, including, for example, Owl's Creek, Oceana Pond, North Landing River, and Ashville Bridge Creek; it also includes coastal waters, such as estuaries, the Atlantic Ocean, and the MAB.

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

- **Water temperature:** Water temperature heavily affects species distribution in the ocean. Large-scale changes to water temperature may affect seasonal phytoplankton blooms.
- **Salinity:** Salinity, or salt concentration, also affects species distribution. In general, seasonal variation in the region is smaller than year-to-year variation and less predictable than temperature changes (Kaplan 2011).
- **Dissolved oxygen:** The amount of DO in water determines the amount of oxygen that is available for marine life to use. Temperature strongly influences DO content, which is further influenced by local biological processes. For a marine system to maintain a healthy environment, DO concentrations should be above 5 milligrams per liter (mg/L); lower levels may affect sensitive organisms (USEPA 2000).
- **Chlorophyll *a*:** Chlorophyll *a* is a measure of how much photosynthetic life is present. Chlorophyll *a* levels are sensitive to changes in other water parameters, making it a good indicator of ecosystem health. USEPA considers estuarine and marine levels of chlorophyll *a* under 5 micrograms per liter (µg/L) to be good, 5 to 20 µg/L to be fair, and over 20 µg/L to be poor (USEPA 2015).
- **Turbidity:** Turbidity is a measure of water clarity, which is typically expressed as a concentration of 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.
- **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.

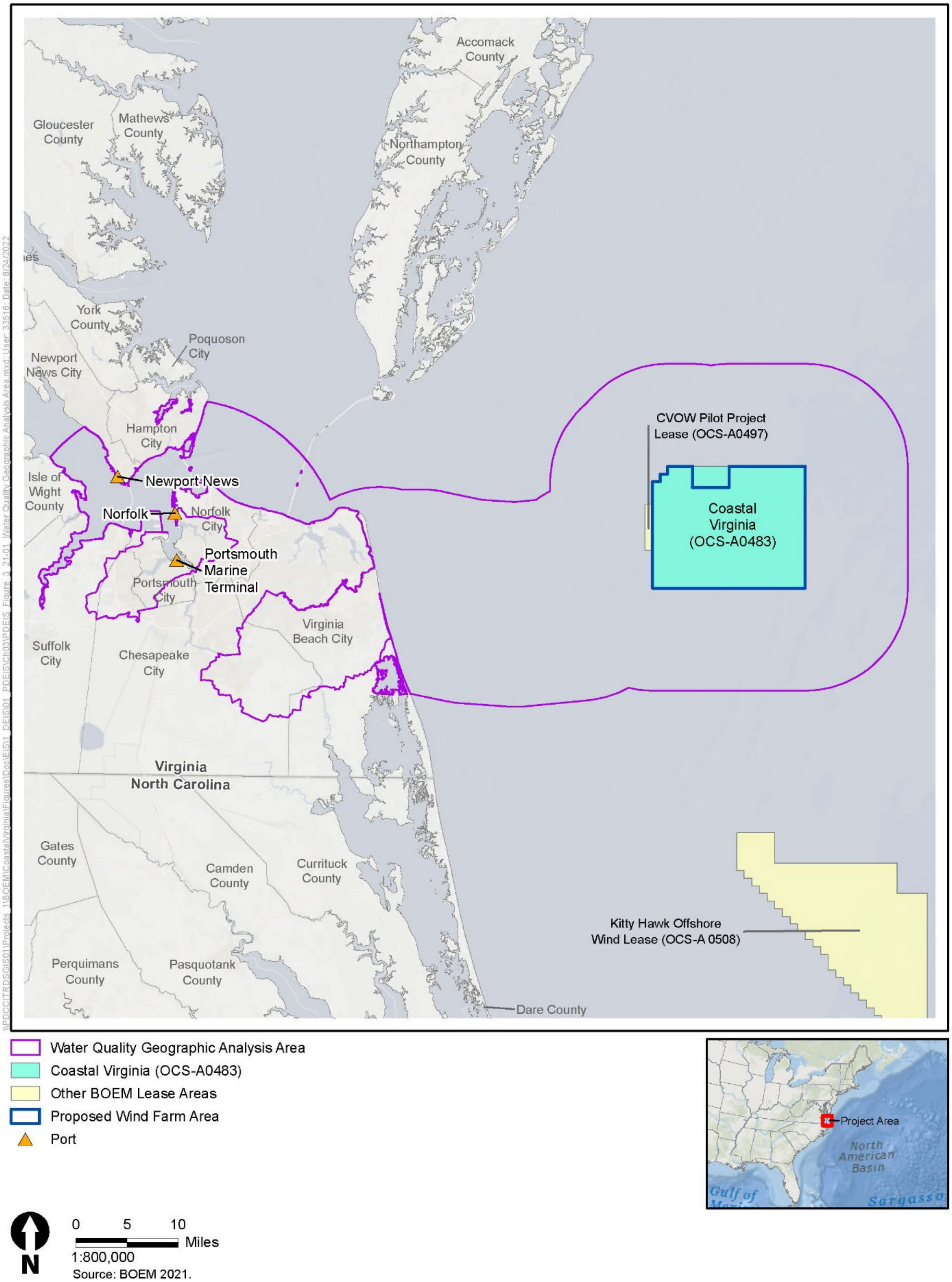


Figure 3.21-1 Water Quality Geographic Analysis Area

The Offshore Project area is located in the Atlantic Ocean (nearshore and offshore waters) and Virginia State Coastal Waters. The Offshore Project components are located in the area of the Atlantic Ocean referred to as the MAB. The Offshore Export Cable Route Corridor crosses Virginia State Coastal Waters to make landfall at Virginia Beach, Virginia.

3.21.1.1 Mid-Atlantic Bight

In 2012, USEPA released the National Coastal Condition Report IV, which assessed dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorous (DIP), chlorophyll *a*, water clarity, and DO for the Northeast Coastal Region ocean waters (USEPA 2012). For coastal waters, USEPA used measured values and determined thresholds to develop water quality index ratings as "good," "fair," or "poor" for various components. However, USEPA did not develop specific water quality index ratings for the MAB ocean waters as a whole because index rating thresholds for ocean waters did not exist for DIN, DIP, chlorophyll *a*, TSS, and DO (USEPA 2012).

For the MAB, USEPA reported average DIN concentrations in ocean surface waters of 0.04 mg/L, and near-bottom DIN concentrations averaged 0.13 mg/L. Average DIP concentrations were reported as 0.04 mg/L. Chlorophyll *a* surface concentrations averaged 0.23 μg/L, and near-bottom concentrations averaged 0.30 μg/L. Ocean water clarity was assessed using measurements of TSS concentrations. TSS averaged 5.6 mg/L, and near-bottom concentrations averaged 6.9 mg/L. DO surface concentrations averaged 8.9 mg/L, and near-bottom concentrations averaged 9.1 mg/L (COP, Section 4.1.2.1; Dominion Energy 2023).

Water temperatures were taken at the sea surface, although water temperatures typically remain the same or decrease with depth. Sea surface temperatures ranged from 32 to 88°F (0 to 31°C). The depth-averaged annual water temperature is 56.39°F (13.55°C) (NOAA n.d.). COP Section 4.1.1, *Physical and Oceanographic Conditions*, provides additional information on water temperatures. NOAA's NEFSC maintains a database of conductivity, temperature, and depth records taken at depth intervals of 3.3 feet (1 meter), collected during various NEFSC cruises within the Offshore Project area. This data was summarized by season within the Lease Area between 2003 and 2006 in Guida et al. 2017). Water temperatures during this period exhibited approximately 36°F (20°C) seasonal range swings at the surface and 27°F (15°C) seasonal range swings at the bottom, with thermal stratification between April and August during most years (Guida et al. 2017).

A persistent cross-shelf salinity gradient exists in the MAB because of freshwater runoff from the Hudson-Raritan Estuary System, Delaware Bay, and Chesapeake Bay (Castelao et.al. 2010). Following periods of high runoff, a strong vertical salinity gradient has been observed across much of the 62-mile-wide (100-kilometer-wide) shelf (Wilkin and Hunter 2013). Stratification starts in early June and often lasts until October (Stevenson et al. 2004). NOAA reports mean surface salinity in 2019 as 32.6 Practical Salinity Unity (PSU) and mean bottom salinity as 33.2 PSU (2020). Seasonal variations in salinity are smaller than variations in temperature (Castelao et.al. 2010). At the shelf edge, strong horizontal gradients in salinity occur separating the shelf water from the warmer saltier sea water (Csanady and Hamilton 1988). NOAA's NEFSC conductivity, temperature, and depth database showed a median salinity of 32.1 PSU (ranging from 29.8 to 33.9 PSU) in the Lease Area between 2003 and 2016, as summarized in Guida et al. (2017 [COP, Section 4.1.2.1]).

3.21.1.2 Virginia State Coastal Waters

Virginia State Coastal Waters include coastal estuaries, intertidal zones, and coastal ocean waters. The USEPA National Coastal Condition Report IV rated the coastal waters of the Northeast Coastal Region as "fair" for water quality (USEPA 2012). The Northeast Coastal Region includes the Virginia State Coastal

Waters. Site water quality indices are rated as "fair" for data points near the offshore cable landing locations (USEPA 2012). Water quality ratings were based on measurements of DIN, DIP, chlorophyll *a*, water clarity, and DO. An assessment of the National Aquatic Resource Survey's 2010 water quality data for 23 stations along Virginia coastal estuaries show that DIN concentrations averaged 0.05 mg/L, DIP concentrations averaged 0.02 mg/L, chlorophyll *a* concentrations averaged 13.4 µg/L, and DO concentrations averaged 5.6 mg/L (USEPA 2016). Light transmissivity was measured to assess water clarity and reported as percent of incident light transmitted through 3.3 feet (1 meter) of water. Light transmissivity ranged from 60.6 percent to 3.52 percent at a depth of 3.3 feet (1 meter), with an average of 32 percent (USEPA 2016). The USEPA National Coastal Condition Report IV rated Virginia coastal estuaries as "good" for DIN and DO concentrations, and as "fair" for DIP and chlorophyll *a*. Light transmissivity has the largest variability across sampling stations, ranging from "poor" to "good" (USEPA 2016). From 2016 to 2017, the United States Navy performed water quality sampling in the nearshore and offshore areas of the Naval Air Station Oceana Dam Neck Annex in Virginia Beach, Virginia. The sampling area overlaps a portion of the nearshore HDD area; therefore, water quality measurements collected during the survey are relevant to the Project. Depending on the season that sampling occurred, concentrations of organic nitrogen (i.e., nitrogen bound to organic chemicals [e.g., ammonia]) ranged from 0.50 to 0.51 mg/L, nitrate-nitrite nitrogen ranged from 0 to 0.1 mg/L, total phosphorous ranged from 0.62 mg/L to 1.7 mg/L, and TSS ranged from 0.03 to 0.11 mg/L. COP Table 4.1-4 details the Dam Neck Annex seasonal water chemistry measurement results. Seasonal in-situ water quality data was also collected from spring 2016 to winter 2017 for the Dam Neck Annex (see details in COP Table 4.1-5; Dominion Energy 2023). In-situ water quality parameters measured were found to be significantly influenced by season or location. DO, pH, and temperature were within acceptable levels compared to Commonwealth of Virginia standards (Virginia Administrative Code, Criteria for Surface Water 9VAC25-260). Virginia has not set numeric nitrogen, phosphorous, or TSS standards for estuaries or open ocean (Virginia Administrative Code, Criteria for Surface Water 9VAC25-260) (COP, Section 4.1.2.1; Dominion Energy 2023).

Virginia Department of Health (VDH) conducts routine *Enterococcus* bacteria water quality sampling at the SMR monitoring station (Station 21VABCH-VA514504), which is also near the preferred cable landing location (VDH 2020a). Monitoring results are available beginning in 2003 through 2020 through the National Water Quality Monitoring Council (NWQMC 2020). For transition and saltwater waterbodies, state water quality standards state that *Enterococci* bacteria shall not exceed a geometric mean of 35 counts/ 100 milliliter (mL) and shall not have greater than a 1-percent excursion frequency of a statistical threshold value of 130 counts/100 mL, both in an assessment period of up to 90 days (VDEQ 2020b). Samples at Station 21VABCH-VA514504 did not exceed state water quality standards in 2019 (VDH 2020a).

The VDH Algal Bloom Surveillance Map is updated regularly from May through October to map algal blooms in Virginia (VDH 2020b). An algal bloom was reported on August 4, 2020, at the 1st Street Jetty, which is approximately 1.0 mile (1.6 kilometers) from the preferred cable landing location. VDH determined the algae to be *Margalefidinium polykrikoides* with a concentration 6,990 cells per mL. *Margalefidinium polykrikoides* produces compounds that are toxic to finfish, shellfish, and planktonic organisms; however, it is not known to be harmful to humans. Other algal blooms were reported north of the project and primarily in the coastal waters during August and September 2020 (COP, Section 4.1.2.1; Dominion Energy 2023).

3.21.1.3 Onshore Groundwater Quality

The onshore geographic analysis area is underlain by the Northern Atlantic Coastal Plain aquifer, which is a large aquifer that extends from New Jersey through North Carolina, containing multiple aquifer and confining units (USGS 2020a). The surficial aquifer is the uppermost aquifer in the system and is made up of many small-scale aquifers. In Virginia, the surficial aquifer is used for domestic and agricultural water supplies, and is susceptible to contamination from anthropogenic sources because of its proximity to the surface; therefore, the water quality of the surficial aquifer is variable (USGS 2020a). The surficial aquifer is used for small-scale irrigation (lawn watering) due to water quality limitations such as high iron content and low pH (causing corrosion), and low well yield potential (Siudyla et al. 1981).

The regional Chesapeake aquifer lies below the surficial aquifer; the aquifers are separated by a confining layer in most locations. Water supply yield from the Chesapeake aquifer is greatest in the parts of the aquifer near the coast, and most withdrawals are for public water supply, domestic uses, commercial uses, and agricultural uses. The aquifers below the Chesapeake aquifer include the Castle Hayne-Aquia, Peedee-upper Cape Fear, and Potomac aquifers (COP, Section 4.1.2.1; Dominion Energy 2023).

Several USGS groundwater monitoring wells are located around the onshore export cable route, switching station, interconnection cable route, and onshore substation (see COP Table 4.1-6 and Figure 4.1-11). Data collected for the period from September 24, 2019, to September 24, 2020, shows that wells in the surficial aquifer had water depths ranging from 3 to 9.5 feet (0.9 to 2.9 meters) from the surface. Wells in the Chesapeake aquifer measured water depths ranging from 3 to 15 feet (0.9 to 4.6 meters) for this same period. Groundwater quality in the area of the onshore substation has been studied extensively during environmental assessments related to the construction of the Battlefield Golf Club, which is located to the east of the onshore substation across the Centerville Turnpike. Groundwater, surface water, and soil samples from 2001 to 2009 were collected at or near the Battlefield Golf Club (Tetra Tech 2010). In 2001, Stokes Environmental Associates, Ltd. collected 40 groundwater samples during a baseline surface water quality survey investigation (Tetra Tech 2010; URS Corporation 2009). Arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, thallium, and zinc were detected in some of the groundwater samples. Two wells produced samples with copper levels above USEPA's maximum contaminant level (MCL) or action level, and one well had thallium levels above the MCL (Tetra Tech 2010; URS Corporation 2009). All other inorganic substances were below USEPA's MCL (COP, Section 4.1.2.1; Dominion Energy 2023).

In 2008, Tetra Tech and USEPA collected groundwater samples from 55 residential wells in the vicinity of the Battlefield Golf Club (Tetra Tech 2010). Locations of the residential wells were not included in the redacted report. The samples were analyzed for dissolved and total target analyte list metals, boron, and molybdenum. Four of the sampled wells measured lead above USEPA MCL (Tetra Tech 2010). All other compounds analyzed were below USEPA's MCL (COP, Section 4.1.2.1; Dominion Energy 2023).

3.21.1.4 Onshore Water Quality and 303(d) Impaired Waters

The overall water quality of Virginia coastal waters in the geographic analysis area is generally impaired, particularly the estuarine waters of or related to the Chesapeake Bay, James River, Nansemond River, Elizabeth River, Lafayette River, Black River, and Harris River (see Appendix I, *Environmental and Physical Setting,* Figure I-5; VDEQ 2021). Impaired non-estuarine surface waters in the geographic analysis area include West Neck Creek and the Pocaty River. The Pocaty River is not crossed by the onshore cable route or interconnection cable route, and the segment of West Neck Creek (upper) crossed by the onshore interconnection cable route is not listed as impaired (VDEQ 2020c, 2021).Appendix I, Table I-6 contains the full list of 303(d) impaired waters (and reasons for impairment) in the geographic analysis area (VDEQ 2021).

Stormwater runoff from the northern portion of the onshore export cable route discharges to the Atlantic Ocean via Owl's Creek into Rudee Inlet. Oceana Pond was monitored as part of a one-time (June 2014) assessment for the following parameters: DO (7.78 mg/L), temperature (79.3°F [26.3°C]), pH (7.78), and specific conductance (0.172 MilliSiemens per square centimeter) (Tetra Tech 2015a). The Virginia

Aquarium maintains a water quality monitoring station within the estuarine portion of Owl's Creek, with data from 1998 to 2010 for the following parameters (annual mean): DO (7.64 mg/L), temperature (63.1°F [17.3°C]), pH (7.68), salinity (24 PSU), and fecal coliform (37 counts/100 mL) (Tetra Tech 2015a). DO, temperature, and pH are within acceptable levels (Virginia Administrative Code 9VAC25-260). Fecal coliform exceeds the state standards for geometric mean for shellfish waters (Virginia Administrative Code 9VAC25-260). Owl Creek is listed on the Draft 2020 303(d) List of Impaired Waters for dissolved oxygen impairment, fecal coliform impairment and *Enterococcus* impairment (VDEQ 2020c). Total maximum daily load (TMDL) studies have not been completed by the state (COP, Section 4.1.2.1; Dominion Energy 2023).

Stormwater runoff from the southern portion of the onshore export cable route discharges to Ashville Bridge Creek into the Currituck Sound. Ashville Bridge Creek is listed on the Draft 2020 303(d) List of Impaired Waters for pH impairment, DO impairment, and *Enterococcus* impairment (VDEQ 2020c). The state has not completed TMDL studies the DO impairment or *Enterococcus* impairment (COP, Section 4.1.2.1; Dominion Energy 2023).

Interconnection Cable Routes 1 and 6 cross over Chesapeake-Albemarle Canal (Intracoastal Waterway) (COP, Figure 4.1-13; Dominion Energy 2023). The switching station and Interconnection Cable Route Options 1 and 6 are located in the North Landing River watershed. While the Bacterial TMDL implementation plan in the North Landing River watershed is in place, water quality in the North Landing River has either remained the same or declined since publication of that implementation plan (City of Virginia Beach 2018). Virginia Department of Environmental Quality (VDEQ) has not completed a TMDL study for the pH impairment. The 2020 Annual Water Quality Monitoring Plan includes one Ashville Bridge Creek monitoring station located at latitude 36.7269 and longitude -75.9861 (VDEQ 2020a). The Ashville Bridge Creek station (VDEQ Station 5BASH002.20) is an ambient long-term trend monitoring station site for permanent monitoring to detect short-, medium- and long-term water quality trends. Samples at this station are collected six times per year and include measurements of nutrients, bacteria, and suspended solids (COP, Section 4.1.2.1; Dominion Energy 2023).

The onshore substation parcel and a portion of the interconnection cable route is within the Pocaty River subwatershed of the North Landing River (City of Chesapeake 2007), with the majority of the interconnection cable route occurring within the North Landing River watershed (COP, Figure 4.1-13; Dominion Energy 2023). The Pocaty River, although not crossed by the Project, is listed on the 2020 303(d) list of impaired waters for DO impairment, E. coli impairment, and for benthic macroinvertebrates bioassessments impairment (VDEQ 2020c). TMDL studies have been completed for both DO impairment and E. coli impairment. VDEQ has not completed a TMDL study for the benthic macroinvertebrates bioassessments impairment (COP, Section 4.1.2.1; Dominion Energy 2023).

One water quality monitoring station is located at the Blackwater Road Bridge. Thirteen different water quality parameters are collected at this station, and averages from data collected in 2019 and 2020 are listed in COP Table 4.1-8. Of the parameters in COP Table 4.1-8, the state has developed numeric water quality criteria for pH, temperature, and E.coli in freshwater streams. pH and temperature are within acceptable levels (Virginia Administrative Code 9VAC25-260). E. coli exceeds the Commonwealth's standards for geometric mean to protect recreation (Virginia Administrative Code 9VAC25-260) (COP, Section 4.1.2.1; Dominion Energy 2023).

Additional surface water quality data was collected in 2014 and 2015 within the upper portion of the Pocaty River watershed that overlaps the Naval Auxiliary Landing Field Fentress for the following average parameters: DO (7.57 mg/L), temperature (72.1°F [22.3°C]), pH (7.60), and specific conductance (0.406 MilliSiemens per square centimeter) (Tetra Tech 2015b). DO, temperature, and pH are within acceptable levels (Virginia Administrative Code 9VAC25-260) (COP, Section 4.1.2.1; Dominion Energy 2023).

3.21.2 Environmental Consequences

3.21.2.1 Impact Level Definitions for Water Quality

Definitions of impact levels are provided in Table 3.21-1. There are no beneficial impacts on water quality.

Table 3.21-1 Impact Level Definitions for Water Quality

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

3.21.3 Impacts of the No Action Alternative 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 activities 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 F.

3.21.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for water quality described in Section 3.21.1, *Description of the Affected Environment for Water Quality,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on water quality generally relate to or include terrestrial runoff, ground disturbance (e.g., construction) and erosion, terrestrial point- and nonpoint-source discharges, and atmospheric deposition. 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 temporary 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.

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on water quality.

- Continued O&M of the CVOW Project (two WTGs) installed in OCS-A 0497.

Ongoing O&M of the CVOW Project would affect water quality through the primary IPFs of accidental releases, anchoring, cable maintenance, port utilization, and discharges. Ongoing offshore wind activities would have the same type of impacts from accidental releases, anchoring, cable maintenance, port utilization, and discharges that are described in detail in Section 3.21.3.2, *Cumulative Impacts of the No Action Alternative*, for planned offshore wind activities, but the impacts would be of lower intensity.

3.21.3.2 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).

Other planned non-offshore wind activities that affect water quality include onshore development activities (including urbanization, municipal waste discharges, and residential and commercial development); marine transportation-related discharges; dredging and port improvement projects; commercial fishing; military use; new submarine cables and pipelines; and climate change (see Appendix F, Section F.2 for a description of ongoing and planned activities). Water quality impacts from these activities, especially from dredging and harbor, port, and terminal operations, are expected to be localized and temporary 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 Appendix F, Table F1-22 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for water quality.

The geographic analysis area does not overlap with any other BOEM offshore wind lease areas; therefore, there would be no future WTGs or OSSs constructed, operated, or decommissioned in the geographic analysis area, and water quality impacts associated with those activities would not occur in the geographic analysis area. Approximately 9 miles (14.5 kilometers) of Kitty Hawk Offshore Wind North Project's (Lease Area OCS-A-0508) proposed offshore cable would travel through the geographic analysis area on its way to landfall in Sandbridge, Virginia. In addition, based on Kitty Hawk Offshore Wind North Project's COP (Avangrid Renewables 2021), the proposed landfall and onshore components (e.g., onshore cable routes) would overlap with the onshore portion of the geographic analysis area. There would also be several years of construction overlap with the Proposed Action and the Kitty Hawk Offshore Wind Projects (Appendix F, Table F-3).

BOEM expects future offshore wind activities to affect water quality through the following primary IPFs, and include those areas where future offshore wind project components overlap with the geographic analysis area.

Accidental releases: Future offshore wind activities could expose coastal offshore 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. This impact would be primarily limited to vessel use to construct and maintain the 9 miles (14.5 kilometers) of Kitty Hawk Offshore Wind North Project's offshore cable that travels through the geographic analysis area. The Kitty Hawk Offshore Wind North Project would result in a small incremental increase in vessel traffic in this 9-mile (14.5-kilometer) area, with a short-term peak during construction. Vessel activity associated with construction is expected to occur regularly in the Virginia and North Carolina lease areas beginning in 2024 and continuing through 2030 and then lessen to near-baseline levels during operational activities. Increased vessel traffic would be localized near the offshore construction area. Increased vessel traffic associated with construction of the 9 miles (14.5 kilometers) of Kitty Hawk Offshore Wind North Project's offshore export cable could increase the probability of allisions in that area, which could result in oil or chemical spills. However, allisions are not anticipated along the offshore export cable route due to the absence of structures in this area, such as WTGs.

All future offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of accidental spills administered by USCG and BSEE. Oil Spill Response Plans 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 operation 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, due to the limited area of overlap of the Kitty Hawk Offshore Wind North Project with the geographic analysis area, low likelihood of a spill occurring, and regulatory requirements, the overall impact of accidental releases is anticipated to be short term and localized, resulting in little change to water quality. As such, accidental releases from future offshore wind development in the water quality geographic analysis area would not be expected to contribute appreciably to overall 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. This impact would be limited to any anchoring that would occur during construction, operations, and decommissioning along the 9 miles (14.5 kilometers) of Kitty Hawk Offshore Wind North Project's offshore cable that travels through the geographic analysis area. If anchoring is required in this 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 *New cable emplacement and maintenance* IPF discussion) and would, therefore, be unlikely to have an incremental impact beyond the immediate vicinity. If the Kitty Hawk Offshore Wind North Project offshore cable is being constructed during the same period as the Proposed Action in the geographic analysis area, the impacts would be greater than for the Kitty Hawk Offshore Wind North Project, and multiple areas would experience water quality impacts from anchoring; however, due to the localized area for sediment plumes, the impacts would likely not overlap each other geographically. The overall impact of increased sediment and turbidity from vessel anchoring is anticipated to be adverse, localized, and short term, resulting in little change to ambient water quality. Anchoring would not be expected to appreciably contribute to overall impacts on water quality.

New cable emplacement and maintenance: Emplacement of submarine cables would result in increased suspended sediments and turbidity. This impact would be limited to the 9 miles (14.5 kilometers) of Kitty Hawk Offshore Wind North Project's offshore cable that travels through the geographic analysis area. As described under *Anchoring*, these activities would contribute to changes in offshore water quality from the resuspension and deposition of sediment. Sediment transport modeling was conducted for the Kitty Hawk Offshore Wind North offshore cable installation, which determined that the suspended sediment concentration, deposition depth, and area of influence is dependent upon flood and ebb current velocities, burial depth, and the percentage of fine sediments in the sediment sample (Avangrid Renewables 2021). The model also determined that the very fine sediments particles (silt and clay) remain in suspension for about 4 hours after being mobilized in the water column. Coarser particles (fine sand) settle at a faster rate, about 1 minute after being mobilized. During peak flood and ebb tides, the suspended sediment concentrations diminish rapidly away from the release point, and at most stations over 80 percent of the suspended particles deposit within 33 feet (10 meters) of the trench centerline. The typical concentration at 328 feet (100 meters) is about 300 mg/L above background concentration for flood tides and about 50 mg/L above background concentration for ebb tides. Deposition thicknesses were predicted to decrease rapidly away from the trench. Average deposition thicknesses were less than 1.57 inches (4 centimeters) within 82 feet (25 meters) of the trench centerline for flood tides and less than 0.09 inch (0.25 centimeter) within 82 feet (25 meters) of the trench centerline for ebb tides. Deposition thicknesses were less than 0.02 inch (0.05 centimeter) at all stations within 492 feet (150 meters) of the trench centerline. 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 adverse, resulting in little change to ambient water quality. New cable emplacement and maintenance activities would not be expected to appreciably contribute to overall 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. Several offshore wind projects (e.g., Kitty Hawk Offshore Wind Projects, and Ocean Wind 1 and 2) would use ports within, or would have vessels go through, the geographic analysis area to reach ports. For example, Kitty Hawk Offshore Wind Projects are considering the use of Newport News, Portsmouth, and Chesapeake, Virginia, as O&M facilities, which are all in the geographic analysis area or would require vessels to transit the geographic analysis area. 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 would not be expected to appreciably contribute to overall impacts on water quality.

Discharges: Future offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. This impact would be primarily limited to vessel use to construct and maintain the 9 miles (14.5 kilometers) of Kitty Hawk Offshore Wind North Project's offshore cable that travels through the geographic analysis area. Vessel activity associated with future offshore wind project construction is expected to occur regularly in the Virginia and North Carolina lease areas beginning in 2024 and continuing through 2030, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. Future offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be localized. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. BOEM assumes that all vessels operating in the same area will comply with federal and state regulations on effluent discharge. All future offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of discharges and of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162. Furthermore, each project's vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151, and allowable vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids. Therefore, due to the minimal amount of allowable discharges from vessels associated with future offshore wind projects, BOEM expects impacts on water quality resulting from vessel discharges to be minimal and to not exceed background levels over time.

Due to 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. The level of impact in the water quality geographic analysis area from future offshore wind development would be similar to existing conditions and would not be expected to appreciably contribute to overall impacts on water quality.

Land disturbance: Future offshore wind development would include Kitty Hawk Offshore Wind North Project onshore components that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during the construction and installation of onshore components (e.g., equipment, substation). With the exception of approximately 0.5 mile (0.8 kilometer) of onshore export cable, all of Kitty Hawk Offshore Wind North Project's onshore project components are located in the geographic analysis area. 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. The Kitty Hawk Offshore Wind North Project would prepare a Stormwater Pollution Prevention Plan that would conform with the VDEQ Stormwater Management Program regulations, the construction general permit, and the City of Virginia Beach Erosion and Sediment Control Ordinance (Avangrid Renewables 2021). The erosion and sedimentation controls that will be required as part of the permit requirements and ordinance would minimize impacts, resulting in infrequent and temporary erosion and sedimentation events.

In addition, onshore construction and installation activities would involve the use of fuel and lubricating and hydraulic oils. Use of heavy equipment onshore could result in potential spills during active use or refueling activities. The Kitty Hawk Offshore Wind North Project would prepare an Oil Spill Response Plan to address accidental spills or releases of oils and other hazardous wastes during onshore activities (Avangrid Renewables 2021) and would outline spill prevention plans and measures to contain and clean up spills if they were to occur. Additional mitigation and minimization measures (such as refueling away from wetlands, waterbodies, or known private or community potable wells) would be in place to decrease impacts on coastal water quality. Impacts on water quality would be limited to periods of onshore construction and periodic maintenance over the life of each project.

Overall, the impacts from onshore activities that occur near waterbodies could result in temporary introduction of sediments or fluids into coastal waters in small amounts where erosion and sediment controls fail. Land disturbance for future offshore wind developments that are 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 the Kitty Hawk Offshore Wind North Project could be under construction at the same time as the CVOW-C Project, the likelihood that construction of the onshore components overlaps in time or space is minimal, and the total amount of erosion that occurs and impacts on water quality at any one given time could be minimal. Land disturbance from future offshore wind development is anticipated to be localized and short term and would not be expected to appreciably contribute to overall impacts on water quality.

3.21.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, water quality would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent, **minor** impacts on water quality.

Cumulative impacts of the No Action Alternative. 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. Planned activities would contribute to impacts on water quality due to increased onshore construction

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have temporary impacts on water quality primarily through accidental releases, increased anchoring, new cable emplacement and maintenance, port utilization, discharges, and land disturbance. BOEM anticipates that the impacts of ongoing activities, such as vessel traffic, military use and survey, commercial activities, recreational activities, and ground disturbance, would be **minor**. In addition to ongoing activities, planned activities other than offshore wind may also contribute to 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 ongoing and planned activities other than offshore wind would be **minor**. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor** impacts on water quality, primarily driven by vessel traffic and associated accidental releases.

Considering all of the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area would be **minor** due to cable emplacement and maintenance, port utilization, and discharges. These activities affect offshore water quality through sediment suspension and turbidity or potential spill and marine debris risks. Construction and decommissioning activities associated with future offshore wind activities would lead to increases in sediment suspension and turbidity in the offshore lease areas during the first 6 to 10 years of construction of projects and in the latter part of the 33-year life spans of offshore wind projects due to decommissioning activities. However, sediment suspension and turbidity increases would be temporary and localized.

3.21.4 Relevant Design Parameters and Potential Variances in Impacts

This 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 E, *Project Design Envelope and Maximum-Case Scenario*) 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. Representing the maximum-case scenario, this would be a maximum of 202 WTGs installed, three OSSs, 300 miles (484 kilometers) of inter-array cable, and 416.9 miles (671 kilometers) of offshore export cable.
- Installation methods chosen and the duration of installation.
- Proximity to sensitive water sources and mitigation measures used for Onshore 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 Project equipment.

Variability of the proposed Project design exists as outlined in Appendix E. This includes the exact number of WTGs and OSSs (determining the total area of foundation footprints); the number of monopile foundations (WTGs) and piled jacket foundations (OSSs only); the total length of inter-array 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.

3.21.5 Impacts of the Proposed Action on Water Quality

The Proposed Action would contribute to impacts through all of the IPFs named in Section 3.21.3.1, *Impacts of the No Action Alternative,* plus the presence of structures IPF. The most impactful IPFs would likely include new cable emplacement and maintenance that could cause noticeable temporary impacts during construction through increased suspended sediments and turbidity, the presence of structures that could result in alteration of local water currents and lead to the formation of sediment plumes, and discharges that could result in localized turbidity increases during discharges or bottom disturbance during dredged material disposal.

Accidental releases: The Proposed Action would have a maximum of 855,670 gallons of coolants, 283,860 gallons of oils and lubricants, and 20,409 gallons of diesel stored within WTG foundations or OSSs within the water quality geographic analysis area (COP, Table 3.3-2 and Appendix Q; Dominion Energy 2023). The risk of a spill from any single offshore structure would be low, and any effects would likely be localized. A reduction in the number of WTGs required due to increased capacity would result in a smaller total amount of materials being stored offshore. BOEM has conducted extensive modeling to determine the likelihood and effects of a chemical spill at offshore wind facilities at three locations along the Atlantic Coast, including an area near the proposed Project area (North Carolina Kitty Hawk Call Area, North Carolina; 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 during the life of a project is 90 to 440 gallons (341 to 1,666 liters) at a rate of one time per month, or a diesel fuel spill of up to 2,000 gallons (7,571 liters) at a rate of one time in 10 to 50 years, which would have brief, localized impacts on water quality (Bejarano et al. 2013). The North Carolina Kitty Hawk Call Area is much larger than the CVOW-C Lease Area and would likely contain more WTGs than the 202 under the Proposed Action, which would lead to a decreased 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 and short term.

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 Project components on navigation charts. 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 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. In addition, Dominion Energy would implement its Oil Spill Response Plan (COP, Appendix Q; Dominion Energy 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. With implementation of the Oil Spill Response Plan, risk of fuel spills and leaks from vessels that could adversely affect water quality would be minimized.

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. Dominion Energy would implement a HDD Inadvertent Release Plan with use of non-toxic drilling fluids for review and approval by the appropriate regulatory agencies. Dominion Energy would also develop and implement a Spill Prevention, Control, and Countermeasure Plan to address any ongoing concerns regarding accidental releases to minimize impacts on water quality (which will be provided for agency review and approval, as applicable). 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. Dominion Energy would use detailed and specific project execution plans, which would include mitigation techniques and specific construction practices, to avoid saltwater intrusion for HDD and/or direct pipe installations, and associated dewatering efforts. Utilizing these plans in concert with ongoing monitoring throughout construction and dewatering activities would ensure no saltwater contamination of freshwater environments/features including drinking-water aquifers. Therefore, BOEM anticipates the Proposed Action alone would result in negligible, temporary, and long-term impacts on water quality as a result of releases from heavy equipment during construction and other cable installation activities.

Dominion Energy intends to lease a portion of an existing facility to act as the O&M facility. A location for this facility has not yet been finalized, but Dominion Energy is evaluating leasing options in Virginia Port Authority's existing Portsmouth Marine Terminal and Newport News Marine Terminal in the Hampton Roads area of Virginia. The preferred lease location for the O&M facility is Lambert's Point, which is located on a brownfield site in Norfolk, Virginia. This O&M facility will monitor operations and include office, control room, warehouse, shop, and pier space. The O&M plan for both the Project's onshore and offshore infrastructure will be finalized as a component of the Facility Design Report/Fabrication Installation Report review process. Dominion Energy anticipates that they will require a building with an area of up to approximately 0.8 acre (0.3 hectare) to meet the needs of an operation and maintenance facility for an offshore wind farm off the coast of Virginia. In the event that upgrades or a new, build to suit, facility is needed, construction would be undertaken by the lessor and would be separately reviewed and authorized by the USACE and local authorities, as needed. Due to the already developed/disturbed nature of the locations under consideration, BOEM anticipates negligible impacts on water quality if any of the facilities are used for the O&M facility.

Anchoring: There would be increased vessel anchoring during the construction, installation, O&M, and decommissioning of offshore components of the Proposed Action. Anchoring would cause increased turbidity levels. Impacts on water quality from the Proposed Action alone due to anchoring would be localized, temporary, and minor during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in reduced impacts. During construction Dominion Energy anticipates an average of 46 vessel trips during a typical workday. The number of vessels is anticipated to result in 42 acres (17 hectares) of impact from anchoring, which would be additive with the impact(s) of any and all other anchoring activities, including offshore wind activities that occur within the water quality geographic analysis area during the same timeframe.

New cable emplacement and maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., sandwave clearance, boulder removal) and cable installation via jet plow, jet trenching, chain cutting, trench former, hydroplow (simultaneous lay and burial), mechanical plow (simultaneous lay and burial), pre-trenching (both simultaneous and separate lay and burial), mechanical trenching (simultaneous lay and burial), and other available technologies, which can cause temporary increases in turbidity and sediment resuspension. Other projects using similar installation methods have been characterized as having minor impacts on water quality due to the temporary and localized nature of the disturbance (Latham et al. 2017). To evaluate the impacts of offshore export cable and inter-array cable installation, Dominion Energy developed an analytical sediment transport model to conservatively evaluate potential suspended sediment transport and deposition (COP, Appendix J; Dominion Energy 2023). The analytical sediment transport model determined that the suspended sediment concentration, deposition depth, and area of influence is dependent upon flood and ebb current velocities, burial depth, and the percentage of fine sediments in the sediment sample. The model also determined that the very fine sediments particles (silt and clay) remain in suspension for about 4 hours after being mobilized in the water column. Coarser particles (fine sand) settle at a faster rate, about 1 minute after being mobilized. During peak flood and ebb tides, the suspended sediment concentrations diminish rapidly away from the release point, and at most stations over 80 percent of the suspended particles deposit within 16 feet (5 meters) of the trench centerline. The typical concentration at 328 feet (100 meters) is about 500 mg/L above background concentration for flood tides and about 50 mg/L above background concentration for ebb tides. Deposition thicknesses were predicted to decrease rapidly away from the trench. Average deposition thicknesses were less than 0.27 inch (0.69 centimeter) within 82 feet (25 meters) of the trench centerline for flood tides and less than 0.09 inch (0.25 centimeter) within 82 feet (25 meters) of the trench centerline for ebb tides. Deposition thicknesses were less than 0.004 inch (0.01 centimeter) at all stations within 1,640 feet (500 meters) of the trench centerline. Results from the model were also consistent with other sediment transport models completed for wind farm installation projects in the mid-Atlantic region. 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, temporary, and adverse, resulting in little change to ambient water quality. Therefore, given the known hydrodynamic conditions within the area of the Project and the expected BMPs associated with installation methods, no long-term impacts on water quality are anticipated following cable installation activities. Overall, impacts on water quality from the Proposed Action alone due to cable emplacement and resulting suspension of sediment and turbidity would be temporary and minor.

Port utilization: The current bearing capacity of existing ports was considered suitable for WTGs, requiring no port modifications for supporting offshore wind energy development (DOE 2014). Dominion Energy intends on leasing a portion of an existing facility to act as the O&M facility. A location for this facility has not yet been finalized, but Dominion Energy is evaluating leasing options in Virginia Port Authority’s existing Portsmouth Marine Terminal and Newport News Marine Terminal in the Hampton Roads area of Virginia. The preferred lease location for the O&M facility is Lambert’s Point, which is located on a brownfield site in Norfolk, Virginia. This O&M facility will monitor operations and include office, control room, warehouse, shop, and pier space. The O&M plan for both the Project’s onshore and offshore infrastructure will be finalized as a component of the Facility Design Report/Fabrication Installation Report review process. Dominion Energy anticipates that they will require a building with an area of up to approximately 0.8 acre (0.3 hectare) to meet the needs of an operation and maintenance facility for an offshore wind farm off the coast of Virginia. In the event that upgrades or a new, build to suit, facility is needed, construction would be undertaken by the lessor and would be separately reviewed and authorized by the USACE and local authorities, as needed. The impacts on water quality could include accidental fuel spills or sedimentation during port use. The incremental increases in ship 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 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 202 WTGs, three OSSs, and related Project elements, which would increase seabed disturbance. During operations, scour processes around foundations and submarine export and inter-array cables are a concern due to the potential impacts on water quality through the formation of suspended sediment plumes. The Proposed Action would result in 2.9 acres

(1.17 hectares) of permanent seabed impact with scour protection for the three offshore substation foundations, and 196 acres (79 hectares) of permanent seabed impact for WTG foundations and scour protection. Scour around foundations is dependent on water currents, wave action, and water depths, and scour depth can range from 0.3 times the pile diameter to 2.0 times the pile diameter or greater. Water currents are typically the largest indicator of the amount of expected scour (Tempel et al. 2004). In general, studies have shown the maximum scour depth around most piles is 1.3 times the diameter of the pile (DNV GL 2016; Whitehouse et al. 2011). The foundations will be located in deeper water depths with lower current speeds (typically 0.7 foot [0.2 meter] per second), and piles located in areas of similar depths and currents have minimal scour (BOEM 2018; Epsilon 2018; Nielsen et al. 2014; Whitehouse et al. 2011). Several studies have shown that most scour tends to occur within the first month of installation (Harris et al. 2011; Tempel et al. 2004). However, scouring is a continuous process that can change over a period of years (Harris et al. 2011; Whitehouse et al. 2011). In addition, large storms with strong currents can temporarily increase the scour rate (Harris et al. 2011, Whitehouse et al. 2011, Tempel et al. 2004). At some sites, backfilling occurs in the scour hole around the pile when there are changes in current conditions (Peterson 2014). The magnitude of scour around the edge of scour protection is related to the size of the rock and the depth and tapering of the protection, with smaller rock and shallower protections with more tapering resulting in less edge scour (Peterson 2014). Edge scour has been shown to be approximately 0.12 times the diameter of the pile (Whitehouse et al. 2011) and, depending on the scour protection and currents, could be half of that value (Peterson 2014; Tempel et al. 2004). In some areas, specifically in deep areas and those with small waves, scour is minimal and scour protection can be foregone (Whitehouse et al. 2011). The relatively low velocities in the Wind Farm Area, combined with scour mitigation, will limit scour potential around foundations (BOEM 2018). Furthermore, limited scour is anticipated around the cable due to the target cable burial depths. The addition of scour protection would further minimize effects on local sediment transport.

The proposed Project's contribution to impacts on water quality due to the presence of structures would be additive with the impacts of the 9 miles (14.5 kilometers) of the Kitty Hawk Offshore Wind North Project's offshore cable that goes through the geographic analysis area, and that would remain for 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 for as long as the structures remain in operation.

Offshore wind facilities have the potential to affect 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 on 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 a 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). Results from a recent BOEM (2021) hydrodynamic model 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 wind energy area 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. Alterations in currents and mixing would affect water quality parameters such as temperature, DO, and salinity, but would vary seasonally and regionally. The impacts from the Proposed Action alone on water quality due to the presence of structures would be negligible during construction, decommissioning, and operations.

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 their 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 or 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).

Discharges: During construction of the Proposed Action, vessel traffic would increase in and around the Wind Farm Area, leading to potential discharges of uncontaminated water and treated liquid wastes. In accordance with 30 CFR 585.626(b)(9), Dominion Energy has provided a preliminary list of wastes expected to be generated during Project construction (COP, Table 3.5-1; Dominion Energy 2023). Dominion Energy would only be allowed to discharge uncontaminated water (e.g., uncontaminated ballast water and uncontaminated water used for vessel air conditioning) or treated liquid wastes overboard (e.g., treated deck drainage and sumps). Other waste such as sewage and solid waste or chemicals, solvents, oils, and greases from equipment, vessels, or facilities would be stored and properly disposed of on land or incinerated offshore.

Dominion Energy expects substantially less vessel use during routine O&M than during construction. Vessel use would consist of scheduled inspection and maintenance activities, with corrective maintenance as needed. In a year, the Proposed Action would generate a maximum of 26 crew vessel trips, 26 service operation vessel trips, and 50 helicopter trips (COP, Section 3.5.1; Dominion Energy 2023). The proposed Project would require all vessels to comply with regulatory requirements related to the prevention and control of discharges, accidental spills, and nonindigenous species. All vessels would need to comply with waste and water management regulations described in Section 3.21.3.2, *Cumulative Impacts of the*

No Action Alternative, including USCG ballast water management requirements and USCG bilge water regulation. The bilge water from the proposed Project would either be retained onboard vessels in a holding tank and discharged to an onshore reception facility or treated onboard with an oily water separator, after which the treated water could be discharged overboard. In addition, bilge water would not be allowed to be discharged into the sea unless the oil content of the bilge water without dilution is less than 15 parts per million. For vessels operating within 3 nautical miles (5.6 kilometers) from shore, bilge water regulations under USEPA's National Pollutant Discharge Elimination System program apply to any of the proposed Project's vessels that are covered by a Vessel General Permit (those that are 79 feet [24 meters] or greater in length). Bilge discharges within 3 nautical miles (5.6 kilometers) from shore are subject to the rules in Section 2.2.2 of the Vessel General Permit and must occur in compliance with 40 CFR Parts 110, 116, and 117, and 33 CFR Part 151.10. Dominion Energy has also committed to developing and implementing an Oil Spill Response Plan for the Project (COP, Appendix Q; Dominion Energy 2023). With implementation of this measure and these regulatory requirements, the temporary impact of routine vessel discharge is expected to be minor.

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

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 and downstream surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity. Dominion Energy would develop a Stormwater Pollution Prevention Plan for construction activities that would conform with the VDEQ Construction General Permit, Dominion Energy's approved Annual Standards and Specifications for Erosion and Sediment Control and Stormwater Management for Electric Transmission Line Development, and local pollution prevention and spill response procedures. Construction would lead to an increased potential for water quality impacts resulting from accidental fuel spills or sedimentation in waterbodies. Dominion Energy would routinely inspect and clean onsite stormwater control features to remove debris or excess vegetation that may impede the designed functionality. The Stormwater Management Plan would describe how the stormwater control facilities would be operated and maintained after construction is complete. Permanent stormwater management facilities for the Harpers Switching Station include sand filters and detention ponds. Additionally, stormwater management systems would be installed in accordance with Dominion Energy's Stormwater Pollution and Prevention Plan, which would be prepared based on the requirements at 9 VAC §25-840 and 9 VAC §25-870-55, respectively, as applicable. The incremental increases in land disturbance from the Proposed Action would be small and mitigation measures, such as the use of a Spill Prevention, Control, and Countermeasure Plan and Stormwater Pollution and Prevention Plan, would be implemented. As such, impacts from the Proposed Action alone on water quality from land disturbance would be negligible to minor.

Disturbance of soils during construction of the onshore export cables, interconnection cable, switching station, and the onshore substation could temporarily impact the water quality of surface or groundwater resources. There is also the potential to encounter contaminated groundwater during excavation near the

Battlefield Golf Club. Final engineering design would determine if groundwater would need to be managed during construction activities, requiring digging of pits or trenches for the Onshore Project components. Dominion Energy would avoid or minimize excavation dewatering in the location of the Battlefield Golf Club. Dominion Energy would develop a Stormwater Pollution and Prevention Plan for construction activities that would conform with the VDEQ Construction General Permit and Dominion Energy's approved Annual Standards and Specifications for erosion sediment control and stormwater management for Electric Transmission Line Development. The Stormwater Pollution and Prevention Plan would include steps Dominion Energy must take to comply with the permit, including water quality requirements, and discuss the potential to encounter contaminated groundwater during excavation near the Battlefield Golf Club. The Stormwater Pollution and Prevention Plan would discuss how to protect surface water and groundwater quality if contaminated groundwater is encountered (COP, Section 4.1.2.2; Dominion Energy 2023).

The extent of potential water quality impacts from constructing the onshore cable routes would generally depend on the construction methods and the amount of wetlands and waterbodies within the rights-of-way of affected by the interconnection cable route and associated onshore components. The Onshore Export Cable Route would require multiple HDD crossings below Lake Christine. Interconnection Cable Route Option 1 would require overhead crossings of the following waterbodies: perennial tributary of West Neck Creek, West Neck Creek, perennial tributaries of the North Landing River, North Landing River, and the Chesapeake Albemarle Canal (Intracoastal Waterway) (COP, Table 4.2-3; Dominion Energy 2023). These crossings will require authorization from VMRC and the USACE under Section 10 of the Rivers and Harbors Act of 1899. Royalties for the VMRC jurisdictional crossings are expected to be based on the crossing lengths identified in Dominion Energy's Joint Permit Application (USACE 2022). Minor impacts on 154 linear feet of a perennial stream would result from stormwater outfall infrastructure associated with the Harpers Switching Station. Dominion Energy evaluated pre-construction conditions of stream segments using the Virginia Unified Stream Methodology and included the information in the Joint Permit Application for the Project. To offset impacts on the 154 linear feet of streams impacted by stormwater outfall infrastructure at the Harpers Switching Station, Dominion Energy has proposed the purchase of 101 stream mitigation measures. There would be no other stream impacts associated with construction of the Onshore Project components.

Interconnection Cable Route Option 1 would result in permanent impacts on approximately 25.88 acres [10.47 hectares] of wetlands (Section 3.22, Table 3.22-3), primarily through the conversion of wetlands from forested wetlands to emergent wetlands. Because Interconnection Cable Route Option 1 would be entirely overhead, direct impacts in wetlands would be limited to the footprint of transmission towers and related water quality impacts from construction are anticipated to be minor. See Section 3.22, *Wetlands*, for additional information related to potential wetland impacts associated with cable routes.

3.21.5.1 Cumulative Impacts of the 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. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined accidental release impacts on water quality from ongoing and planned activities would likely be short term and minor due to the low risk and localized nature of the most likely spills, and the use of an Oil Spill Response Plan for projects. These impacts would occur primarily during construction but also during operation and decommissioning, to a lesser degree. In the unlikely event that an allision or collision involving Project vessels or components resulted in an oil or chemical spill, it would be expected that a small spill would have negligible temporary impacts, while a larger spill would have potentially increased temporary impacts. Given the low probability of these spills occurring, BOEM does not expect ongoing and planned activities, including the Proposed Action, to contribute to impacts on water quality resulting from oil and chemical spills.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined anchoring impacts on water quality from ongoing and planned activities are anticipated to be localized, temporary, and minor, primarily during construction and decommissioning. In context of reasonably foreseeable environmental trends, during operations, the contribution of the Proposed Action to the combined anchoring impacts on water quality from ongoing and planned activities would likely be localized, temporary, and negligible.

The contribution from the Proposed Action to increased sediment concentration and turbidity would be additive with the impact(s) of any and all other cable installation activities, including offshore wind activities, that occur within the water quality geographic analysis area and that would have overlapping timeframes during which sediment is suspended. These activities in the context of reasonably foreseeable environmental trends, including the Proposed Action, would likely be temporary and minor. There could be limited overlap in construction schedules for cable installation for the proposed Project and the 9 miles (14.5 kilometers) of the Kitty Hawk Offshore Wind North Project's offshore export cable that travels through the geographic analysis area. These impacts would not occur during operation.

In context of reasonably foreseeable environmental trends and due to the need for minimal port modifications or expansions and the small increase in ship traffic, the contribution of the Proposed Action to the combined port use impact on water quality from ongoing and planned activities would likely be localized, short term, and negligible.

In context of reasonably foreseeable environmental trends, the contributions of the Proposed Action to the combined structure placement impacts on water quality from ongoing and planned activities would likely be constant over the lifespans of the ongoing and planned activities.

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, in context of reasonably foreseeable environmental trends, BOEM expects that the contribution of the Proposed Action to the combined discharge impacts on water quality from ongoing and planned activities would likely be short term and localized, primarily during construction and to a lesser extent during decommissioning and operations.

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

3.21.5.2 Conclusions

Impacts of the Proposed Action. BOEM anticipates the impacts on water quality resulting from the Proposed Action would range from **negligible** to **moderate**. Impacts from routine activities—including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; vessel discharges; 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, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts associated with the Proposed Action are likely to be temporary or small in proportion to the size of the geographic analysis area.

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

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts from individual IPFs on water quality resulting from ongoing and planned activities would likely range from **negligible** to **moderate**. 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 short-term, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures. BOEM has considered the possibility of a **moderate** impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic release. While it is an impact that should be considered, it is unlikely to occur. The Proposed Action would contribute to the overall impact rating primarily through the increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures. Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts from the Proposed Action but would not change the impact ratings. The impact on water quality would be small, and the resource would recover completely after decommissioning.

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

3.21.6 Impacts of Alternatives B and C on Water Quality

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, described in this section.

Impacts of Alternatives B and C. The impacts resulting from individual IPFs under Alternatives B and C would be slightly less than those described under the Proposed Action due to the removal of WTGs and associated connecting inter-array cables in the Offshore Project area. Under Alternative B, 29 WTGs (for total of up to 176 WTGs) and associated connecting inter-array cables would be removed. Under Alternative C, 33 WTGs (for a total of up to 172 WTGs) and associated connecting inter-array cables would be removed. All other Offshore and Onshore Project components would stay the same. The only IPF that would not be affected under Alternatives B and C compared to the Proposed Action is *land disturbance*. While the decreased number of WTGs under Alternatives B and C may slightly decrease localized water quality impacts during construction and operations, the difference in impacts compared to the Proposed Action would not be notable. Impacts on water quality from cable emplacement would still result in short-term and localized sediment suspension, and mitigation measures, such as the use of a Spill

Prevention, Control and Countermeasures Plan and Stormwater Pollution Prevention Plan, would be implemented. In addition, all vessels would need to comply with the regulatory requirements described in Section 3.21.5, *Impacts of the Proposed Action on Water Quality,* to avoid and minimize impacts on water quality. Therefore, while there is a decreased potential for impacts on water quality from reduced WTGs and inter-array cables, BOEM does not anticipate the impacts from Alternatives B and C to be materially different than those described under the Proposed Action.

Cumulative impacts of Alternatives B and C. The contribution of Alternative B or C to the combined impacts from individual IPFs on water quality resulting from ongoing and planned activities would be similar to the Proposed Action.

3.21.6.1 Conclusions

Impacts of Alternatives B and C. BOEM anticipates the impacts on water quality resulting from Alternatives B and C to be similar to the Proposed Action and range from **negligible** to **moderate**. Impacts from routine activities—including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; vessel discharges; 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, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts associated with Alternative B or C are likely to be temporary or small in proportion to the size of the geographic analysis area.

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

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternative B or C to the combined impacts from individual IPFs on water quality resulting from ongoing and planned activities would be similar to the Proposed Action and would likely be **minor**.

3.21.7 Impacts of Alternative D on Water Quality

Impacts of Alternative D. The impacts resulting from individual IPFs under Alternative D would be similar to those described under the Proposed Action. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). Because Alternative D is specific to the Onshore Project component, the only IPF that would be affected under Alternative D compared to the Proposed Action is land disturbance. Interconnection Cable Route Option 1 (Alternative D-1) is the same as the Proposed Action; therefore, potential impacts on water quality from the construction and operation of onshore components of the Project would be the same.

Trenching for underground installation of portions Hybrid Interconnection Cable Route Option 6 and construction of the Chicory Switching Station under Alternative D-2 is anticipated to result in greater disturbance and permanent fill impacts on wetlands compared to the conversion of forested wetlands to emergent wetlands impacts associated with installation of the overhead interconnection cable route and the Harper's Switching Station considered under Alternative D-1 (COP, Section 4.2.1.2; Dominion Energy 2023). The Chicory Switching Station associated with Hybrid Interconnection Cable Route Option 6 (Alternative D-2) would result in approximately 19.57 acres (7.92 hectares) more permanent wetland impacts than the Harpers Switching Station, which is associated with Interconnection Cable

Route Option 1. Additionally, while Interconnection Cable Route Option 1 would result in greater permanent wetland impacts (6.75 acres more than Interconnection Cable Route Option 6), Interconnection Cable Route Option 6 would result in greater temporary impacts on wetlands because its underground installation would require trenching. As a result, the 17.59 acres (7.12 hectares) of temporary wetland impacts under Interconnection Cable Route Option 6 (Alternative D-2) would increase the potential for water quality impacts during construction when compared to the completely overhead cable under Interconnection Cable Route Option 1 (Alternative D-1) (see Section 3.22, *Wetlands*, for details).

Cumulative impacts of Alternative D. The cumulative impacts on water quality will not be materially difference than those described under the Proposed Action. In the context of reasonably foreseeable environmental trends, the impacts contributed by Alternative D to the cumulative water quality impacts would be similar to those described under the Proposed Action.

3.21.7.1 Conclusions

Impacts of Alternative D. BOEM anticipates the impacts on water quality resulting from Alternative D to be similar to the Proposed Action and range from **negligible** to **moderate**. The water quality impacts from the onshore component from cable installation would have the same **negligible** to **minor** impacts on water quality under Alternative D compared to the Proposed Action. Impacts from routine activities—including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; vessel discharges; discharges from the WTGs or OSSs during operation; and sediment plumes due to scour—would be the same as the Proposed Action: **negligible** to **minor**. Impacts from non-routine activities, such as accidental releases, would be **minor** from small spills, while a larger spill, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts associated with Alternative D alone would likely be temporary or small in proportion to the size of the geographic analysis area.

In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the combined impacts from individual IPFs on water quality resulting from ongoing and planned activities would be similar to the Proposed Action and likely would range from **negligible** to **moderate**.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action. While there could be slightly less potential for impacts on water quality compared to the Proposed Action, regulatory requirements to avoid and minimize impacts on water quality would still be implemented, and Dominion Energy's proposed mitigation measures to avoid and minimize impacts on water quality under the Proposed Action would still apply under Alternative D.

3.21.8 Agency-Required Mitigation Measures

No measures to mitigate impacts on land use have been proposed for analysis.

3.22. 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 described in Appendix F, *Planned Activities Scenario,* Table F-1, and shown on Figure 3.22-1, 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 3.21, *Water Quality*, for a discussion of impacts on water quality.

3.22.1 Description of the Affected Environment for Wetlands

The Project is located in the following watershed areas: Rudee Inlet-Atlantic Ocean (Hydrologic Unit Code [HUC] 020403040501), Asheville Bridge Creek (HUC 030102051301), West Neck Creek (HUC 030102051203), 030102051202—Upper North Landing River, 030102051201—Chesapeake Canal, and 030102051204—Pocaty Creek. Sixty wetlands totaling approximately 78,480 acres (31,759 hectares) were identified in the geographic analysis area based on review of available GIS mapping data and evidence collected during field surveys, including Dominion Energy's completed wetland delineation for the Onshore Project area (USFWS 2021; COP, Appendix U; Dominion Energy 2023). Notable natural habitats and rare natural communities as defined by the Virginia Department of Conservation and Recreation (VDCR 2022) are located within or adjacent to the Onshore Project components. These include areas of the North Landing River, Pocaty River, and West Neck Creek. Refer to Appendix I for a description of these natural areas. Table 3.22-1 displays the wetland communities within the geographic analysis area based on National Wetland Inventory (NWI) data.

Through 2021 and up to the end of August 2022, Dominion Energy performed wetland delineations for all onshore components of the Project except the State Military Reservation (SMR) and portions of the Fentress Substation, which were previously delineated by others and verified by USACE. Additional supplemental delineations were completed near the Princess Anne Athletic complex in May 2023, following a shift in the interconnection cable routing. All components of the Onshore Project area are either covered under an existing Preliminary Jurisdictional Determination (PJD) or the PJD confirmed for the Project by the USACE (COP, Appendix U; Dominion Energy 2023). Because wetland delineations are complete and a PJD for the entire Onshore Project area has been received, additional PJD requests and/or addendums will be submitted by Dominion Energy to the USACE as necessary if alignment shifts are made to Onshore Project components (COP, Section 4.2.1.2; Dominion Energy 2023).

While wetlands within the geographic analysis area are estimated using the NWI, the analysis of alternatives in this Final EIS relies on wetland delineation data collected by Dominion Energy for the interconnection cable route options with the exception of the Chicory Switching Station. Because field verified delineation data were not available for the Chicory Switching Station, wetland impacts at this location were estimated by Dominion Energy based on a recent jurisdictional determination of the adjacent property and an in-depth review of light detection and ranging (LiDAR) data (COP, Section 4.2.1.2; Dominion Energy 2023). A targeted wetland delineation based on regulatory guidelines was completed for the Onshore Export Cable Route and Interconnection Cable Route Option 1, including all Onshore Project components associated with Interconnection Cable Route Option 1. The delineation was verified by the USACE on September 29, 2022, and was subsequently used for determination of Project-related impacts.

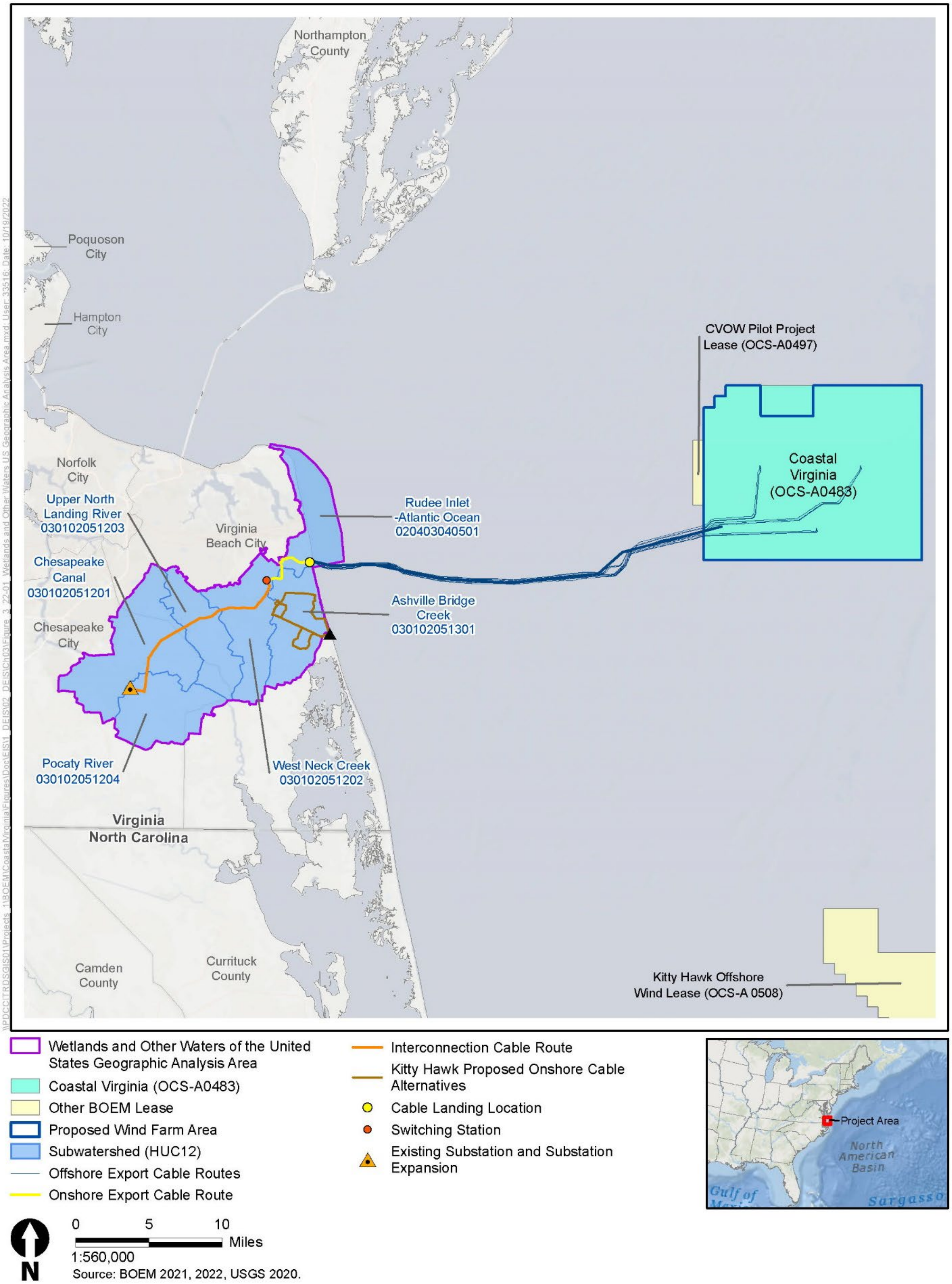


Figure 3.22-1 Wetlands Geographic Analysis Area

Table 3.22-1 Wetland Communities in the Geographic Analysis Area

NWI Feature (Cowardin Classification)	Acres	Percent of Total
Estuarine and Marine Deepwater (E1UBL6)	30,846	39.3%
Estuarine and Marine Wetland (E2EM1)	5,190	6.6%
Freshwater Emergent Wetland (PEM)	1,346	1.7%
Freshwater Forested/Shrub Wetland (PFO/PSS)	35,161	44.8%
Freshwater Pond (PUBx)	1,728	2.2%
Lake (L1UBHx)	1,220	1.6%
Other	0	0.0%
Riverine	2,987	3.8%
Total	**78,480**	**100%**

Source: USFWS 2021.

The wetland impacts identified in Sections 3.22.5, 3.22.6 and 3.22.7 are based on Dominion Energy's evaluation of Project design, the nature of the impact, and coordination with USACE regarding classifications of impacts. The wetland impacts for the Proposed Action, Alterative B, Alternative C, and Alternative D-1 of this Final EIS are the same as impacts proposed in Dominion Energy's Joint Permit Application[1] to the Virginia Marine Resources Commission (VMRC) for the Project. The impacts identified for Alternative D-2 are also the same as the impacts proposed in the Joint Permit Application with the exception of those for the Chicory Switching Station, which have been estimated using the aforementioned available data.

3.22.2 Environmental Consequences

3.22.2.1 Impact Level Definitions for Wetlands

As described in Section 3.3, *Definition of Impact Levels*, this EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. USACE defines wetland impacts differently than BOEM due to requirements under CWA Section 404. The definitions of impact levels are provided in Table 3.22-2. There are no beneficial impacts on wetlands.

Table 3.22-2 Impact Level Definitions 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, wetlands would completely recover.

[1] U.S. Army Corps of Engineers, Norfolk District Public Notice for Permit NAO-13-00418; Coastal Virginia Offshore Wind (CVOW) Commercial Project (https://www.nao.usace.army.mil/Media/News-Stories/Article/3157796/nao-13-00418-coastal-virginia-offshore-wind-cvow-commercial-project/). A copy of the Joint Permit Application can be found on the Virginia Marine Resources Commission's website (https://webapps.mrc.virginia.gov/public/habitat/additionaldocs.php?id=20221183).

Impact Level	Impact Type	Definition
Moderate	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be unavoidable. Compensatory mitigation required to offset impacts on wetland functions and values and 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 required to offset impacts on wetland functions and values would have a marginal or unknown probability of success.

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 or permanent placement of fill within wetlands is considered a permanent impact. USACE regulates waters of the United States and wetlands under Section 10 of the Rivers and Harbors Act, and Section 404 of the Clean Water Act. VDEQ regulates wetlands under Section 401 of the Clean Water Act. VMRC acts as the clearinghouse for distribution of Joint Permit Applications to the appropriate agencies and regulates impacts and encroachments to activities in, on, under, or over state-owned submerged lands, tidal wetlands, and dunes/beaches (Code of Virginia Title 28.2 §1200–1420). Where present, jurisdiction for tidal wetlands from edge to mean low water table is considered under the regulatory purview of the Local Wetland Board (LWB). In this instance, VMRC retains an oversight and appellate role for localities that have adopted these coastal resource ordinances. The City of Virginia Beach coastal resource ordinances are regulated by the LWB. The City of Chesapeake has no LWB and, thus, coastal resource ordinances are under the regulatory purview of VMRC (COP, Section 4.2.1.1, Dominion Energy 2023).

The City of Virginia Beach LWB is responsible for reviewing requests for permits for the use, alteration, or development of tidal wetlands, coastal primary sand dunes, and beaches (Virginia Beach Code of Ordinances, Appendix A, Article 14). LWB's jurisdiction for non-vegetated wetlands lies between mean low water and mean high water; for vegetated wetlands, it lies from mean low water to an elevation 1.5 times the mean tidal range. The mean tidal range is from approximately 2 feet (0.6 meter) for rivers and bay areas to 3.5 feet (1.1 meters) for ocean areas. Upland of this elevation, LWB does not have jurisdiction.

In accordance with the Virginia Beach Southern Rivers Watershed Management Ordinance (Virginia Beach Code of Ordinances, Appendix G, Ord. No. 2115), land disturbance activities within 50 feet (15.2 meters) of any jurisdictional wetland or shoreline, except where wetlands or shorelines have been established in connection with structural best management practice facilities, are prohibited except by application (permit, exception, or exemption) through the City of Virginia Beach.

All earth disturbances from construction activities would be conducted in compliance with the Virginia Discharge Elimination System General Permit for stormwater discharges associated with construction activities and the approved Stormwater Pollution Prevention Plan for the Project. Any work in wetlands would require a Joint Permit Application for corresponding permits through the USACE, VMRC, VDEQ, and the LWB, and a Section 401 Water Quality Certification from VDEQ; any wetlands permanently lost would require compensatory mitigation.

3.22.3 Impacts of the No Action Alternative 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 activities and ongoing offshore wind activities, 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 F.

3.22.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for wetlands described in Section 3.22.1, *Description of the Affected Environment for Wetlands*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that may contribute to impacts on wetlands are generally associated with onshore development activities and climate change (see Appendix F, Section F.2 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 F, Table F1-23 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for wetlands.

Other planned non-offshore wind activities that may affect wetlands would primarily include increasing onshore construction (Appendix F, Table F-9). These activities may permanently (e.g., fill placement) and temporarily (e.g., vegetation removal) affect 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.

There are no ongoing offshore wind activities within the geographic analysis area that contribute to impacts on wetlands.

3.22.3.2 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).

Impacts on wetlands from future offshore wind projects may occur if onshore activity from these projects overlaps with the geographic analysis area. Based on review of the Kitty Hawk Wind North and South projects (Lease Area OCS A-0508) COP (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022), proposed landfall and onshore components (e.g., onshore cable routes) would intersect the geographic analysis area in Virginia (Figure 3.22-1). Specifically, onshore components (onshore export cables and substation) for the Kitty Hawk Wind North project would occur within two watersheds of the CVOW-C Project geographic analysis area for wetlands: the Asheville Bridge Creek (HUC 030102051301) and

West Neck Creek (HUC 030102051203) watersheds. However, the construction corridors for onshore components of the CVOW-C Project and those associated with the Kitty Hawk North and South projects are not anticipated to overlap.

While a wetland delineation has not yet been completed for the Kitty Hawk Wind North and South projects, approximately 294 acres (119 hectares) of wetlands are mapped by NWI data within the limits of the Kitty Hawk North and South onshore project component study area (Kitty Hawk Wind North 2021; Kitty Hawk Wind South 2022). The majority of these wetlands occur in the Asheville Bridge Creek watershed and within wetlands geographic analysis area for the CVOW-C Project; however, potential impacts on wetlands are not anticipated to overlap between the CVOW-C and Kitty Hawk Wind projects. The impacts of other offshore wind activities on wetlands would be of the same type and in the same geographic area as those of the Proposed Action, including impacts related to land disturbance. There would also be several years of construction overlap with the Proposed Action and the Kitty Hawk Wind North project (Appendix F, Table F-3). These activities may permanently (e.g., fill placement) and temporarily (e.g., vegetation removal) affect 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.

BOEM expects other offshore wind activities to affect wetlands through the following primary IPFs.

Land disturbance: Construction of onshore components (e.g., export cables, substation) for Kitty Hawk Wind North in Virginia is anticipated to require clearing, excavating, trenching, fill, and grading, which could result in the loss or alteration of wetlands in the geographic analysis area. Although BOEM expects future offshore wind projects would be designed to avoid wetlands to the extent feasible, in areas where wetlands cannot be avoided, loss of wetland habitat could occur if permanent placement of fill is required in wetlands. Temporary wetland impacts may occur from construction activity that crosses or is adjacent to wetlands, such as rutting, compaction, and mixing of topsoil and subsoil. Where construction leads to unvegetated or otherwise unstable soils, precipitation events could erode soils, resulting in sedimentation that could affect water quality in nearby wetlands. 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. All projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. This would include compliance with the Virginia Pollutant Discharge Elimination System General Permit for Stormwater Discharges associated with construction activities and implementation of sediment controls and a Stormwater Pollution Prevention Plan to avoid and minimize water quality impacts during onshore construction. Any in-wetland work in wetlands would require a Joint Permit Application and a Section 401 Water Quality Certification from the VDEQ. If impacts would not be avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands.

Refer to Section 3.21, *Water Quality*, for a discussion of accidental releases (activities that could expose wetlands to contaminants such as fuel, solid waste, chemicals, solvents, oils, drilling mud, or grease from equipment).

3.22.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, wetlands would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on wetlands. These effects are primarily driven by onshore construction impacts. Therefore, the No Action Alternative would result in **moderate** impacts on wetlands.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and wetlands would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on wetlands due to habitat loss from increased onshore construction.

Kitty Hawk Wind North and South and their impacts would go forward as cumulative projects under the cumulative impacts of the No Action Alternative, and land disturbance from onshore construction activities could cause temporary and permanent loss of wetlands in portions of approximately 294 acres (119 hectares) of wetlands within the onshore project component study area for Kitty Hawk Wind North and Kitty Hawk Wind South. 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. Ongoing activities, especially land disturbance, would likely result in **moderate** impacts on wetlands. 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 impacts of planned activities other than offshore wind would be **moderate** given that an activity could result in permanent wetland impacts that require compensatory mitigation. 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.

Other offshore wind activities could cause impacts that would be similar to the impacts of the proposed Project. 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, mitigation would be anticipated for projects that would allow wetlands to recover to the extent possible.

Under the No Action Alternative, existing environmental trends and activities would continue, and wetlands would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on wetlands. Considering the IPFs and regulatory requirements for avoiding, minimizing, and mitigating impacts on wetlands, BOEM anticipates that the No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts, primarily through land disturbance. Other offshore wind activities are expected to contribute to the impacts through land disturbance, although the majority of this IPF would be attributable to ongoing activities.

3.22.4 Relevant Design Parameters and Potential Variances in Impacts

This 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.

Dominion Energy has committed to measures to minimize impacts on wetland resources, including the collocation of Onshore Project components in existing rights-of-way, existing roads, previously disturbed areas, and otherwise urbanized locations to the extent practicable. Dominion Energy would also use a combination of HDD and overhead routing to the best extent practicable and restrict access during construction to avoid alteration of soil properties from compaction. Additional avoidance, minimization, and mitigation measures for wetlands are provided in Appendix H, *Mitigation and Monitoring*.

3.22.5 Impacts of the Proposed Action on Wetlands

The Proposed Action could affect wetlands through the following primary IPF. Refer to Section 3.21, *Water Quality*, for a discussion of accidental releases (activities that could expose wetlands to contaminants such as fuel, solid waste, chemicals, solvents, oils, drilling mud, or grease from equipment).

Land disturbance: The Onshore Project area includes the cable landing location, onshore export cable route corridor, the proposed Harpers Switching Station, interconnection cable route corridor, and Fentress Substation. The route for the approximately 4.4-mile (7.1-kilometer) underground 230 kV onshore export cable circuits between the cable landing location on the SMR and the proposed Harpers Switching Station located north of Harpers Road was developed in close coordination with SMR and NAS Oceana to avoid conflicts with the operation and future development of these military installations, as well as avoid and minimize impacts on wetlands. This was achieved by avoiding impacts on Lake Christine and Owls Creek by utilizing HDD installation methodology. In addition, wetland impacts on NAS Oceana property were minimized by siting the proposed Harpers Road Switching Station within the boundaries of the existing Aeropines Golf Club. Interconnection Cable Route Option 1 would be constructed to provide transmission from the common location north of Harpers Road to the onshore substation. Interconnection Cable Route Option 1 would be entirely overhead and use existing corridors to the greatest extent possible. The Onshore Project area for the Proposed Action and NWI-mapped wetlands in the geographic analysis area are shown on Figure 3.22-2.

Construction of the Onshore Project components would result in permanent wetland impacts consisting of concrete manholes, overhead structure foundations, permanent fill from the substation expansion, and associated stormwater management facilities. Conversion impacts would consist of new right-of-way for the onshore export cable route corridor and various areas of new right-of-way and right-of-way expansion for Interconnection Cable Route Option 1. Temporary impacts would consist of open trench installation of underground cables and access and construction matting.

Within wetlands, the primary impacts would be excavation, rutting, compaction, mixing of topsoil and subsoil, and the potential alteration of habitat due to clearing at HDD entry pit locations. Loss of wetland habitat could occur if permanent placement of fill is required in wetlands and through installation of permanent structures within wetlands, wetland transition areas, riparian areas, and protected watersheds. The onshore substation and switching station would include associated construction practices as defined by the final design and is assumed to include permanent construction practices such as reinforced concrete foundations, permeable gravel lots, and associated security fencing (COP, Section 4.2.1.3; Dominion Energy 2023). Construction activities would also have the potential to result in conversion of palustrine forested wetlands to palustrine emergent wetlands and conversion of palustrine shrub-shrub wetlands to palustrine emergent wetlands, resulting in permanent impacts.

The Project would require the permitting of an underground crossing of Owl's Creek and aerial crossings over West Neck Creek, North Landing River, Gum Swamp,[2] and the Chesapeake and Albemarle Canal (Intracoastal Waterway). These crossings will require authorization from VMRC and the USACE under Section 10 of the Rivers and Harbors Act of 1899. Royalties for the VMRC jurisdictional crossings are expected to be based on the crossing lengths identified in Dominion Energy's Joint Permit Application. Impacts on higher quality forest corridors in the vicinity of the North Landing River crossing were minimized in coordination with The Nature Conservancy by using existing corridors and selectively identifying the areas needed for expansion of the right-of-way where expansion is needed. Permanent fill impacts on wetlands associated with the overheard transmission infrastructure would be limited to the foundations of the new transmission structures. Except for the foundations, there would be no new permanent structures proposed, including no new permanent access roads. Access roads for construction are limited to existing right-of-way, state roads, private roads, existing maintenance paths, and temporary access features.

[2] Previously referred to as an unnamed tributary of the North Landing River.

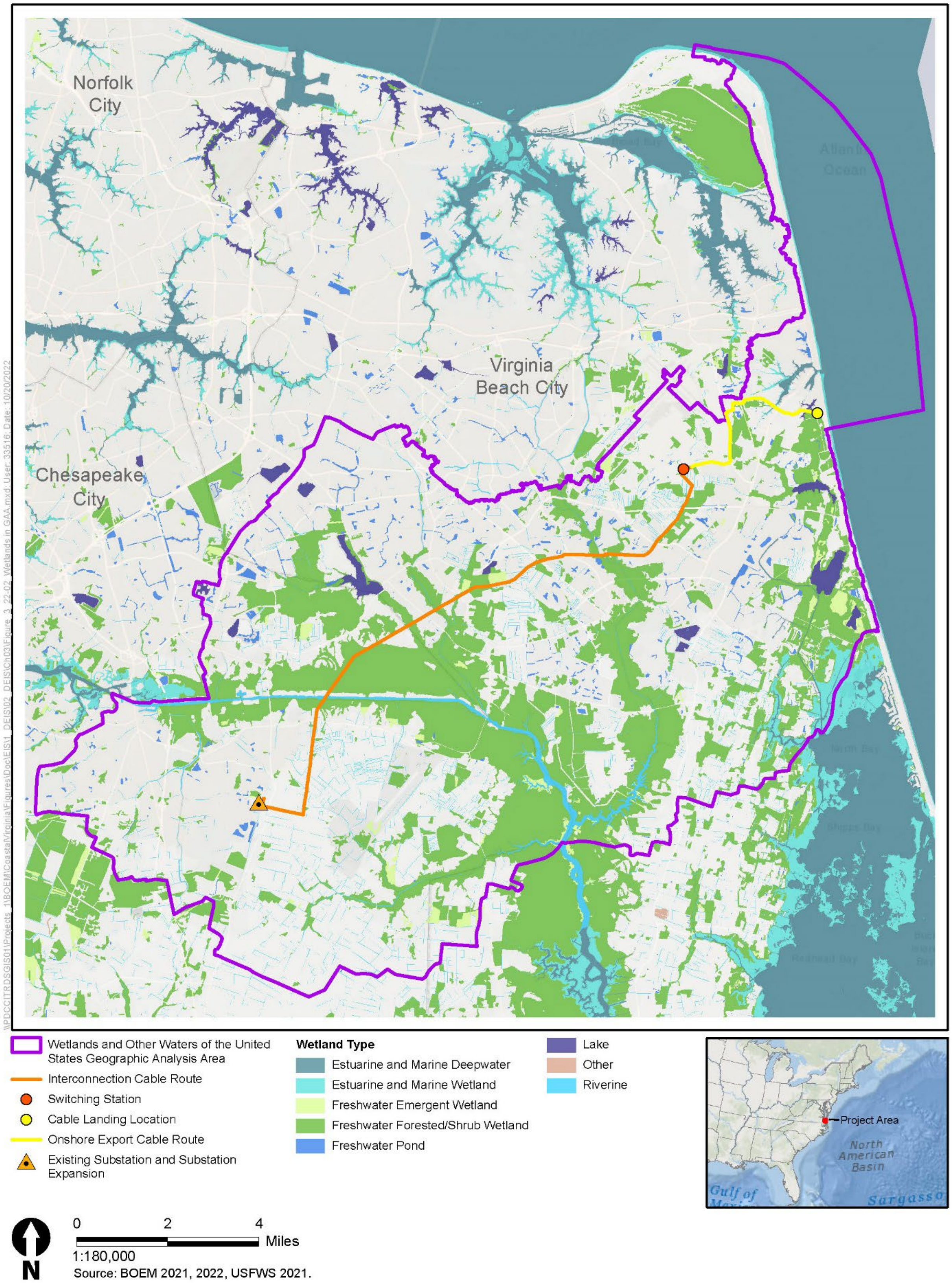


Figure 3.22-2 Proposed Action Onshore Project Area and NWI Wetlands in the Geographic Analysis Area

Table 3.22-3 quantifies the estimated temporary and permanent wetland impacts under the Proposed Action based on wetland delineation survey data. Permanent impacts estimated in Table 3.22-3 for overhead construction under Interconnection Cable Route Option 1 include both permanent loss and permanent conversion (i.e., palustrine forested/scrub-shrub to palustrine emergent). The onshore export cable route would result in 0.16 acre (0.06 hectare) of temporary impacts and 4.02 acres (1.63 hectares) of permanent wetland impacts. Interconnection Cable Route Option 1 would result in 15.29 acres (6.19 hectares) of temporary wetland impacts, the conversion of 25.76 acres (10.42 hectares) of forested wetlands, and a permanent impact of 0.12 acre of emergent wetlands. Therefore, total permanent wetland impacts resulting from Interconnection Cable Route Option 1 would be 25.88 acres (10.47 hectares). The Harpers Switching Station and onshore substation would not result in temporary wetland impacts but would permanently impact 1.02 acres (0.41 hectare) and 9.14 acres (3.67 hectares) of wetlands, respectively. In total, the Proposed Action would result in 16.52 acres (6.67 hectares) of temporary wetland impacts, and 40.06 acres (16.21 hectares) of permanent wetland impacts (Table 3.22-3). Wetland impacts are further defined as part of Dominion's Joint Permit Application (COP, Section 4.2.1.2; Dominion Energy 2023).

The placement of permanent features within wetlands, protected watershed buffer areas, and flood hazard areas would be avoided to the maximum extent practicable, and where appropriate, regulatory requirements as stipulated by regional and local permitting authorities would be followed. This compliance would include adherence to stormwater, erosion, and sediment control requirements (COP, Section 4.2.1.3; Dominion Energy 2023). Onshore Project components would be collocated in existing right-of-way, existing roads, previously disturbed areas, and otherwise urbanized locations to the maximum extent practicable. To reduce land disturbance and to minimize impacts, Dominion Energy would utilize timber mats (or trestles where high organic soil content is present) to cross wetlands and streams. All mats would be removed upon completion, and site restoration would consist of restoring the area to preconstruction contours and re-seeding with approved seed mixes. Compensation for the proposed permanent wetland impacts would be required as part of the Project. Compensation for impacts on wetlands is determined by multiplying the amount of impact in acres by the mitigation compensation ratio designated for each Cowardin classification and impact type. Dominion Energy is proposing fulfilment of compensation requirements through the purchase of wetland and stream mitigation credits from an approved mitigation bank(s) and in lieu fee in areas where credits are not available. The mitigation plan would be further refined as a component of the USACE permitting package (COP, Section 4.2.1.3; Dominion Energy 2023). A complete listing of measures proposed by Dominion Energy to avoid, minimize, and mitigate impacts on wetlands is provided in COP Section 4.2.1.4, Table 4.2-5 (Dominion Energy 2023).

BOEM would not expect normal O&M activities to involve further wetland alteration. The Onshore Project components 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 short term and negligible. All activities would utilize existing access roads and entry points, approved via agency review. Decommissioning of the Onshore Project components would have similar impacts as construction.

Table 3.22-3 Wetland Impacts in Onshore Project Area – Proposed Action

Onshore Project Component	Wetland Classification[1]	Acres in Onshore Project Area	Temporary Impact (acres)	Permanent Impact (acres)	Percent Permanent Impacts Relative to Wetlands in Geographic Analysis Area
Offshore Export Cable Route Landing Location					
Proposed Parking Lot, West of the Firing Range at SMR, Located East of Regulus Avenue and North of Rifle Range Road	PEM	1.07	1.07	0.00	0.00
	PFO	0.00	0.00	0.00	0.00
	Total:	1.07	1.07	0.00	**<0.01**
Switching Station					
Harpers Switching Station (Interconnection Cable Route Option 1)	PEM	0.34	0.00	0.34	0.03
	PSS	0.68	0.00	0.68	<0.01
	Total:	**1.02**	**0.00**	**1.02**	**<0.01**
Onshore Substation					
Fentress Substation (Includes Expansion Area)	PEM	1.24	0.00	1.24	0.09
	PFO	7.90	0.00	7.90	0.02
	Total:	**9.14**	**0.00**	**9.14**	**0.03**
Onshore Export Cable Route					
Onshore Export Cable Route Construction ROW	PEM	1.10	0.16	0.00	0.00
	PFO	6.37	0.00	4.02	0.01
	Total:	**7.47**	**0.16**	**4.02**	**0.01**
Interconnection Cable Route Option 1					
Overhead Interconnection Cable Route Option 1 Construction ROW	PEM	78.32	14.91	0.12	0.01
	PSS	0.38	0.38	0	0.00
	PFO	27.38	0.00	25.76	0.07
	Total:	**106.08**	**15.29**	**25.88**	**0.07**
Grand Total – Proposed Action					
Onshore Project Components	**N/A**	**124.78**	**16.52**	**40.06**	**0.11**

Source: Dominion Energy 2023.
[1] Wetland classifications use the following Cowardin classifications: PFO = Palustrine Forested; PSS = Palustrine Scrub-Shrub; PEM = Palustrine Emergent.
ROW = right-of-way; N/A = not applicable.

3.22.5.1 Cumulative Impacts of the 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. Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on wetlands through the primary IPF of land disturbance.

In context of reasonably foreseeable environmental trends, the impacts on wetlands under the Proposed Action may add to the impacts of ongoing and future land disturbance. Impacts due to onshore land use changes are expected to include a gradually increasing amount of wetland alteration and loss. The future extent of land disturbance from ongoing activities and future non-offshore wind activities over the next 33 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. If a future project were to overlap the geographic analysis area or even be collocated (partly or completely) within the same right-of-way corridor that the Proposed Action would use, then the impacts of that future project on wetlands would be of the same type as those of the Proposed Action; the degree of impacts may increase, although the location and timing of future activities would influence this. For example, repeated construction in a single right-of-way corridor would be expected to have less impact on wetlands than construction in an equivalent area of undisturbed wetland. All earth disturbances from construction activities would be conducted in compliance with the Virginia Pollutant Discharge Elimination System General Permit for Stormwater Discharges associated with Construction Activities and the approved Stormwater Pollution Prevention Plan for the Project. Any work in wetlands would require a Joint Permit Application and associated permits, and a Section 401 Water Quality Certification from VDEQ; any wetlands permanently lost would require compensatory mitigation.

3.22.5.2 Conclusions

Impacts of the Proposed Action. The Proposed Action may affect wetlands through temporary or permanent disturbance 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 alone would likely have **moderate** to **major** impacts on wetlands.

Cumulative impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would be **moderate** to **major**. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the impacts on wetlands from ongoing and planned activities would likely be **moderate** to **major**. The Proposed Action would contribute to the overall impact rating primarily through temporary and permanent impacts on wetlands from onshore construction activities in and adjacent to these resources. Measurable impacts would be 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.

3.22.6 Impacts of Alternatives B and C on Wetlands

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, described here in this section.

Impacts of Alternatives B and C. The impacts resulting from individual IPFs under Alternatives B and C would be the same as those described under the Proposed Action because the onshore components would stay the same.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be different from those described under the Proposed Action. As described under Section 3.22.5, *Impacts of the Proposed Action on Wetlands*, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts from Alternatives B and C but would not change the impact ratings.

3.22.6.1 Conclusions

Impacts of Alternatives B and C. The expected **moderate** to **major** impacts associated with the Proposed Action alone would not change under Alternatives B and C because the alternatives only differ in offshore components, and offshore components would not contribute to impacts on wetlands; the same construction, O&M, and decommissioning activities would still occur.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of individual IPFs resulting from ongoing and planned activities would be the same as the Proposed Action: **moderate** to **major**. Offshore wind projects would contribute to wetland impacts in the geographic analysis area but the overall scale of impacts is expected to be small, and compliance with mitigation measures and regulations would minimize these impacts.

3.22.7 Impacts of Alternative D on Wetlands

Impacts of Alternative D. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under sub-alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same. The Onshore Project area for Alternative D and NWI-mapped wetlands in the geographic analysis area are shown on Figure 3.22-2.

The impacts resulting from *land disturbance* under Alternative D would generally be similar to the Proposed Action; however, Hybrid Interconnection Cable Route Option 6 under sub-alternative D-2 would require more trenching and clearing in wetlands (including forested wetlands) when compared to the Proposed Action. Additionally, Dominion Energy's detailed analysis determined that Alternative D-1 (Interconnection Cable Route Option 1) would result in fewer impacts on wetlands than Hybrid Interconnection Cable Route Option 6 due to the amount of trenching and backfilling Hybrid Interconnection Cable Route Option 6 would require within wetlands (COP, Section 4.2.1.2; Dominion Energy 2023). Trenching required for underground installation of portions the interconnection cable route and construction of the Chicory Switching Station under Alternative D-2 is anticipated to result in greater disturbance and permanent fill impacts on wetlands compared to the conversion of forested wetlands to emergent wetlands impacts associated with installation of the overhead interconnection cable route and the Harper's Switching Station considered under Alternative D-1 (COP, Section 4.2.1.2; Dominion Energy 2023). In addition, the Chicory Switching Station associated with Hybrid Interconnection Cable Route Option 6 (Alternative D-2) would result in approximately 19.57 acres (7.92 hectares) more permanent wetland impacts than the Harpers Switching Station, which is associated with Interconnection Cable Route Option 1 (Alternative D-1).

Table 3.22-4 quantifies the estimated temporary and permanent wetland impacts under Alternative D-2 based on wetland delineation survey data, with the exception of the Chicory Switching Station where wetland impacts were estimated through a combination of a jurisdictional determination of the adjacent property and review of LiDAR data. In total, Alternative D-2 would result in 18.82 acres (7.62 hectares) of temporary wetland impacts and 52.88 acres (21.34 hectares) of permanent wetland impacts. Compared to the Proposed Action and Alternative D-1, temporary and permanent wetland impacts would be increased respectively by 2.30 acres (0.93 hectare) and 12.82 acres (5.19 hectares) under Alternative D-2 (Dominion Energy 2023).

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of sub-alternatives D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action. While Alternative D-2 would result in a greater amount (52.88 acres [21.40 hectares]) of wetlands permanently lost when compared to the Proposed Action or Alternative D-1 (40.06 acres [16.21 hectares]), the same regulatory requirements to avoid and minimize impacts on wetlands would be implemented, and Dominion Energy's proposed mitigation measures to avoid and minimize impacts on wetlands under the Proposed Action would still apply.

Table 3.22-4 Wetland Impacts in Onshore Project Area – Alternative D-2

Onshore Project Component	Wetland Classification[1]	Acres in Onshore Project Area	Temporary Impact (acres)	Permanent Impact (acres)	Percent Permanent Impacts Relative to Wetlands in Geographic Analysis Area
Offshore Export Cable Route Landing Location					
Proposed Parking Lot, West of the Firing Range at SMR, Located East of Regulus Avenue and North of Rifle Range Road	PEM	1.07	1.07	0.00	0.00
	PFO	0.00	0.00	0.00	0.00
	Total:	1.07	1.07	0.00	**<0.01**
Switching Station					
Chicory Switching Station (Hybrid Interconnection Cable Route Option 6)	PEM	0.21	0.00	0.21	0.02
	PFO	20.38	0.00	20.38	0.06
	Total:	**20.59**[2]	**0.00**	**20.59** [2]	**0.06**
Onshore Substation					
Fentress Expanded Substation	PEM	1.24	0.00	1.24	0.09
	PFO	7.90	0.00	7.90	0.02
	Total:	**9.14**	**0.00**	**9.14**	**0.03**
Onshore Export Cable Route					
Onshore Export Cable Route Construction ROW	PEM	1.10	0.16	0.00	<0.01
	PFO	6.37	0.00	4.02	0.01
	Total:	**7.47**	**0.16**	**4.02**	**0.01**
Hybrid Interconnection Cable Route Option 6					
Hybrid Interconnection Cable Route Option 6 Construction ROW	PEM	73.45	17.21	1.52	0.11
	PSS	0.38	0.38	0	0.00
	PFO	25.24	0.00	17.61	0.05
	Total:	**99.07**	**17.59**	**19.13**	**0.05**
Grand Total – Alternative D2					
Onshore Project Components	**N/A**	**137.34**	**18.82**	**52.88**	**0.14**

Source: Dominion Energy 2023.
[1] Wetland classifications use the following Cowardin classifications: PFO = Palustrine Forested; PSS = Palustrine Scrub-Shrub; PEM = Palustrine Emergent.
[2] Wetland impacts for the Chicory Switching Station are estimated based on a recent jurisdictional determination of the adjacent property, in-depth review of LiDAR, and the revised limits of disturbance for the Chicory Switching Station.
ROW = right-of-way; SMR = State Military Reservation

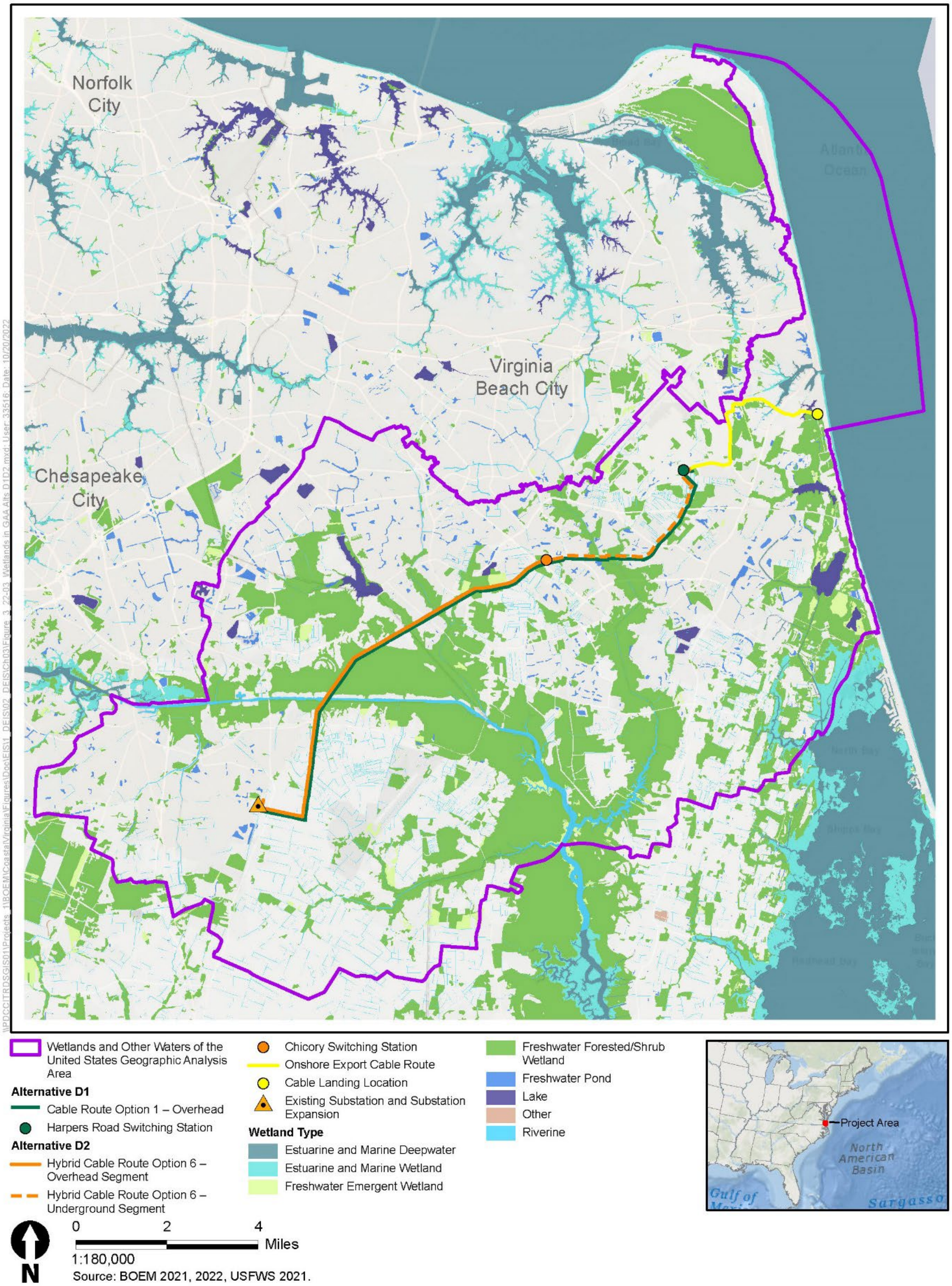


Figure 3.22-3 Alternative D Onshore Project Area and NWI Wetlands in the Geographic Analysis Area

3.22.7.1 Conclusions

Impacts of Alternative D. BOEM anticipates the impacts on wetlands resulting from Alternatives D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be greater than under the Proposed Action due to the amount of trenching and backfilling Hybrid Interconnection Cable Route Option 6 would require within wetlands, and additional wetland impacts associated with the Chicory Switching Station when compared to wetland impacts associated with construction of the Harpers Switching Station under the Proposed Action. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), the wetland impacts from the onshore component from cable installation would have the same, or similar **moderate** to **major** impacts on wetlands under Alternatives D-1 or D-2 compared to the Proposed Action.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the combined impacts from individual IPFs on wetlands resulting from ongoing and planned activities would be similar to the Proposed Action and likely would range from **moderate** to **major**.

3.22.8 Agency-Required Mitigation Measures

The mitigation measure listed in Table 3.22-5 is recommended for inclusion in the Preferred Alternative and would ensure that wetland impacts are avoided or minimized to the maximum extent possible while also requiring compensatory mitigation for unavoidable impacts on jurisdictional wetlands.

Table 3.22-5 Additional Agency-Required Measures (Also Identified in Appendix H, Table H-3): Wetlands

Measure	Description	Effect
Wetland Mitigation	Dominion Energy will comply with all mitigation required by USACE for CWA Section 404 and Section 10 impacts.	The measure would require impacts on wetlands are avoided or minimized to the maximum extent possible and provide compensatory mitigation for unavoidable impacts on jurisdictional wetlands.

3.22.8.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures incorporated into the Preferred Alternative are listed in Table 3.22-4 and in Appendix H, *Mitigation and Monitoring*, Table H-1. Mitigation measures implemented in the Preferred Alternative would compensate for unavoidable impacts on waters of the United States, including wetlands, and ensure compliance with additional conditions required by USACE for CWA Section 404 and Section 10 permit approvals. While mitigation efforts would compensate for unavoidable impacts on wetlands, it would not reduce the impact level of the Proposed Action from what is described in Section 3.22.5, *Impacts of the Proposed Action on Wetlands*.