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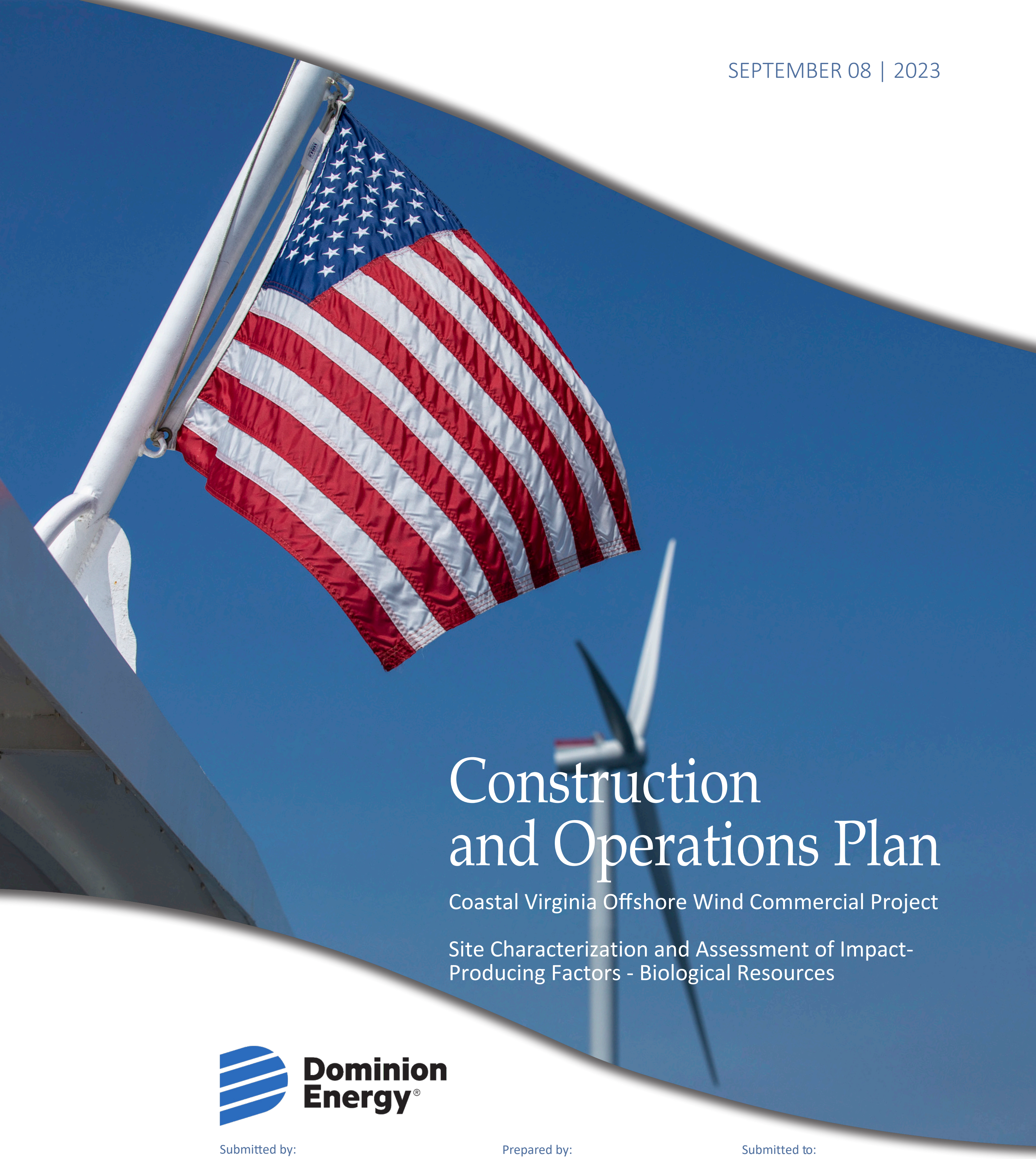

Construction and Operations Plan

Coastal Virginia Offshore Wind Commercial Project

Site Characterization and Assessment of Impact-Producing Factors - Biological Resources

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4.2 Biological Resources

4.2.1 Wetlands and Waterbodies

This section describes the wetland and waterbody resources within the surrounding Onshore Project Area. Potential impacts to wetlands and waterbodies resulting from construction, O&M, and decommissioning of the Project are discussed. Recommended best management practices (BMPs) and proposed mitigation measures are described that are intended to reduce, minimize, and/or avoid potential impacts to wetlands and waterbodies.

Other resources and assessments detailed within this document that are related to wetlands and waterbodies include:

- Terrestrial Vegetation and Wildlife (Section 4.2.2);
- Avian and Bat Species (Section 4.2.3);
- Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat (Section 4.2.4);
- Benthic Resource Characterization Report (Appendix D).
- Avian and Bat Impact Assessment (Appendix O); and
- Compiled USACE Preliminary Jurisdictional Determination (PJD) Package (includes results of the wetland delineation field survey) (Appendix U).

The Wetland and Waterbodies Study Area includes associated coastal wetlands, tidal zones, and all onshore wetlands and waterbodies that may be impacted by the various aspects of construction, O&M, and decommissioning of the Project.

4.2.1.1 Regulatory Framework

Wetlands and waterbodies in the Commonwealth of Virginia are protected under both federal jurisdiction by the USACE and state jurisdiction by VDEQ. Under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899, the USACE has regulatory jurisdiction over Waters of the U.S., including wetlands. Additionally, under Section 401 of the CWA, applicants for a federal license or permit must obtain certification from the state in which the discharge would originate to ensure a project will not violate the state’s water quality standards or stream designated uses. Virginia also provides regulatory jurisdiction through the VMRC, local wetland boards (LWBs), and local watershed protection authorities as described below.

Virginia Marine Resources Commission

The VMRC acts as the clearinghouse for distribution of Joint Permit Applications (JPAs) 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 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.

Virginia Beach Local Wetland Board

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). The 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 ft (0.6 m) for rivers and bay areas to 3.5 ft (1.1 m) for ocean areas. Upland of this elevation, the LWB does not have jurisdiction.

Virginia Beach Southern Watershed Management

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 ft (15.2 m) of any jurisdictional wetland or shoreline, except where wetlands or shorelines have been established in connection with structural BMP facilities, are prohibited except by application (permit, exception, or exemption) through the City of Virginia Beach. The buffer, in association with the Virginia Beach Southern Rivers Watershed Management Ordinance, is typically delineated based on offsets applied to jurisdictionally approved aquatic resource maps.

4.2.1.2 Affected Environment

Existing wetland and waterbody resources within the Study Area were reviewed using a combination of desktop analysis of publicly available data and field surveys (where parcel access has been granted, and where boots-on-the-ground surveys are feasible). Large contiguous inundated wetlands and waters where physical surveys were determined to be unfeasible due to water depth and health and safety concerns, were primarily assessed using desktop analysis and targeted field truthing of boundaries. The following resources were reviewed as part of the desktop analysis:

- U.S Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) (2021);
- USGS National Hydrography Dataset (NHD, NHDPlus) (2018, 2020);
- Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (2020);
- VDEQ Wetland Condition Assessment Tool (WetCAT) (Havens et al. 2018);
- City of Virginia Beach, Virginia (2016):
    - 2019 Aerial Imagery,
    - 2012 Digital Elevation Models,
    - 2013 Light Imaging and Ranging Digital Elevation Models,
    - Topographic data including Contours and Spot Elevations from 2018 Light Imaging and Ranging, Version 6.0, and
    - Base maps including flood zones and protected watersheds;
- Google Earth;

- NAS Oceana; and
- SMR.

Where publicly accessible, a preliminary reconnaissance survey of the Cable Landing Location and the Onshore Export Cable Route Corridor was conducted on April 6, 2020, to verify presence of potential wetland and waterbody features. Field reconnaissance identified waterbody crossings and several large, forested wetlands within or directly adjacent to portions of the Study Area. Findings of the preliminary reconnaissance determined that the Onshore Export Cable Route Corridor likely would impact Waters of the U.S., and it was recommended that a wetland delineation be completed and a jurisdictional determination be requested from the USACE for the entire Onshore Project Area.

Through 2021 and up to the end of August 2022, Tetra Tech performed aquatic resources surveys for all Onshore Project Components with the exception of the SMR and portions of the Fentress Substation, which were previously delineated by others and verified by the USACE. Additional supplemental delineations were completed near the Princess Anne Athletic Sports complex in May 2023 following a shift in the routing. All components of the Onshore Project Area are either covered under an existing PJD or the PJD confirmed for the Project by the USACE (see Appendix U), addended in June of 2023. Field delineated wetland features, stream features, and jurisdictional ditches within the surveyed portion of the Study Area are summarized in Appendix U. Because wetland delineations are complete and a PJD for the entire Onshore Project Area has been received, additional PJD request(s) and/or addendums will be submitted to the USACE as necessary if alignment shifts are made to Onshore Project Components.

Wetland boundaries were delineated in the field using the technical criteria described in the USACE Wetland Delineation Manual (Environmental Laboratory 1987) and the Regional Supplement to the USACE Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0) (USACE 2010). Cover classes for wetlands are based on the NWI and Cowardin classification system (Cowardin et al. 1979). NWI cover classes were assigned by determining the most abundant vegetation cover classes within the wetland. Results of the wetland delineation field survey are provided in Appendix U.

For the current COP Section 4.2.1 submittal, analysis of the Preferred Route (Option 1) related to aquatic resources listed below is based on field verified delineations. Analysis of Interconnection Cable Route Option 6 was also based on field verified delineations except for the proposed Chicory Switching Station property. Since field verified delineation data was not available for the Chicory Switching Station, wetland impacts at this location were estimated based on a recent jurisdictional determination of the adjacent property and an in-depth review of LIDAR. A targeted wetland delineation based on regulatory guidelines was completed for the Onshore Export Cable Route and the Preferred Interconnection Cable Route Option 1, including all Onshore Project Components associated with Route Option 1. The delineation was verified by the USACE on September 29, 2022, and subsequently used for determination of Project-related impacts. The permanent wetland impacts listed in Table 4.2-2 include both permanent loss and permanent conversion (Palustrine Forested to Palustrine Scrub-Shrub). The analysis is based on evaluation of Project design, nature of impact, and coordination with the USACE regarding classification of impacts. The impacts reflected for the Preferred Interconnection Cable Route Option 1 and associated Onshore Project Components are the same as the impacts proposed in the Joint Permit Application for the Project.

Wetlands and Waterbodies

There is currently one Onshore Export Cable Route for transmission from the Cable Landing Location to the Common Location north of Harpers Road. This route is proposed for underground installation and has potential impacts to delineated wetland features. Additionally, the route crosses NHD waterbodies located within three hydrologic units: 020403040501, 030102051203, and 030102051301. The Onshore Export Cable Route would originate from the Cable Landing Location at the Proposed Parking Lot, west of the Firing Range at SMR, and generally follow along developed corridors to the Common Location north of Harpers Road. Details on the Onshore Export Cable Route, in reference to potentially affected HUCs, wetlands, and waterbodies are shown in Table 4.2-1, Table 4.2-2, and Table 4.2-3.

Table 4.2-1. Affected Hydrologic Unit Codes by Onshore Project Component

Route/Length	Hydrologic Unit Codes
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	020403040501
Switching Station	
Harpers Switching Station (Interconnection Cable Route Option 1)	030102051202
Chicory Switching Station (Interconnection Cable Route Option 6)	030102051202
Onshore Substation	
Fentress Substation (includes Expansion area)	030102051204, 030102051201
Onshore Export Cable Route	
Onshore Export Cable Route Construction ROW	020403040501, 030102051301, 030102051202
Interconnection Cable Route Option 1 (Overhead)	
Overhead Interconnection Cable Route Option 1 Construction ROW	030102051203, 030102051202, 030102051201, 030102051204
Interconnection Cable Route Option 6 (Hybrid)	
Hybrid Interconnection Cable Route Option 6 Construction ROW	030102051203, 030102051202, 030102051201, 030102051204

Notes:
020403040501—Rudee Inlet-Atlantic Creek; 030102051301—Asheville Bridge Creek; 030102051202—West Neck Creek; 030102051203—Upper North Landing River; 030102051201—Chesapeake Canal; 030102051204—Pocaty Creek

Table 4.2-2. Mapped Wetlands within Study Area

Project Feature	Classification a/	Acres Within Study Area	Permanent Impact b/	Temporary Impact
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	0.00	1.07
	PFO	0.00	0.00	0.00
	Total:	**1.07**	**0.00**	**1.07**
Switching Station				
Harpers Switching Station (Interconnection Cable Route Option 1)	PEM	0.34	0.34	0.00
	PSS	0.68	0.68	0.00
	Total c/:	**1.02**	**1.02**	**0.00**
Chicory Switching Station (Interconnection Cable Route Option 6) d/	PEM	0.21	0.21	0.00
	PFO	20.38	20.38	0.00
	Total:	**20.59**	**20.59**	**0.00**
Onshore Substation				
Fentress Substation (includes Expansion area)	PEM	1.24	1.24	0.00
	PFO	7.90	7.90	0.00
	Total:	**9.14**	**9.14**	**0.00**
Onshore Export Cable Route				
Onshore Export Cable Route Construction ROW	PEM	1.10	0.00	0.16
	PFO	6.37	4.02	0.00
	Total:	**7.47**	**4.02**	**0.16**
Interconnection Cable Route Option 1 (Overhead)				
Overhead Interconnection Cable Route Option 1 Construction ROW	PEM	78.32	0.12	14.91
	PSS	0.38	0.00	0.38
	PFO	27.38	25.76	0.00
	Total:	**106.08**	**25.88**	**15.29**
Interconnection Cable Route Option 6 (Hybrid)				
Hybrid Interconnection Cable Route Option 6 Construction ROW	PEM	73.45	1.52	17.21
	PSS	0.38	0.00	0.38
	PFO	25.24	17.61	0.00
	Total:	**99.07**	**19.13**	**17.59**

Notes:
a/ Cowardin classification:

- PFO: Palustrine Forested
- PSS: Palustrine Scrub-Shrub
- PEM: Palustrine Emergent

b/ Wetland impacts have been updated to use field delineation data within the revised limits of disturbance for the Onshore Project Area – Field delineation data available for all Onshore Project Components except the Chicory Switching Station. All Permanent Impacts include permanent loss and permanent conversion (PFO to PSS).

c/ Total acres include Permanent, Temporary, and No Impact.

d/ Wetland impacts for Interconnection Cable Route Option 6 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.

Table 4.2-3. National Hydrography Dataset Features within Project Area Boundaries

Project Features	Potentially Impacted Waterbody Features a/
Cable Landing Location	
Proposed Parking Lot, west of the Firing Range at SMR, located east of Regulus Avenue and north of Rifle Range Road	N/A
Onshore Switching Station	
Harpers Switching Station (Interconnection Cable Route Option 1)	N/A
Chicory Switching Station (Interconnection Cable Route Option 6)	N/A
Onshore Substation	
Fentress Substation Parcel (includes Expansion area)	N/A
Onshore Export Cable Route Corridor	
Onshore Export Cable Route Construction ROW	HDD crossings of Lake Christine (two crossings) and Owl's Creek b/
Interconnection Cable Route (Overhead)	
Interconnection Cable Route Option 1 Construction ROW	Overhead crossings of perennial tributary of West Neck Creek, West Neck Creek, Gum Swamp (tributary of North Landing River), North Landing River, Chesapeake Albemarle Canal (Intracoastal Waterway) c/
Interconnection Cable Route 6 (Hybrid)	
Interconnection Cable Route Option 6 Construction ROW	Overhead crossings of West Neck Creek, perennial tributary of West Neck Creek, Gum Swamp (tributary of North Landing River), North Landing River, Chesapeake Albemarle Canal (Intracoastal Waterway) c/

Notes:
a/ Does not address instances of parallel alignment with waterbody features. Potentially Impacted Waterbody Features are features specifically crossed by proposed routing. Additionally, these are not indicative of actual impacts but instead, where the limits of disturbance potentially interacts with the waterbody – for example, overhead crossings will not be considered an impact.
b/ HDD Crossing #1 of Lake Christine = ~221.45 LF; HDD Crossing #2 of Lake Christine = ~372.88 LF; and HDD Crossing of Owl's Creek = ~70 LF
c/ Overhead Crossing of perennial tributary of West Neck Creek = ~35.25 LF; Overhead Crossing of West Neck Creek = ~20 LF; Overhead Crossing of Gum Swamp = ~35 LF; Overhead Crossing of North Landing River = ~48 LF; and Overhead Crossing of Chesapeake Albemarle Canal = ~ 490 LF
N/A = not applicable

There are currently two Interconnection Cable Route options for transmission from the Common Location north of Harper's Road, to the Onshore Substation. One of the Interconnection Cable Route options (Option 6) proposes a hybrid installation method consisting of both underground (trenching, microtunneling, and HDD) and overhead installation, while the other Interconnection Cable Route option (Option 1) proposes overhead installation only. Both Interconnection Cable Route options offer different impacts for wetlands and waterbodies. Both options are situated in the same HUCs and cross through both the City of Virginia Beach and the City of Chesapeake.

A breakdown of field verified wetlands within the potential construction area for each Onshore Project Component is provided in Table 4.2-2. Both Interconnection Cable Route options will result in wetland impacts. The detailed impact analysis completed for the Project determined that Overhead Interconnection Cable Route Option 1 would have less impact on wetlands than the Hybrid Interconnection Cable Route Option 6. Interconnection Cable Route Option 6 would require significant trenching resulting in more permanent fill impacts as opposed to conversion impacts associated with Interconnection Cable Route

Option 1. In addition, the Chicory Switching Station associated with Interconnection Cable Route Option 6 would have significantly more wetland impacts than the Harpers Switching Station, which is associated with Interconnection Cable Route Option 1. Mapping of wetlands and waterbodies within the Onshore Project Area is provided in Appendix U. In addition, significant wetland habitat and natural communities are described in Section 4.2.2, Terrestrial Vegetation and Wildlife.

Based on review of the NHD, NHD Plus, and NWI datasets in combination with field delineation and subsequent verification by the USACE, all Onshore Project Components, except the Cable Landing Location, Onshore Substation, and both Switching Stations cross named perennial waterways and associated tributaries. The manner and scale of impact for each waterway would be based on the most practicable and least impactful alternatives for construction crossings and access. Figure 4.2-1 provides mapped NHD features in reference to each route included in the Onshore Project Area. Table 4.2-3 presents potential waterway and stream crossings identified through analysis of NHD mapped features. In addition to the waterway and stream crossings identified in Table 4.2-3, there will also be minor impacts to a perennial stream located on the Harpers Switching Station site due to stormwater management infrastructure. These impacts were included in the latest version of the Joint Permit Application submitted to the USACE and VMRC in June 2023.

Floodplains

FEMA online data indicates that the Onshore Project Area is situated in special flood hazard areas that are associated with Lake Christine, Owl Creek, West Neck Creek, North Landing River and intracoastal waterways, and general surface waters. Hazard areas include Zone A, Zone AE, Zone X–shaded, and Zone X–unshaded. Zone A is subject to inundation with 1 percent of annual chance of flooding but has baseline flood elevation. Zone AE is subject to inundation with 1 percent annual chance of flooding and is considered the base floodplain for Flood Insurance Rate Map review. Zone X–shaded are low-lying areas associated with the interim between base flood and 0.2 percent annual chance of flooding. Mapped special flood hazard areas are listed in Table 4.2-4 and illustrated in Figure 4.2-2. Work in special flood hazard areas would be subject to the requirements of the respective floodplain management ordinances of the City of Virginia Beach and the City of Chesapeake.

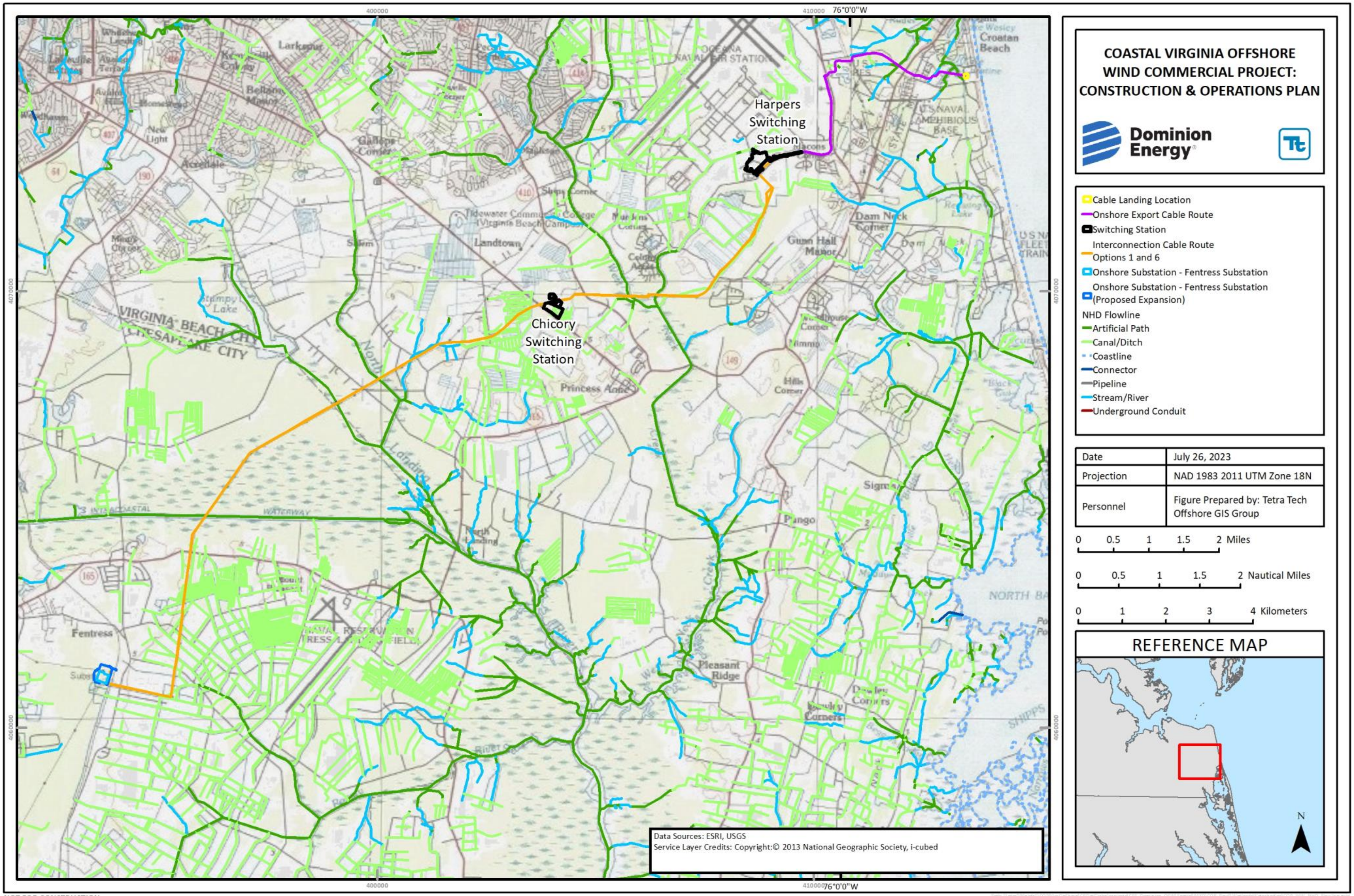


Figure 4.2-1. National Hydrography Dataset Plus, Waterbody Features Adjacent or within Proposed Project Area

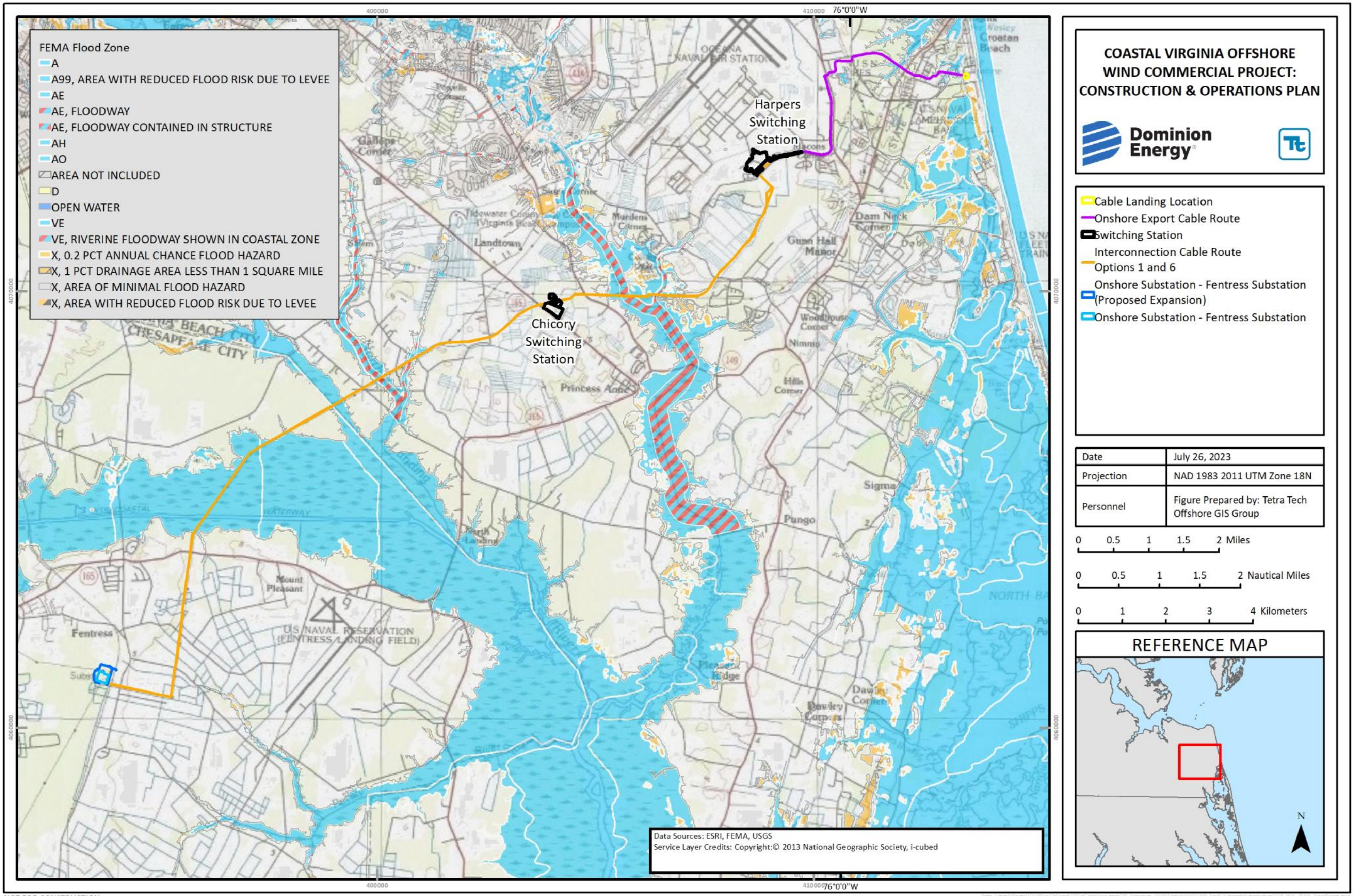


Figure 4.2-2. Federal Emergency Management Agency Proposed Project Area

Table 4.2-4. Federal Emergency Management Agency Flood Zones within Onshore Project Components

Project Feature	FEMA Flood Zone Type	FEMA Flood Zone Subtype	Acres Within Project Area
Cable Landing Location			
Proposed Parking Lot, west of the Firing Range at SMR, located east of Regulus Avenue and north of Rifle Range Road	X	Area of Minimal Flood Hazard	2.27
Onshore Switching Station			
Harpers Switching Station (Interconnection Cable Route Option 1)	X	Area of Minimal Flood Hazard	46.5
Chicory Switching Station (Interconnection Cable Route Option 6)	X	Area of Minimal Flood Hazard	35.5
Onshore Substation			
Fentress Substation Parcel Construction ROW (includes Existing Substation and Expansion Area)	X	Area of Minimal Flood Hazard	32.1
Onshore Export Cable Route			
Onshore Export Cable Route Construction ROW	AE	--	7.02
	A	--	0.01
	X	0.2% Annual Chance Flood Hazard	0.61
		Area of Minimal Flood Hazard	41.67
Interconnection Cable Route (Overhead)			
Overhead Interconnection Cable Route Option 1 Construction ROW	AE	Floodway	8.07
		--	65.24
	X	0.2% Annual Chance Flood Hazard	5.04
		Area of Minimal Flood Hazard	194.39
Interconnection Cable Route 6 (Hybrid)			
Hybrid Interconnection Cable Route Option 6 Construction ROW	AE	Floodway	8.99
		--	59.25
	X	0.2% Annual Chance Flood Hazard	3.74
		Area of Minimal Flood Hazard	168.48

Protected Watersheds

Within Virginia Beach, the Onshore Project Area is situated entirely within the watershed boundaries of the Southern Rivers Watershed, which is managed by the Southern Rivers Watershed Management Ordinance. The intent of the ordinance is to protect, enhance, and restore the quality of waters within the Southern Rivers Watershed. To achieve this goal, the ordinance prohibits development activities within or in 50 ft (15.2 m) of any wetland or shoreline except where the shoreline or wetland was developed in connection with structural BMP facilities.

The North Landing River and associated intracoastal causeways serve as a rough boundary for the transition of the Project from the City of Virginia Beach to the City of Chesapeake. Once that boundary is crossed, roughly associated with the Blackwater Creek-North Landing River, Upper North Landing River, and Chesapeake Canal HUCs; the Project enters either the Northwest River Watershed or Albemarle and Chesapeake Canal watersheds. These watersheds hold no additional protections beyond standard natural resource considerations. The Southern Rivers Watershed boundary and protected buffers that may impact project permitting are shown in Figure 4.2-3.

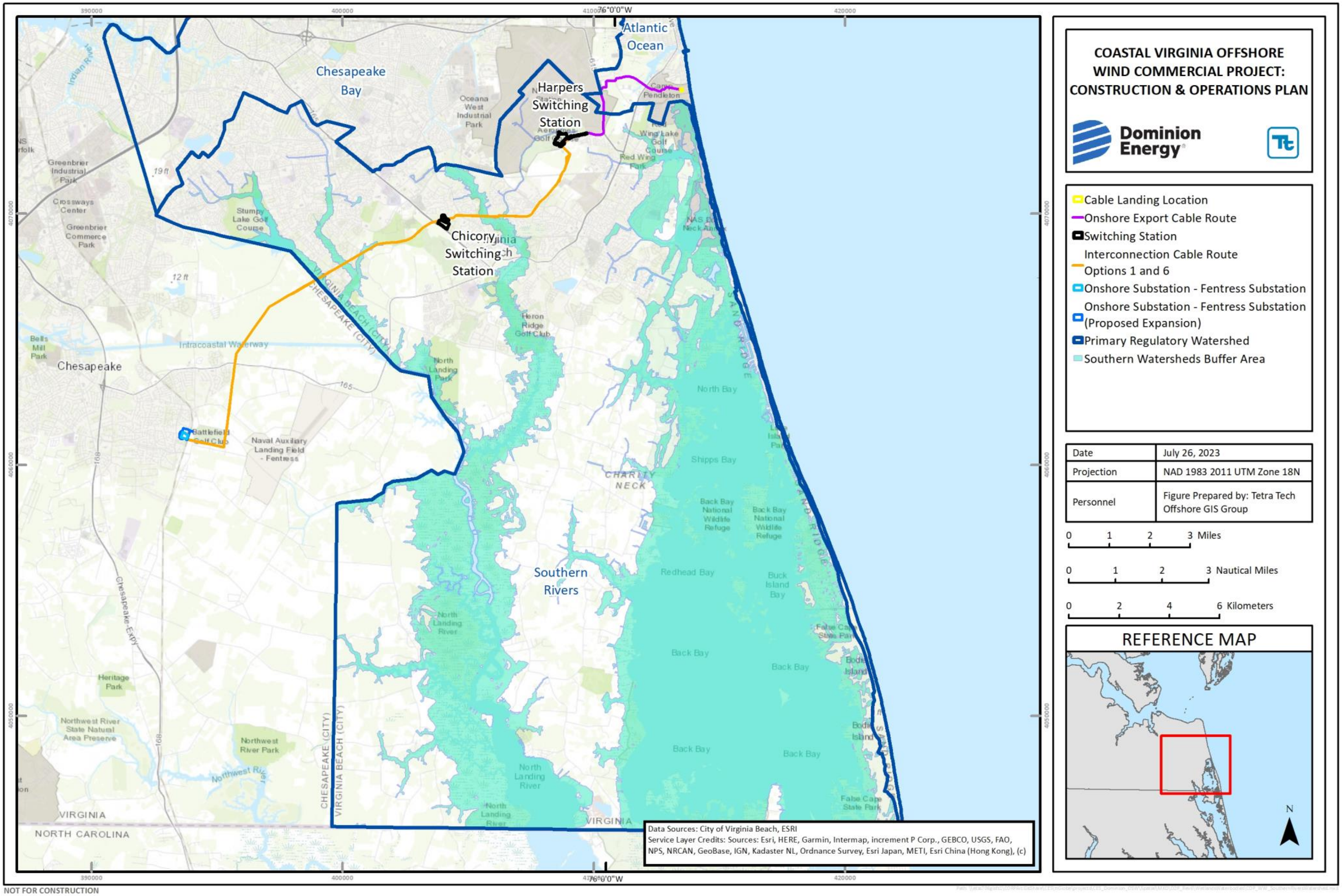


Figure 4.2-3. Southern Rivers Watershed Regulated Areas in the Proposed Project Area

4.2.1.3 Impacts Analysis for Construction, Operations and Maintenance, and Decommissioning

The potential impacts resulting from the construction, O&M, and decommissioning of the Project, as described below, are based on the maximum design scenario. For the purposes of this section, the maximum design scenario of the Onshore Project Components, including the greatest amount of impacts to wetlands and waterbodies, as described in Section 4.2.1.2, Affected Environment.

Construction

During construction, the potential impact-producing factors to wetland and waterbody resources may include the installation of permanent structures within wetlands and waterbodies, wetland transition areas, riparian areas, and protected watershed areas and the permanent conversion of existing wetland cover types. Additionally, construction activities have the potential to result in conversion of palustrine forested wetlands to palustrine emergent wetlands and conversion of palustrine scrub-shrub wetlands to palustrine emergent wetlands. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project construction. Potential impacts during construction resulting as a consequence of those factors may include:

- Installation of permanent structures within wetlands, wetland transition areas, riparian areas, and protected watersheds;
- Installation of permanent stormwater management infrastructure within a waterbody at the Harpers Switching Station;
- The permanent conversion of existing wetland cover types;
- The temporary removal of vegetation within wetlands, wetland transition areas, riparian buffers, and protected watershed features;
- Erosion of sediment from construction activities into adjacent wetlands and waterbodies;
- The potential for an inadvertent release of non-toxic drilling fluids to the surface during HDD activities; and
- The potential for accidental releases from construction vehicles or equipment.

A compensatory mitigation plan will be developed as a component of the final Project design. Wetland and stream mitigation credits will be purchased to mitigate for all wetland and stream impacts associated with the Project. The compensatory mitigation will comply with all federal, state, and regional permitting requirements as it pertains to impacts to wetlands and waterbodies.

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, for the purposes of the COP, it is assumed to include permanent construction practices such as reinforced concrete foundations, permeable gravel lots, and associated security fencing. Placement of permanent features within wetlands, protected watershed buffer areas, and flood hazard areas would be avoided to the maximum extent practicable. Where appropriate, all construction activities would follow the appropriate regulatory requirements as stipulated by regional and local permitting authorities. This compliance would include adherence to stormwater, erosion, and sediment control requirements. Additionally, Dominion Energy proposes the following measures to avoid, minimize, and mitigate impacts:

- Co-locating Onshore Project Components in existing ROWs, existing roads, previously disturbed areas, and otherwise urbanized locations to the maximum extent practicable;
- Siting permanent structures outside of protected watershed features and flood-prone areas to the maximum extent practicable;
- Using a combination of HDD and overhead routing to the best extent practicable to avoid and minimize impacts to natural resources; and
- Developing a compensatory mitigation plan, where impacts to wetlands and waterbodies are unavoidable, to include purchase of wetland and stream mitigation credits. This mitigation plan would be further refined as a component of the USACE permitting package.

The permanent conversion of existing wetland cover types. The construction process is expected to result in conversion of forested/scrub-shrub wetlands, wetland transition zones, and protected watershed riparian areas. The conversion is currently anticipated for portions of all Interconnection Cable Routes, whether using overhead cabling or HDD. Depending on the siting of the Switching Station, the design could incur additional conversion as well. Dominion Energy proposes the following measures to avoid, minimize, and mitigate impacts:

- Co-locating/siting Onshore Project Components in ROWs, existing roads, previously disturbed areas, and other urbanized locations to the maximum extent practicable;
- Restricting access during construction to existing paved roads or access roads constructed for stream or waterbody crossings. Where necessary, access would also be restricted to avoid alteration of soil properties (compaction) that may result in unintended impacts;
- Using temporary avoidance/minimization efforts for wetland access where avoidance is not possible. These efforts would include use of temporary timber mats, using 8 to 12 in (20 to 30 cm) thick timber, for heavy machinery movement and to avoid unintended impacts to wetlands such as soil compaction, damage to root systems, and development of ruts;
- Develop invasive species control plan or comply with current vegetative maintenance plans to prevent the spread of invasive species throughout the maintained ROWs and recently disturbed locations. Only agency-approved native species would be replanted, and all plans would be guided by desktop and on-the-ground evaluation of invasive species present in the area; and
- Developing a compensatory mitigation plan, where permanent conversion of wetlands is unavoidable, to include on-site mitigation where practicable, off-site mitigation, or purchase of mitigation credits. This mitigation plan would be further refined as a component of the USACE permitting package.

The temporary removal of vegetation within wetlands, wetland transition areas, riparian buffers, and protected watershed features. Construction activities, including open-cut trenching, HDD, workspace staging, and overhead cabling, all have the potential to temporarily impact vegetation within the pertinent natural resource areas. Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Co-locating/siting Onshore Project Components in ROWs, existing roads, previously disturbed areas, and other urbanized locations to the maximum extent practicable;
- Using temporary avoidance/minimization efforts for wetland access where avoidance is not possible. This would include use of temporary timber mats, using 8 to 12 in (20 to 30 cm) thick timber, for heavy machinery movement and to avoid unintended impacts to wetlands;
- Restricting access through wetlands except where approved by regional and local regulatory entities;
- Restricting access during construction to existing paved roads or access roads constructed for stream or waterbody crossings. Where necessary, access would also be restricted to avoid alteration of soil properties (compaction) that may result in unintended impacts; and
- Developing and implementation of an agency-approved invasive species control plan to avoid the spread of invasive species associated with temporary impacts.

Erosion of sediment from construction activities into adjacent wetlands and waterbodies. Construction activities associated with the Cable Landing Location and installation of Onshore Export Cables and Interconnection Cables may result in erosion and sediment discharge into downstream wetlands and waterbodies. Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Developing and implementing erosion and sediment control plans in compliance with Dominion Energy's VDEQ-approved Standards and Specifications for Erosion and Sediment Control (ESC) and SWM for Electric Transmission Line Development and appurtenant facilities such as substations and switching stations, as well as any additional requirements specific to DoD lands (if applicable);
- Restricting access to paved roads or approved road crossings for wetland and waterbodies, where possible; and
- Installing temporary timber matting for access routes through wetlands to protect vegetation to reduce compaction, minimize ruts, and reduce soil discharge.

The potential for an inadvertent release of non-toxic drilling fluids to the surface or saltwater intrusion during HDD. The use of HDD technology may avoid sensitive areas related to coastlines, wetlands and waterbodies, wetland transition areas, protected watershed buffer areas, and flood prone locations. Additionally, HDD may be implemented as a mitigation/avoidance effort regarding locations of sensitive terrestrial wildlife and vegetation. With HDD, there is the possibility of an inadvertent release within a regulated or sensitive area, causing drilling fluids to escape to the surface and impact wetlands, waterbodies, and other locations downstream of the return. Although unlikely, there is also a potential for saltwater intrusion into freshwater habitats during HDD. Dominion Energy proposes to implement the following measure to avoid, minimize, and mitigate impacts:

- Developing and implementing an Inadvertent Release Plan with use of non-toxic drilling fluids to be reviewed and approved by the appropriate regulatory agencies. Any accidental spills or releases of oils will also be managed through an agency-approved SPCC plan.
- Developing and implementing project execution plans that will include mitigation techniques and construction practices to avoid saltwater intrusion for HDD installations and associated dewatering efforts. Utilizing these plans in concert with ongoing monitoring throughout the construction and dewatering activities will ensure no saltwater contamination of freshwater environments.

The potential for accidental releases from construction vehicles or equipment. Vehicles used for construction or associated activities, such as environmental inspections, would be accessing regulated areas throughout the life of the Project. It is possible that these vehicles would be serviced and refueled within the Project Area. Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Restricting access to paved roads, approved road crossings, and designated construction areas; and
- Managing accidental spills or releases of oils through an agency-approved SPCC plan.

Operations and Maintenance

It is not anticipated that Project-related activities in association with O&M would result in new impacts to wetlands and waterbodies. All activities would utilize existing access roads and entry points, approved via agency review. Temporary construction areas and workspaces would be restored to pre-construction conditions, while permanent structures would remain in place. Features associated with erosion and sediment control and not converted to stormwater management features would be removed and the conditions would be returned to pre-construction. Any ongoing concern regarding accidental releases would be continually evaluated via the agency-approved SPCC plan. Any activities that require a land disturbance, such as inspection via excavation, would follow similar proposed mitigation and avoidance practices as described above for construction. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project O&M. Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate impacts:

- Use of protective measures to prevent access to any active operation area including, but not limited to, security and safety fencing;
- Monitoring revegetation throughout the life of the Project and leading up to decommissioning. Monitoring would comply with a site restoration plan and invasive species control plan. Monitoring would serve as the primary measure for ensuring return of wetland, waterbody, and special area functionality following completion of construction and during necessary O&M;
- Monitoring mitigation efforts where appropriate and defined via the approved permitting package; and
- Assessing and maintaining stormwater control and treatment features on a regular interval, as specified in the SWPPP. This would include removal of debris and a determination of functionality.

Decommissioning

Impacts resulting from decommissioning of the Project are expected to be similar to or less than those experienced during construction. Decommissioning techniques are further expected to advance during the lifetime of the Project. A full decommissioning plan will be provided to the appropriate regulatory agencies for approval prior to decommissioning activities, and potential impacts will be re-evaluated at that time.

4.2.1.4 Summary of Avoidance, Minimization, and Mitigation Measures

Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate the potential impact-producing factors described (Table 4.2-5). Dominion Energy will continue discussions and engagement with the appropriate regulatory agencies and environmental non-governmental organizations throughout the life of the Project to develop an adaptive mitigation approach that provides the most flexible and protective mitigation measures.

Table 4.2-5. Summary of Avoidance, Minimization, and Mitigation Measures

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
Construction; Decommissioning	Onshore Project Area	Installation of permanent structures within wetlands, waterbodies, wetland transition areas, riparian areas, and protected watersheds The permanent conversion of existing wetland cover types The temporary removal of vegetation within wetlands, wetland transition areas, riparian buffers, and protected watershed features Erosion of sediment from construction activities into adjacent wetlands and waterbodies The potential for an inadvertent release of non-toxic drilling fluids to the surface or saltwater intrusion during horizontal directional drilling (HDD) activities The potential for accidental releases from construction vehicles or equipment	• Dominion Energy would collocate Onshore Project Components in existing rights-of-way (ROWs), existing roads, previously disturbed areas, and otherwise urbanized locations to the maximum extent practicable; • Dominion Energy would site permanent structures outside of protected watershed features and flood-prone areas to the maximum extent practicable; • Dominion Energy would use a combination of HDD and overhead routing to the best extent practicable to avoid and minimize impacts to natural resources; • Dominion Energy would purchase stream and wetland mitigation credits in the applicable service area of a mitigation bank or contribute to an approved in-lieu-of-fee program, such as the Virginia Aquatic Resources Trust Fund Program, prior to construction to mitigate unavoidable impacts to wetlands and waterbodies; • Dominion Energy would restrict access during construction to existing paved roads or access roads constructed for stream or waterbody crossings. Where necessary, access would also be restricted to avoid alteration of soil properties (compaction) that may result in unintended impacts; • Dominion Energy would use temporary avoidance/minimization efforts for wetland access where avoidance is not possible. These efforts would include use of temporary timber mats (or trestles where high organic soil content is present), using 8 to 12 in (20 to 30 cm)-thick timber, for heavy machinery movement and to avoid unintended impacts to wetlands such as soil compaction, damage to root systems, and development of ruts; • Dominion Energy would develop an invasive species control plan to prevent the spread of

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
			invasive species throughout the maintained ROWs and recently disturbed locations. Only agency-approved native species would be replanted, and all plans would be guided by desktop and on-the-ground evaluation of invasive species present in the area; • Dominion Energy would develop a compensatory mitigation plan, where impacts to wetlands and waterbodies are unavoidable, to include purchase of wetland and stream mitigation credits. This mitigation plan would be further refined as a component of the U.S. Army Corps of Engineers permitting package; • Dominion Energy would restrict access through wetlands except where approved by regional and local regulatory entities; • Dominion Energy would develop and implement erosion and sediment control plans in compliance with Dominion Energy's Virginia Department of Environmental Quality-approved Annual Standards and Specifications for Erosion and Sediment Control and Stormwater Management for Electric Transmission Line Development and appurtenant facilities such as substations and switching stations, as well as any additional requirements specific to the U.S. Department of Defense lands (if applicable); • Dominion Energy would install temporary timber matting for access routes through wetlands to protect vegetation to reduce compaction, minimize ruts, and reduce soil discharge; • Dominion Energy would develop and implement an inadvertent release plan with use of non-toxic drilling fluids to be reviewed and approved by the appropriate regulatory agencies; • Dominion Energy would develop and implement project execution plans that will include mitigation techniques and construction practices to avoid saltwater intrusion for HDD installations and associated dewatering efforts; and • Dominion Energy would manage accidental spills or releases of oils through an agency-approved spill prevention, control, and countermeasures plan.
Operations and Maintenance	Onshore Project Area	It is not anticipated that project-related activities in association with O&M would result in new impacts to wetlands and waterbodies	• Dominion Energy would take protective measures to prevent access to any active operation area including, but not limited to, security and safety fencing; • Dominion Energy would monitor revegetation throughout the life of the Project and leading up to decommissioning. Monitoring would comply with a restoration plan and invasive species control plan. Monitoring would serve as the primary measure for ensuring return of wetland, waterbody, and special area functionality following completion of construction and during necessary O&M;

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
			• Dominion Energy would monitor mitigation efforts where appropriate and define via the approved permitting package; and • Dominion Energy would assess and maintain stormwater control and treatment features on a regular interval, as specified in the stormwater pollution prevention plan. This would include removal of debris and a determination of functionality.

4.2.2 Terrestrial Vegetation and Wildlife

This section describes the terrestrial vegetation, and wildlife known to be present, traverse, or incidentally occur through and around the Onshore Project Area. Potential impacts to terrestrial vegetation and wildlife resulting from Project construction, O&M, and decommissioning are discussed. Proposed measures and BMPs are described in the section, with intent to avoid, minimize, and/or mitigate potential impacts to terrestrial vegetation, wildlife, and critical and other protected habitats where necessary.

This section builds upon other resources, assessments, and reports that further inform the assessment and analysis within the section, including the following:

- Wetlands and Waterbodies (Section 4.2.1);
- Avian and Bat Species (Section 4.2.3);
- Sea Turtles (Section 4.2.6);
- Avian and Bat Impact Assessment (Appendix O);
- Threatened and Endangered Species Review (Appendix R); and
- Compiled USACE Preliminary Jurisdictional Determination (PJD) Package (Appendix U).

This section was prepared in accordance with the BOEM site characterization requirements at 30 CFR § 585.626(3) and applicable federal, state, and local guidelines for the assessment of terrestrial vegetation and wildlife.

4.2.2.1 Affected Environment

The Onshore Project Components cross urbanized, agricultural, and natural landscapes in the cities of Virginia Beach and Chesapeake, Virginia. Portions of each route are located along or adjacent to existing public roadways or existing electric transmission lines.

Vegetation

Urban Areas

Vegetation located in urbanized areas 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. The urban forest within the City of Virginia Beach consists of all trees in the city on both public and private property. In 2014, the City of Virginia Beach adopted an urban forest management plan to manage its urban forest because the benefits of a strong urban forest include cleaner air and water, cooler temperatures, and energy savings (City of Virginia Beach 2014). Urban trees are a valuable resource because they slow down and temporarily store stormwater runoff and reduce pollutants and nutrients by absorbing them through their roots (EPA 2013).

The City of Chesapeake adopted a similar urban forest management plan in 2010 that targets growth of a waning urban forest population (City of Chesapeake 2010). Objectives 5 and 6 of the urban forest management plan focus on promoting proper care of public trees, which includes all trees in federal, state, and local territory. Based on the City's review, the routing of Interconnection Cable Route Options through the City of Chesapeake occurs in suburban and rural cover classes. Urban areas within the Onshore Project

Area located within the City of Chesapeake are minimal and include roadside landscapes—trees/shrubs and mixed vegetation typically associated with developed/disturbed easements.

Agricultural Areas

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. The local economic impact of the agricultural industry in Virginia Beach is more than $136 million, and the City of Virginia Beach Department of Agriculture maintains an agricultural reserve program to preserve and protect agricultural lands and rural heritage in southern Virginia Beach (City of Virginia Beach 2019).

Natural Areas

Vegetation located 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*). As described in Section 4.2.1, Wetlands and Waterbodies, and Appendix U, Compiled USACE Preliminary Jurisdictional Determination (PJD) Package, extensive forested wetland communities associated within the protected Southern Rivers Watershed exist within the Onshore Project Area.

The Virginia Department of Conservation and Recreation Division of Natural Heritage (VDCR-DNH) Program manages an inventory of exemplary natural communities as well as rare, threatened and endangered (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 the VDCR-DNH to be very high, and the relative density in the City of Chesapeake has been found to be high (VDCR-DNH 2018a). This high diversity is associated with the mosaic of large undisturbed wetland habitats that spread contiguously across the two cities. These significant natural communities are discussed in further detail below.

Invasive Vegetation

Per Executive Order 13571, Safeguarding the Nation from the Impacts of Invasive Species (December 5, 2016), federal agencies are directed to prevent the introduction of invasive species and provide for their control and to minimize the economic, plant, animal, ecological, and human health impacts that invasive species cause.

Invasive plant species commonly associated with disturbed roadsides, easements, agricultural fields, and urban areas are expected to occur in the Onshore Project Area. A comprehensive list of invasive vegetation typical of the coastal region is detailed in the VDCR Virginia Invasive Plant Species List (Heffernan et al. 2014).

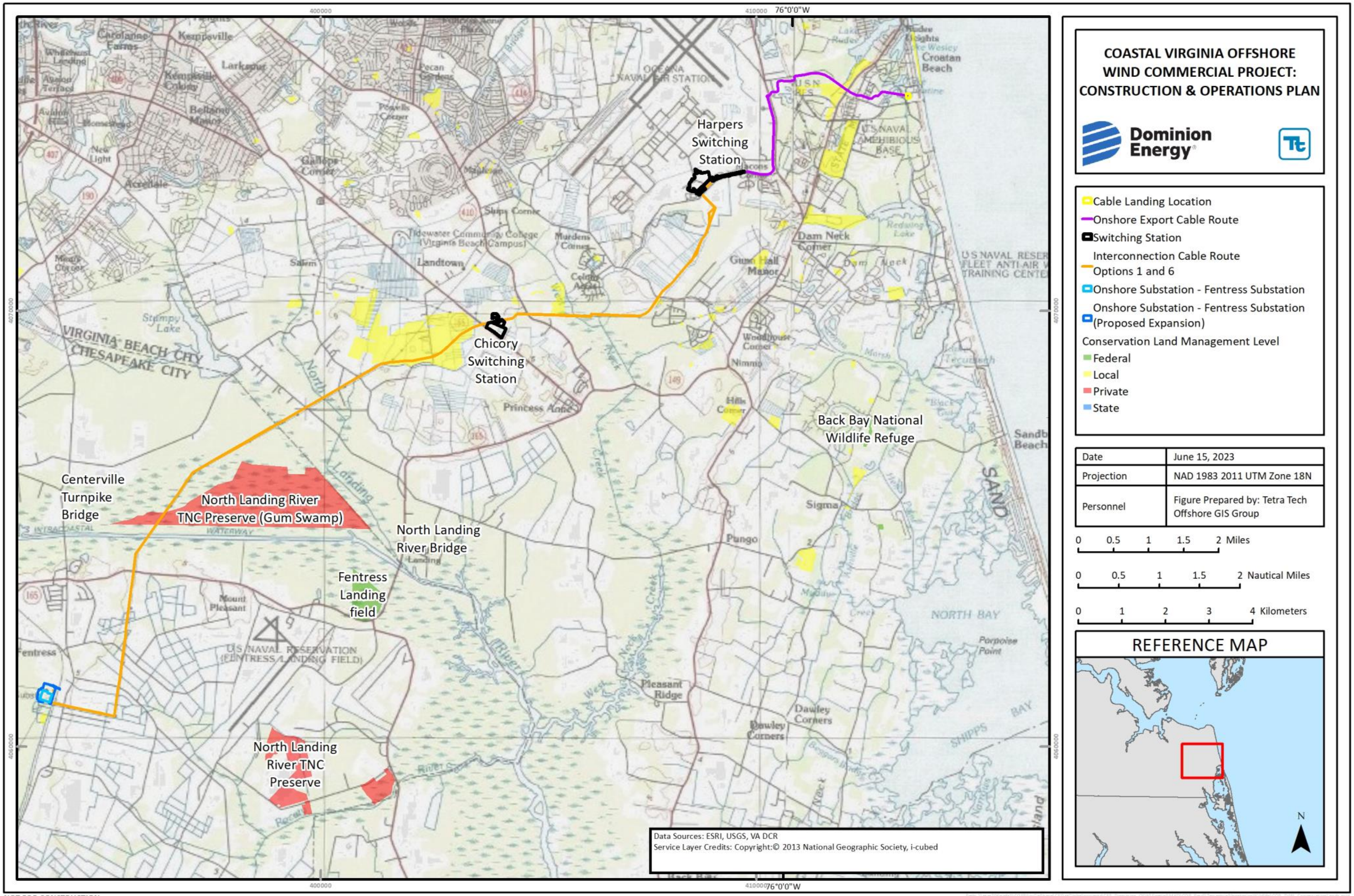
Disturbed areas often allow for the introduction of invasive vegetation into adjacent habitats, and when established, they proliferate and displace native plant species and reduce the quality of wildlife habitat. They may clog important waterways and sensitive aquatic habitats and can result in economic losses due to the increased efforts required to control and maintain ROWs (Pimentel et al. 2005; VDCR-DNH 2019).

Common invasive species within or near the Onshore Project Area may include, but are not limited to, alligator weed (*Alternanthera philoxeroides*), common reed (*Phragmites australis*), Japanese stiltgrass (*Microstegium vimineum*), Johnson grass (*Sorghum halepense*), Japanese honeysuckle (*Lonicera japonica*), swamp morning glory (*Ipomoea aquatica*), Asiatic dayflower (*Commelina communis*), giant foxtail (*Setaria faberi*), Eurasian water-milfoil (*Myriophyllum spicatum*), parrot-feather (*Myriophyllum aquaticum*), shrubby lespedeza (*Lespedeza bicolor*), weeping lovegrass (*Eragrostis curvula*), yellow flag iris (*Iris pseudacorus*), and ailanthus tree (*Ailanthus altissima*) (USFWS 2014). Additional invasive vegetation observed during a preliminary reconnaissance survey on April 6, 2020, included mimosa (*Albizia julibrissin*), English ivy (*Hedera helix*), Callery pear (*Pyrus calleryana*), Chinese and Japanese wisteria (*Wisteria* spp.), and white mulberry (*Morus alba*).

The presence of common reed has been documented at Naval Air Station Oceana, and common reed, alligator weed, and golden bamboo (*Phyllostachys aurea*) have all been found at Naval Auxiliary Landing Field Fentress, which is located within the Onshore Construction Corridor. Treatments of these areas by the Navy were completed between 2014 and 2017 (NAVFAC 2018). Wisteria and privet also have been documented within the Onshore Project Area where Interconnection Cable Routes intersect the northern boundary of Naval Auxiliary Landing Field Fentress (NAVFAC 2019).

Natural Communities and Conservation Lands

Notable natural habitats and/or rare natural communities (as defined by VDCR-DNH [2017]) are located within or adjacent to the Onshore Project Components. These include areas of the North Landing River, Gum Swamp, and West Neck Creek as described below. General locations for the above-listed areas and any associated private, local, state, and federally designated conservation lands are shown in Figure 4.2-4 below; full detailed descriptions of each route are provided in Section 3, Description of Proposed Activity.



NOT FOR CONSTRUCTION

Figure 4.2-4. Onshore Natural Communities and Conservation Lands

North Landing River

The North Landing River watershed occurs through large portions of western and southwestern portions of the City of Virginia Beach and eastern portions of the City of Chesapeake. Rare communities that are associated with the North Landing River, a designated State Scenic River, and its tributaries include non-riverine swamp forest, pond pine (*Pinus serotina*) woodland and high pocosin subtype, peatland Atlantic white cedar (*Chamaecyparis thyoides*) forest, and several globally rare types of oligohaline marshes (VDCR-DNH 2001). The North Landing River Natural Area Preserve occurs approximately 1.7 mi (2.7 km) southeast of the Onshore Project Area and consists of state-owned conservation lands maintained by the VDCR. The North Landing River Preserve consists of approximately 7,599 ac (3,075 ha) of conservation lands privately managed by TNC and preserves large swathes of forested wetland habitat on the west side of the North Landing River from the Virginia-North Carolina border and northwards to include Gum Swamp. The Interconnection Cable Routes (Options 1 and 6) would cross TNC-protected lands. These areas support wetland types considered rare in the Commonwealth of Virginia including pocosins, which are characterized by dense evergreen shrubs and vines with scattered pond pine. These areas also contain numerous swamps and freshwater tidal marshes and host rare plant and wildlife species (VDCR-DNH 2020; TNC 2020). Rare plant and wildlife species with the potential to occur within these areas based on publicly accessible database searches is provided in this section below. Potential threats to these ecosystems include habitat loss and fragmentation and introduction of exotic and invasive species (VDCR-DNH 2001).

Gum Swamp

Gum Swamp is located near the border of the City of Chesapeake and the City of Virginia Beach and directly north of the Intracoastal Waterway. Gum Swamp is crossed by the Interconnection Cable Routes (Options 1 and 6). Gum Swamp includes large contiguous areas of forested wetlands extending from Stumpy Lake to the north, the Centerville Turnpike Bridge crossing of the Intracoastal Waterway to the southwest, and east to the North Landing River bridge. Located within the North Landing River Watershed, Gum Swamp contains the western headwaters of the North Landing River, which adjoin the Intracoastal Waterway, also known as the Chesapeake and Albemarle Canal. Natural heritage community types within Gum Swamp include swamp tupelo (*Nyssa biflora*)–bald cypress swamps, and seasonally flooded forests/non-riverine swamp forests (VDCR-DNH 2001). Potential threats include drainage and hydrological perturbations, land use conversion, habitat loss, clearcutting and forest fragmentation, road construction, and non-point source pollution.

West Neck Creek (Upper and Lower)

The upper section of West Neck Creek, an eastern tributary of the North Landing River, is crossed by the Interconnection Cable Routes (Options 1 and 6). The lower portions of West Neck Creek contain rare natural heritage communities, including Atlantic white cedar swamp, big cordgrass (*Spartina cynosuroides*) oligohaline marsh, sweetbay (*Magnolia virginiana*)–red bay (*Persea borbonia*) shrub swamp, and three-square bulrush (*Schoenoplectus americanus*)–cattail (*Typha* spp.) oligohaline marsh (VDCR-DNH 2001).

Land Cover

Land use within and adjacent to the Onshore Project Area was assessed using the 2016 National Land Cover Database (NLCD). NLCD land cover classifications for the entire Onshore Project Area and vicinity are shown in Figure 4.2-5. 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 shown on Figure 4.2-5.

The VDCR Natural Heritage Program performed a Virginia Natural Landscape Assessment in 2017, which used NLCD to identify large patches of natural land with at least 100 ac (41 ha) of interior cover, and small patches with 10–99 ac (4–40 ha) 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 2018b).

The Virginia Natural Landscape Assessment ecological cores for the entire Onshore Project Area, ranked from C1, Outstanding, to C5, General, are shown in Figure 4.2-6.

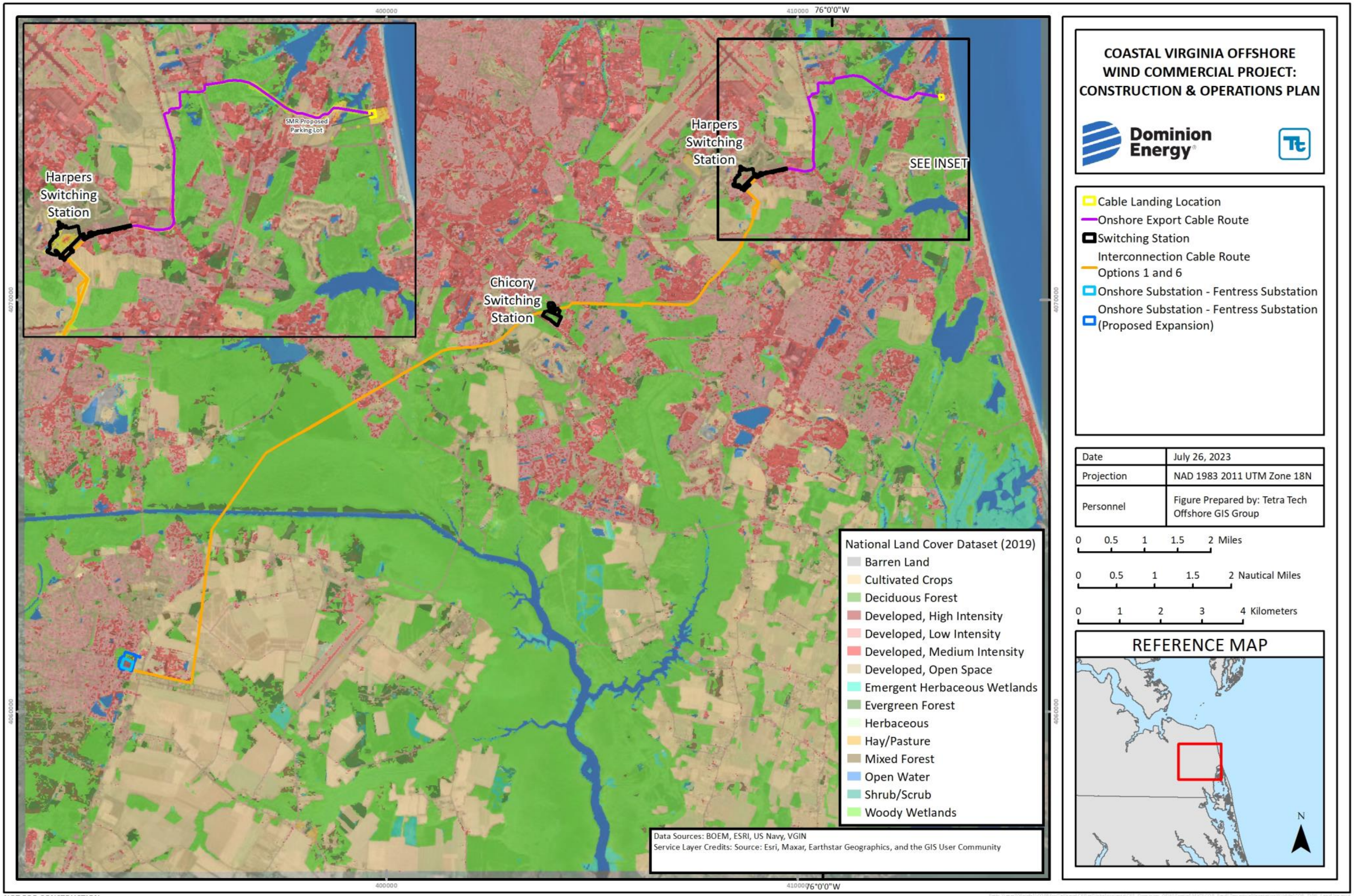


Figure 4.2-5. **Onshore NLCD Land Cover Classification**

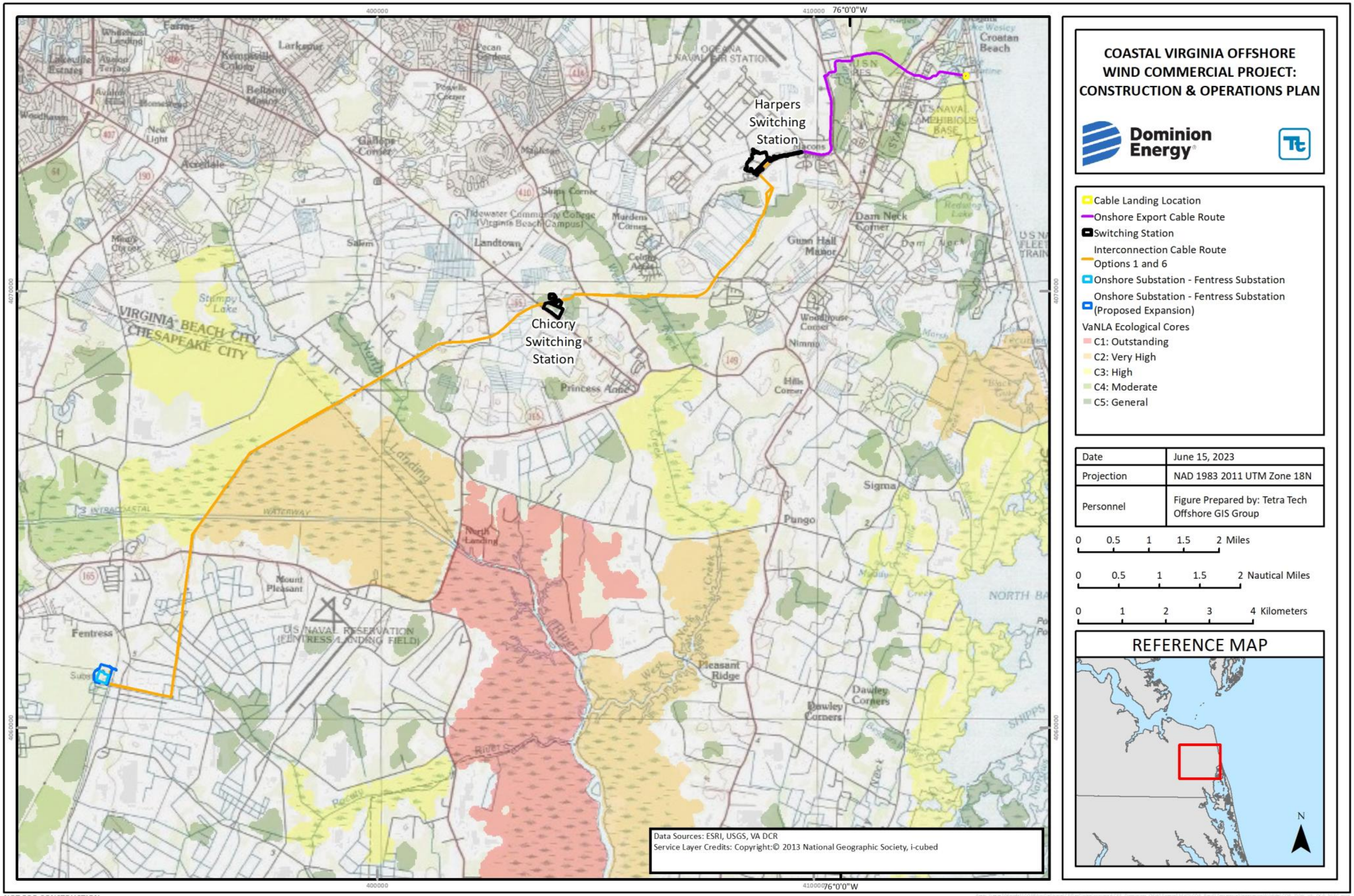


Figure 4.2-6. Onshore Virginia Natural Landscape Assessment Ecological Core Areas

Locations ranked as C1, C2, and C3 generally correspond with the significant natural heritage communities described above. 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 upper sections of West Neck Creek are ranked C3. See Table 4.2-6 and Table 4.2-7 for temporary and permanent impacts of each onshore component to NLCD land cover classes and ecological cores.

Table 4.2-6. DCR Ecological Core Dataset Features within Onshore Project Area Boundaries

Onshore Project Component	Route Length (miles) a/	Total Project Area (acres)	Ecological Core b/	Temporary Impacts (acres) c/	Permanent Impacts (acres) c/
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**
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**
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**
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 Project Component	Route Length (miles) a/	Total Project Area (acres)	Ecological Core b/	Temporary Impacts (acres) c/	Permanent Impacts (acres) c/
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**

Notes:

a/ OH = overhead; UG = underground

b/ From the VDCR Natural Heritage Program Virginia Natural Landscape Assessment ecological cores. C1=Outstanding, C2=Very High, C3=High, C4=Moderate, C5=General.

c/ 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.

Table 4.2-7. NLCD National Land Cover Dataset Features within Onshore Project Area Boundaries

Onshore Project Component	Route Length (miles) a/	Total Project Area (acres)	NLCD Cover Class b/	Temporary Impacts (acres) c/	Permanent Impacts (acres) c/
Interconnection Cable Route					
Option 1	14.3 (OH)	273.2	Planted/Cultivated Crops d/	78.27	0.10
			Forest e/	0.00	9.11
			Open Space	0.00	0.04
			Woody Wetlands	0.00	117.92
			Total:	**78.27**	**127.18**
Option 6	14.3 (OH=9.8; UG = 4.5)	240.5	Planted/Cultivated Crops	68.65	2.15
			Forest	0.00	9.13
			Developed f/	0.00	0.00
			Open Space	3.43	0.60
			Woody Wetlands	0.00	104.49
			Total:	**72.08**	**116.33**
Switching Station					
Harpers (Option 1)	N/A	46.5	Open Space	0.00	4.34
			Forest	0.00	0.56
			Woody Wetlands	0.00	2.60
			Total:	**0**	**7.51**

Onshore Project Component	Route Length (miles) a/	Total Project Area (acres)	NLCD Cover Class b/	Temporary Impacts (acres) c/	Permanent Impacts (acres) c/
Chicory (Option 6)	N/A	35.5	Planted/Cultivated Crops	0.00	0.22
			Forest	0.00	11.17
			Open Space	0.00	0.25
			Shrub/Scrub	0.00	1.42
			Woody Wetlands	0.00	22.27
			Total:	**0.00**	**35.33**
Onshore Export Cable Route					
Cable Landing to Harpers	4.41	57.9	Planted/Cultivated Crops	2.25	0.01
			Forest	0.00	2.16
			Developed	12.20	3.16
			Open Space	9.02	1.45
			Woody Wetlands	0.00	5.60
			Total:	**23.48**	**12.38**
Onshore Substation					
Fentress Substation and Proposed Expansion	N/A	32.1	Open Space	0.00	1.61
			Emergent Herbaceous Wetlands	0.00	0.31
			Planted/Cultivated	0.00	0.54
			Forest	0.00	2.60
			Woody Wetlands	0.00	8.49
			Total:	**0.00**	**13.55**
Cable Landing Location					
Proposed Parking Lot and Temporary Construction Easement, West of the Firing Range at SMR	N/A	11.1	Developed	0.00	0.16
			Open Space	0.00	0.74
			Total:	**0.00**	**0.90**

Notes:

a/ NA = not applicable; OH = overhead; UG = underground.

b/ From the NLCD.

c/ Comparison of permanent and temporary impacts was estimated based on cross referencing NLCD class with feature type. These are strictly estimations that will be further refined upon development of design specifications.

d/ Planted/Cultivated Crops class include Cultivated Crops and Pasture/Hay NLCD land classes

e/ Forest class includes Evergreen, Mix, and Deciduous NLCD land classes

f/ Developed class includes High Intensity, Medium Intensity, and Low Intensity NLCD land classes

Wildlife

Terrestrial wildlife within 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 the Virginia Department of Wildlife Resources (VDWR) generally involve fur-bearing mammals, including fox (*Vulpes 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 (*Myocastor6, coypus*), and muskrat (*Ondatra zibethicus*). Food and birdseed waste from urban businesses and residences can also attract squirrels and small rodents, which in turn attracts their predators (VDWR 2020a). A comprehensive list of known Virginia wildlife is available from the VDWR List of Native and Naturalized Fauna of Virginia (VDWR 2018).

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 (USFWS 2014). River otter have been documented at Naval Air Station Oceana (NAVFAC 2019).

Many species of insects are common to the region as year-round or seasonal residents. Certain insect pollinators such as bumble bees (*Bombus* spp.), mason bees (*Osmia* spp.), Monarch butterfly (*Danaus plexippus*), zebra swallowtail (*Eurytides marcellus*), and Baltimore checkerspot (*Euphydryas phaeton*) are likely to occur within and around the Onshore Project Area. Some insect pollinators have been experiencing population declines in the region, likely from the effects of pesticides, herbicides, habitat loss, disease, and climate change (Chesapeake Bay Program 2020).

Many species of amphibians and reptiles are likely to occur within the Onshore Project Area, particularly portions within close proximity to major waterbodies and wetland habitats. Amphibians known to occur within the Back Bay National Wildlife Refuge, which occurs east of the Onshore Project Area, include southern leopard frogs (*Lithobates sphenocephalus*), pickerel frogs (*Lithobates palustris*), Brimley’s chorus frogs (*Pseudacris brimleyi*), green frogs (*Lithobates clamitans*), squirrel tree frogs (*Hyla squirella*), bull frogs (*Lithobates catesbeianus*), carpenter frogs (*Lithobates virgatipes*), eastern narrow-mouthed toads (*Gastrophryne carolinensis*), southern toads (*Bufo terrestris*), and Fowler’s toads (*Anaxyrus fowleri*) (USFWS 2014).

Reptiles known to occur within the Back Bay National Wildlife Refuge, which is east of the Onshore Project Area, include rainbow snake (*Farancia erytrogramma*), northern black racer (*Coluber constrictor*), black rat snake (*Pantherophis obsoletus*), northern water snake (*Nerodia sipedon*), brown water snake (*Nerodia taxispilota*), cottonmouth (*Agkistrodon piscivorus*), smooth green snake (*Opheodrys vernalis*), eastern king snake (*Lampropeltis getula*), eastern hognose snake (*Heterodon platirhinos*), eastern garter snake (*Thamnophis sirtalis sirtalis*), and ribbon snake (*Thamnophis saurita*). Lizard species may include the eastern glass lizard (*Ophisaurus ventralis*), fence lizard (*Sceloporus undulatus*), and several skink species. Common turtle species include the eastern box (*Terrapene carolina*), snapping (*Chelydra serpentina*), yellow-bellied (*Trachemys scripta scripta*), red-bellied (*Pseudemys rubriventris*), eastern painted (*Chrysemys picta picta*), stinkpot (*Sternotherus odoratus*), and eastern mud (*Kinosternon subrubrum*) (USFWS 2014; NAVFAC 2016).

Invasive or nuisance wildlife as defined by the Virginia Administrative Code (Title 4 VAC15-20-160) and with the potential to occur within or near the Onshore Project Area include the house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), black rat (*Rattus rattus*), coyote (*Canis latrans*), feral hog (*Sus scrofa*), nutria (*Myocastor coypus*), woodchuck (*Marmota monax*), European starling (*Sturnus vulgaris*), English sparrow (*Passer domesticus*), and pigeon (*Columba livia*). Resident Canada geese (*Branta canadensis*) also are often considered a pest species in the region. The rooting behavior of feral hogs contributes to property damage, erosion issues, and habitat destruction and to impacts to native species that they feed upon (e.g., vegetation, insect larvae, amphibians, reptiles, bird nests/young). Nutria populations are thought to be relatively controlled by existing predator populations (USFWS 2014). Canada geese are often considered a nuisance/pest species as they tend to over-graze areas and contribute to increased erosion, shoreline destabilization, destruction of newly seeded wetland restoration and mitigation sites, and loss of natural vegetation in marshes and impoundments (USFWS 2005).

Multiple federally or state-listed rare and T&E species also may occur within or around the Onshore Project Area, and are discussed further below and in Section 4.2.3, Avian and Bat Species, and Section 4.2.6, Sea Turtles.

Rare, Threatened, and Endangered Species Occurrence

Vegetation, insect, and wildlife species that are protected under the federal Endangered Species Act of 1973, as amended (16 U.S.C. §§ 1531 *et seq.*) (ESA), Virginia ESA, as provided by Article 6 (§§ 29.1-563 *et seq*.) of Chapter 5 of Title 29.1 of the Code of Virginia, and Virginia Administrative Code, 4VAC15-20-130, and the Endangered Plant and Insect Species Act, as provided by Chapter 10 of Title 3.2 of the Code of Virginia (§§ 3.2-1000 *et seq*.) and Virginia Administrative Code 2VAC5-320-10, have the potential to occur within the Onshore Project Area. To determine whether the Onshore Project Components may impact federally or state-listed T&E vegetation, insect, and wildlife species, a review of the following state and federal databases was completed for all Onshore Project Components, including the Cable Landing Location, Onshore Export Cable Route Corridor with a maximum width of 86.5 ft (26 m), both Switching Stations, Onshore Substation, and the Interconnection Cable Route Options 1 and 6 with a maximum width of 250 ft (76.2 m):

- USFWS IPaC online system;
- VDWR Virginia Fish and Wildlife Information Service (VaFWIS) and Wildlife Environmental Review Map Service;
- VDCR Virginia Natural Heritage Data Explorer (VNHDE) Species/Community Search, in collaboration with the Virginia Department of Agriculture and Consumer Services;
- The Center for Conservation Biology Virginia Bald Eagle Nest Locator; and
- The VDWR Northern Long-Eared Bat (NLEB) Winter Habitat and Roost Tree Application.

Federally listed T&E species are monitored and regulated by the USFWS. The VDWR, VDCR, and Virginia Department of Agriculture and Consumer Services cooperate to provide protection for Virginia's T&E species. The VDWR has legal authority for preservation of vertebrate and other invertebrate T&E species. The VDCR-DNH produces an inventory of the Commonwealth's natural resources and maintains a database of ecologically significant sights. The Virginia Department of Agriculture and Consumer Services is the regulatory authority for the conservation and preservation of T&E plant and insect species.

Available surveys and reports from DoD facilities that occur within or adjacent to Onshore Project Components, including NAS Oceana, Naval Auxiliary Landing Field Fentress, and the SMR, also were reviewed for records of rare, T&E species occurrences. Detailed results from these searches pertaining to rare and T&E avian species, bat species, and sea turtle species were excluded from discussion in this section, as they are each addressed in detail in their respective resource sections (Sections 4.2.3, Avian and Bat Species; 4.2.5, Marine Mammals; and 4.2.6, Sea Turtles).

Federally and State-Listed Threatened and Endangered Species Database Search Results

An official species list for the Onshore Project Area was generated using the Information for Planning and Consultation (IPaC) online system on June 27, 2023, to identify federally listed T&E species, proposed and candidate species, as well as any proposed or designated critical habitats that could be directly or indirectly affected by Onshore Project activities.

The IPaC identified two mammals (NLEB, *Myotis septentrionalis*, tri-colored bat, *Perimyotis subflavous*), three birds (piping plover, *Charadrius melodus*; red knot, *Calidris canutus rufa*; and roseate tern, *Sterna dougallii dougallii*), and five reptiles (green sea turtle, *Chelonia mydas*; hawksbill sea turtle, *Eretmochelys imbricata*; Kemp's ridley sea turtle, *Lepidochelys kempii*; leatherback sea turtle, *Dermochelys coriacea*; and loggerhead sea turtle, *Caretta caretta*) that may be present within the Onshore Project Area, or may otherwise be affected by Onshore Project activities. These species are discussed in Section 4.2.3, Avian and Bat Species, Section 4.2.5, Marine Mammals, and Section 4.2.6, Sea Turtles. IPaC identified no designated critical habitats located within the Onshore Project Area. Additionally, the IPaC identified one plant (sea-beach amaranth, *Amaranthus pumilus*). A single insect species (monarch butterfly, *Danaus plexippus*) as a candidate species for listing, was also identified by the IPaC. A copy of the IPaC official species list is provided as Appendix R, Threatened and Endangered Species Review.

A search of the VDWR VaFWIS was completed and further refined using the Wildlife Environmental Review Map Service and identified confirmed species observations of six federally and/or state-listed T&E species within 2 mi (3 km) of the Onshore Project Area. These species include the federally and state-listed endangered Kemp's ridley sea turtle, the federally and state-listed threatened loggerhead sea turtle, the federally and state-listed endangered roseate tern, the state-listed endangered little brown bat (*Myotis lucifugus*), the state-listed endangered tri-colored bat, the state-listed threatened Rafinesque's eastern big-eared bat (*Corynorhinus rafinesquii macrotis*), the state-listed endangered canebrake rattlesnake (*Crotalus horridus*), the federally listed threatened and state-listed endangered west Indian manatee (*Trichechus manatus*), and the state-threatened peregrine falcon (*Falco peregrinus*). Avian species, bat species, marine mammals, and sea turtles are described further in Section 4.2.3, Avian and Bat Species, Section 4.2.5, Marine Mammals, and Section 4.2.6, Sea Turtles, respectively; the canebrake rattlesnake is described below. Two VDWR species of "collection concern" were also identified: spotted turtle (*Clemmys guttata*) and scarlet kingsnake (*Lampropeltis elapsoides*). A status of collection concern is assigned by the VDWR but it is a non-regulatory category that does not grant legal protection. A copy of the VaFWIS results and the Wildlife Environmental Review Service exhibit is provided in Appendix R, Threatened and Endangered Species Review.

Under a memorandum of agreement with Virginia Department of Agriculture and Consumer Services, VDCR provides the VNHDE mapping tool for the review of proposed projects to determine any impact on listed T&E plant, insect, and wildlife species. The VNHDE is updated every 3 months, and newly listed species and new species' locations may not show up in the system for 1 year to 18 months after the sighting in the field.

A species/community search of the VDCR VNHDE was completed on July 6, 2023, for the following affected subwatersheds within the Onshore Project Area:

- 02040304 Eastern Lower Delmarva, AO23 Atlantic Ocean–Rudee Inlet;
- 03010205 Albemarle, AS12 Chesapeake Canal–Stumpy Lake;
- 03010205 Albemarle, AS13 (Upper) North Landing River;
- 03010205 Albemarle, AS14 West Neck Creek;
- 03010205 Albemarle, AS15 Pocaty River; and
- 03010205 Albemarle, AS18 Asheville Bridge Creek–Lake Tecumseh–Redwing Lake–Muddy Creek.

Four state-listed T&E species were identified with the potential to occur within the Onshore Project Area: little brown bat, tri-colored bat, Rafinesque's eastern big-eared bat, and canebrake rattlesnake. Avian species, bat species, and sea turtles are described further in Section 4.2.3, Avian and Bat Species, and Section 4.2.6, Sea Turtles. The canebrake rattlesnake is discussed further below. One federal species of concern, a status which merits special concern according to the USFWS but is a non-regulatory category that does not grant legal protection, also was identified: long beach seedbox (*Ludwigia brevipes).* No proposed threatened, proposed endangered, candidate federal, candidate state species, or protected natural communities were identified in this search report. A copy of the VNHDE species/community search results is provided in Appendix R, Threatened and Endangered Species Review.

One rare state-ranked S2 (imperiled) plant, Virginia least trillium (*Trillium pusillum var. virginianum)*, was documented as occurring within the Onshore Project Area following field surveys completed by VDCR and Dominion Energy personnel in 2022. Two populations were located. State rare plant status is a non-regulatory category that does not grant special legal protection.

Various natural resource reports have also been completed by Naval Facilities Engineering Command (NAVFAC) at Naval Air Station Oceana, and Naval Auxiliary Landing Field Fentress, which intersect Onshore Project Components. The Onshore Export Cable Route crosses Naval Air Station Oceana located east of Oceana Boulevard. In a 2018 study at Naval Air Station Oceana, occurrences of the rare state-ranked S2 (imperiled) long beach seedbox and occurrences of the state-ranked S1 (critically imperiled) multiflowered mud plantain (*Heteranthera multiflora*) were documented at the Onshore Export Cable Route (NAVFAC 2019). Two populations of long beach seedbox were observed at Oceana Pond, a total of over 100 plants. Multiflowered mud plantain was found in the silty substrate of a ditch within a utility ROW along the eastern boundary of Naval Air Station Oceana, northeast of Oceana Pond. The ponds and wooded areas located on the Oceana Parcel are designated by the Navy as the "Oceana Ponds and Forest Special Interest Area." The area contains documented natural heritage resources and is managed to protect and enhance those resources (NAVFAC 2019). During T&E species surveys conducted at Naval Air Station Oceana in 2013, potential habitat for chicken turtle and barking treefrog was observed; however, neither species was detected during the surveys (NAVFAC 2014).

The results of the above-referenced database and report searches are summarized in Table 4.2-8 below.

Federal-Listed Threatened and Endangered Species Descriptions

Species descriptions of all federally listed threatened or endangered species identified with the potential to occur within the Onshore Project Area were excluded from this section, as they are discussed in detail in Section 4.2.3, Avian and Bat Species, Section 4.2.5, Marine Mammals, and Section 4.2.6, Sea Turtles. The Monarch butterfly was identified as a federal candidate for listing in the IPaC but remains a non-regulated species and was therefore not carried forward for further discussion. However, many of the suggested mitigation efforts, including the planting of larval host plants to promote pollination, are applicable to protective measures for the Monarch butterfly.

State-Listed Threatened and Endangered Species Descriptions

Descriptions and preferred habitat of state-listed species with the potential to occur within the Onshore Project Area are described below. These species are afforded legal protection under the Virginia ESA, as provided by Article 6 (§ 29.1-563 *et seq.*) of Chapter 5 of Title 29.1 of the Code of Virginia and Virginia Administrative Code, 4VAC15-20-130. Non-regulated species (spotted turtle, scarlet kingsnake, long beach seedbox, Virginia least trillium, and multiflowered mud plantain) are not carried forward for further discussion.

Canebrake Rattlesnake

The canebrake rattlesnake is currently recognized as a unique Coastal Plain population of the timber rattlesnake that exhibits distinct morphological and ecological differences to mountain populations. The species' range in Virginia includes York County, Hampton, Newport News, Suffolk, Chesapeake, and Virginia Beach (VDWR 2020b). Documented occurrences of this species from the VaFWIS database exist within 2 mi (3 km) of the Onshore Project Area (see Appendix R, Threatened and Endangered Species Review). As discussed above, one occurrence was also documented at the southern end of Naval Auxiliary Landing Field Fentress during rare and T&E species surveys conducted in 2013 (NAVFAC 2014).

Table 4.2-8. Onshore Rare, Threatened, and Endangered Species with the Potential to be Affected by the Onshore Project a/

Common Name	Scientific Name	Federal Protection Status	State Protection Status	NatureServe Global/State Rank b/	Observation Type	Additional Location Information
Reptiles						
Canebrake rattlesnake, Coastal Plain Population	*Crotalus horridus*	—	Endangered	G4S4; T4S1	Virginia Fish and Wildlife Information Service (VaFWIS) species observation, VNHDE	Eleven VaFWIS species observations within 2 miles (mi) (3 kilometers [km]) of the Onshore Project Area between 1990 and 2013. VNHDE documents 18 state-wide occurrences of this species.
Scarlet kingsnake	*Lampropeltis elapsoides*	—	Collection concern c/	G5SU	Virginia Fish and Wildlife Information Service (VaFWIS) species observation	One species observation within 2 mi (3 km) of the Onshore Project Area.
Spotted turtle	*Clemmys guttata*	—	Collection concern c/	G5S4	VaFWIS species observation	Two VaFWIS species observations within 2 mi (3 km) of the Onshore Project Area documented May 2013. d/
Insects						
Monarch butterfly	*Danaus plexippus*	Candidate	—	G2S2	IPaC	—
Plants						
Sea-beach amaranth	*Amaranthus pumilus*	Threatened	Threatened	G4G5/S3	IPaC	--
Long beach seedbox	*Ludwigia brevipes*	Special concern e/	—	G2S2	VNHDE, Naval Facilities (NAVFAC)	VNHDE documents 15 state-wide occurrences of this species; over 100 individuals documented at Oceana Pond (NAVFAC 2019).
Multiflowered mud plantain	*Heteranthera multiflora*	—	—	G4S1	NAVFAC	Documented occurrence in ditch northeast of Oceana Pond (NAVFAC 2019).
Virginia least trillium	*Trillium pusillum var. virginianum*	—	—	G4T3/S2	VDCR-Dominion Energy	Documented occurrence within Onshore Project Area based on unpublished field surveys.

G2 = Imperiled; G3 = Vulnerable; G4 = Apparently Secure; G5 = Secure; T5 = Secure Subspecies; T4 = Apparently Secure Population; T2= Subspecies Imperiled; G5 = Secure; S1 = Critically Imperiled; S2 = Imperiled; S3 = Vulnerable; S4 = Apparently Secure

a/ Avian species, bat species, and sea turtles identified through agency database review and consultations as potentially affected by the Onshore Project Area are excluded from this section, as they are discussed in detail in Sections 4.2.3, Avian and Bat Species, and Section 4.2.6, Sea Turtles.

b/ Source: NatureServe 2020.

c/ Collection concern status merits that the species is considered a collection concern by the VDWR, but is not a regulatory category and does not provide any legal protected status.

d/ Surveys for Spotted turtle are ongoing for Fentress (will be completed at end of growing season, 2021)

e/ SOC status merits special concern by the USFWS, but is not a regulatory category and does not provide any legal protected status.

The preferred habitat for the canebrake rattlesnake consists of large contiguous stands of mature hardwood forests, mixed hardwood-pine forests, cane thickets, and in ridges and glades of swampy areas. This cryptic species shelters in logs, thick leaf litter and humus, the bases of hollow trees and stumps, and in existing tunnels such as those formed by root decomposition and uprooted trees. Gravid females tend to stay close to nesting sites and remain with offspring for approximately 10 days after birth before resuming normal movement. During a 12-year study of the movements of 54 individuals located at Naval Support Activity Hampton Roads-Northwest Annex (approximately 8 mi [12.9 km] southwest of the Onshore Project Area), average daily movement was approximately 97.8 ft (29.8 m) per day (Peterson et al. 2019). Potential habitat for this species exists throughout the Onshore Project Area, predominantly within the large contiguous stands of forested wetlands and natural communities described previously. A canebrake rattlesnake information sheet is provided by the VDWR that provides contact information should this species be encountered on site (VDWR 2020c). This information sheet would be provided to all individuals completing work on site once construction commences. Because the Onshore Project Area would impact canebrake rattlesnake habitat, it is anticipated that coordination and/or a state permit from VDWR may be required. A Canebrake Rattlesnake Habitat Assessment Report was completed in January 2023 and submitted to VDWR in February 2023. Information pertaining to mitigation and permitting for impacts to canebrake rattlesnake habitat is available from the VDWR Canebrake Rattlesnake Mitigation Guidance Document (VDWR 2020b).

4.2.2.2 Impacts Analysis for Construction, Operations and Maintenance, and Decommissioning

The potential impacts resulting from the construction, O&M, and decommissioning of the Onshore Project, as described below, are based on the maximum impact estimates within the Project Area. The maximum design scenario represents the greatest amount of vegetation clearing and conversion with potential to impact vegetation and terrestrial wildlife.

Construction

During construction, the potential impact-producing factor to terrestrial vegetation and wildlife resources may include installation of the Onshore Project Components. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project construction. The following impacts may occur as a consequence of the factor identified above:

- Vegetation removal associated with installation of all Onshore Project Components;
- The inadvertent release of drilling fluids to the surface during HDD activities within environmentally sensitive areas;
- Noise and light activities associated with construction equipment and other noise-generating activities associated with construction;
- Impedance to local migration of terrestrial biota (such as reptiles and amphibians) from installation and placement of erosion- and sediment-control measures such as staggered silt fencing or stabilization matting;
- Accidental releases of petroleum products from construction vehicles or equipment;

- Potential for erosion into adjacent vegetation and wildlife habitat;
- Permanent conversion of existing vegetation cover types (e.g., forested to herbaceous) where the Interconnection Cable Route is not collocated with existing road corridors or utility ROWs;
- Permanent fragmentation of habitat as a result of clearing—particularly of large, contiguous forested wetland habitats;
- Permanent colonization and establishment of invasive vegetation in formerly undisturbed areas due to clearing; and
- Impacts to protected or sensitive species and natural communities.

As the Onshore Project design and routing is still in the preliminary design stage and specific impacts associated with construction methods are not yet certain, detailed mitigation strategies would be developed as a component of the final design. The implemented construction methods would comply with all federal, state, and local/regional laws and regulatory requirements pertaining to T&E species, vegetation, land disturbance/erosion and sediment control, invasive species prevention, nuisance wildlife/pest management (if applicable), and vegetation restoration.

Vegetation removal associated with installation of all Onshore Project Components. Construction activities would include belowground installation of cables, overhead installation of transmission cables, nearshore trenchless installation and HDD work areas, site clearing and grading, and work-yard areas for staging of equipment and supplies. On-site and adjacent vegetation would be temporarily impacted until construction activities are completed.

In order to avoid, minimize, and/or mitigate potential impacts, the following measures would be employed:

- Dominion Energy would collocate/site Onshore Project Components in or adjacent to existing ROWs, existing roads, previously disturbed areas, and other urbanized locations to the maximum extent practicable;
- Dominion Energy would seed and stabilize construction areas involving temporary vegetation clearing with an appropriate grass seed mix (in urban areas) or native seed mix (in natural areas) and in accordance with Virginia Erosion and Sediment Control Law and Regulations (VDEQ 2014) and the Virginia Erosion and Sediment Control; Handbook (VDEQ 1992);
- Dominion Energy would prepare and submit a mitigation planting plan to the City of Virginia Beach for approval to address unavoidable temporary impacts that would occur within sensitive ecological areas (such as within the Southern Rivers Watershed), or Dominion Energy would provide financial compensation for any unavoidable impacts; and
- Dominion Energy would plant or seed larval host plants and forage plants in the Interconnection Cable Routes after construction efforts have been completed in order to avoid and minimize impacts to pollinator species. A list of regionally appropriate species as well as regional suppliers of native seed mixes are available from the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS 2020).

The inadvertent release of drilling fluids to the surface during HDD activities within environmentally sensitive areas. The use of trenchless installation may be used to avoid sensitive areas (e.g., dune, beach) along the coastline. The use of HDD technology may be used to avoid sensitive areas within wetlands and waterbodies, rare natural communities, T&E species habitat, protected watershed areas, and locations of sensitive terrestrial wildlife and vegetation. With the use of HDD, there exists the possibility of an inadvertent release within a regulated or sensitive area, causing drilling fluids to escape to the surface and impact sensitive vegetation communities and wildlife habitat downstream of the return. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would develop and implement an inadvertent release plan, for onshore HDD, with use of non-toxic drilling fluids to be reviewed and approved by the appropriate regulatory entities; and
- Dominion Energy would coordinate with the USFWS, VDWR, and Virginia Natural Heritage Program to ensure potential impacts to T&E species are avoided and minimized to the maximum extent practicable.

Noise and light activities associated with construction equipment and other noise-generating activities associated with construction. Construction and installation activities would potentially generate noise and light that might disturb terrestrial wildlife in the area. Species may temporarily avoid the area or relocate, and/or normal behavior such as breeding, foraging, or roosting may be disrupted during these activities. This disturbance would be temporary, and for the most part, species would be expected to return to the area following construction completion. For additional information on potential impacts to avian and bat species, see Section 4.2.3, Avian and Bat Species. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would evaluate time-of-year restrictions for applicable T&E species via coordination with the USFWS, VDWR, and Virginia Natural Heritage Program; and
- Dominion Energy would limit lighting associated with construction vehicles and work zones when possible to reduce interaction with or disturbance of wildlife species such as bats and insectivorous birds.

Impedance to local migration of terrestrial biota (such as reptiles and amphibians) from installation and placement of erosion- and sediment-control measures such as staggered silt fencing or stabilization matting. Construction and installation activities would require the installation of staggered silt fencing and other erosion- and sediment-control measures that may temporarily impede the movement of reptiles and amphibians, particularly during the breeding season when some species migrate to adjacent habitat types. The use of plastic netting erosion-control blankets also is a potential source of mortality to snakes and other wildlife (USDA NRCS 2013). The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would initiate coordination with the VDWR and Virginia Natural Heritage Program to evaluate potential impacts to T&E reptile and amphibian species, including the canebrake rattlesnake;
- Dominion Energy would implement staggered silt fencing in areas surrounding wetlands, waterbodies, and areas with the potential to contain T&E species, rare natural communities, and habitat for reptiles and amphibians. Staggered gaps would ensure reptiles and amphibians could continue to move relatively unrestricted through the Onshore Project Area. This strategy would be

employed on a site-specific basis following coordination with VDWR and the Natural Heritage Program; and

- Dominion Energy would employ, when applicable, snake-friendly erosion-control blankets containing natural or biodegradable fibers or loose-weave netting in areas surrounding wetlands, waterbodies, and areas with the potential to contain habitat for reptiles and amphibians.

Accidental releases of petroleum products from construction vehicles or equipment. Vehicles used for construction or associated activities, such as environmental inspections, would be accessing regulated areas throughout the life of the Project. It is possible that these vehicles would be serviced and refueled within the Onshore Project Area. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would restrict vehicular access to paved roads, approved road crossings, and designated construction areas;
- Dominion Energy would prepare and maintain a SWPPP in compliance with Virginia Pollution Discharge Elimination System VAR10 Construction General Permit. This would be required because the land-disturbing activity would exceed 1.0 ac (0.4 ha). As a component of the permit, the SWPPP would be prepared and maintained throughout Project construction and retained for 3 years following construction completion as required by Virginia Law;
- Dominion Energy would manage accidental spills or releases of oils through a SPCC Plan approved by the appropriate regulatory entity; and
- Dominion Energy would collocate Onshore Project Components with existing roadways, ROWs, and other previously disturbed areas to the greatest extent practicable to avoid unnecessary impacts.

Potential for erosion into adjacent vegetation and wildlife habitat. Construction activities including excavation and grading associated with the landfall and installation of Onshore Export Cables may result in erosion and sediment discharge into vegetation and wildlife habitat. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would develop and implement erosion and sediment control plans in compliance with Dominion Energy's VDEQ-approved Standards and Specifications for Erosion and Sediment Control (ESC) and Stormwater Management (SWM) for Electric Transmission Line Development and appurtenant facilities such as substations and switching stations, as well as any additional requirements specific to DoD lands (if applicable);
- Dominion Energy would prepare and maintain a SWPPP in compliance with Virginia Pollution Discharge Elimination System VAR10 Construction General Permit. A permit would be required because the land-disturbing activity would exceed 1.0 ac (0.4 ha). As a component of the permit, the SWPPP would be prepared and maintained throughout Project construction and retained for 3 years following construction completion as required by Virginia Law; and
- Dominion Energy would collocate Onshore Project Components with existing roadways, ROWs, and other previously disturbed areas to the greatest extent practicable to avoid unnecessary impacts.

Permanent conversion of existing vegetation cover types (e.g., forested to herbaceous) where the Interconnection Cable Route is not collocated with existing road corridors or utility ROWs. The clearing of mature forested areas and forested wetlands for construction access within the Onshore Construction Corridor in certain locations (such as within the sensitive habitats adjacent to Gum Swamp and the North Landing River) would constitute a permanent vegetation conversion as these habitats would take many decades to return to their original condition, even if allowed to revert following construction conditions. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would collocate Onshore Project Components in ROWs, existing roads, previously disturbed areas, and other urbanized locations to the maximum extent practicable;
- Dominion Energy would restrict construction access to existing paved roads or access roads constructed for stream or waterbody crossings. Where possible, restrict access to avoid alteration of soil properties (compaction) that may result in unintended impacts;
- Dominion Energy would use temporary timber mats in wetlands, using 8 to 12 in (20 to 30 cm)-thick timber, for heavy machinery movement and to avoid unintended impacts to wetland soils;
- Dominion Energy would develop an invasive species control plan to prevent the spread of invasive vegetation into natural communities via maintained ROWs and recently disturbed locations. Replanting would be an approved use of native species only, and all plans would be guided by desktop and on-site evaluation of invasive species present in the area;
- Dominion Energy would develop and implement a landscape restoration plan in compliance with applicable local and regional ordinances, paying specific attention to re-seeding and replanting with native plant stock; and
- Dominion Energy would plant or seed larval host plants and forage plants in the Interconnection Cable Route ROWs after construction efforts have been completed in order to avoid and minimize impacts to pollinator species. A list of regionally appropriate species as well as regional suppliers of native seed mixes are available from the USDA NRCS (2020).

Permanent fragmentation of habitat as a result of clearing—particularly of large, contiguous forested wetland habitats. The clearing of previously undisturbed natural habitats, particular areas of large, contiguous forested wetland, for construction access and development of permanent ROWs may result in habitat fragmentation impacts to sensitive natural communities, vegetation, and wildlife species. Fragmentation of contiguous habitat has been shown to reduce biodiversity, and larger habitat patches are known to provide enhanced ecosystem services. Some cryptic or reclusive species require cover deep within the interior of contiguous habitat and away from natural or human-disturbed edges (VDCR-DNH 2018b). The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would collocate Onshore Project Components in or adjacent to existing ROWs, existing roads, previously disturbed areas, and other urbanized locations to the maximum extent practicable;
- Dominion Energy would revegetate temporary access areas with native plants and/or an appropriate native seed mix;
- Dominion Energy has developed and maintains internal guidance for invasive species management, which is intended to control and prevent the spread of invasive vegetation into natural communities via maintained ROWs and recently disturbed locations. Replanting would be an approved use of

native species only, and all plans would be guided by desktop and on-site evaluation of invasive species present in the area;

- Dominion Energy would develop and implement a landscape restoration plan in compliance with applicable local and regional ordinances, paying specific attention to re-seeding and replanting with native plant stock; and
- Dominion Energy would develop a compensatory mitigation plan, where permanent conversion of wetlands is unavoidable, to include on-site mitigation where practical, off-site mitigation, or purchase of mitigation credits or payment of an in-lieu fee mitigation as appropriate. This mitigation plan would be further refined as a component of the USACE permitting package.

Permanent colonization and establishment of invasive vegetation in formerly undisturbed areas due to clearing. Disturbed areas may allow for the potential colonization and establishment of invasive plant species, particularly in ROWs. When established, the invasive species proliferate and displace native plant species and reduce the quality of wildlife habitat. They may clog important waterways and sensitive aquatic habitats and can result in economic losses due to the increased efforts required to control and maintain ROWs (Pimentel et al. 2005; VDCR-DNH 2019). The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy has developed and maintains internal guidance for invasive species management, which is intended to control and prevent the introduction and spread of invasive vegetation into natural communities via maintained ROWs and recently disturbed locations;
- Dominion Energy would develop and implement a landscape restoration plan that would specify planting of approved native species and/or regionally appropriate native seed mix;
- Dominion Energy would develop standard BMPs to reduce the spread of invasive species to previously uncolonized areas that would be incorporated into the invasive species control plan and implemented during construction. Resources detailing BMPs to prevent the introduction and spread of invasive species are recommended by the USDA National Invasive Species Information Center (NISIC), and a comprehensive guide was published by the University of Georgia in 2011 (USDA NISIC 2020, Moorhead et al. 2011). Examples of applicable BMPs include:
    - Cleaning of construction and transporting equipment, as needed, prior to entering the Onshore Project Area;
    - Cleaning of equipment and vehicles used within areas infested with invasive species prior to leaving such areas;
    - Siting staging areas in locations that are free of invasive species;
    - Avoiding the cleaning of equipment, vehicles, or clothing in the vicinity of waterways; and
    - Disposing of plant materials appropriately that are removed during cleaning practices discussed above.

Impacts to protected or sensitive species and natural communities. Natural heritage resources and significant natural communities and wildlife habitats potentially occur within the vicinity of the Onshore Project Area. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would coordinate with the USFWS, VDWR, and the Virginia Natural Heritage Program to avoid impacts to rare and T&E species or natural communities to the greatest extent practicable, and to identify additional minimization and mitigation measures if necessary;
- Dominion Energy would collocate Onshore Project Components in ROWs, existing roads, previously disturbed areas, and other urbanized locations to the maximum extent practicable; and
- Dominion Energy has developed and maintains internal guidance for invasive species management, which is intended to control and prevent the introduction and spread of invasive vegetation into natural communities via maintained ROWs and recently disturbed locations. Replanting would be an approved use of native species only and all plans would be guided by desktop and on-site evaluation of invasive species present in the area.

Operations and Maintenance

During O&M, the potential impact-producing factors to terrestrial vegetation and wildlife resources may include the routine mowing associated with permanent ROWs and lighting and noise generated at the Switching Station and Onshore Substation locations. However, emergency repairs during Onshore Project Area operations may include limited and localized excavation to access underground cable routes or associated structures, which may result in limited disturbance. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project O&M. The following impacts may occur as a consequence of the factors identified above:

- Conversion of existing vegetation cover types as a result of permanent access roads, structures, and facilities in previously vegetated areas;
- Vegetation disturbance as a result of routine or periodic facility maintenance (e.g., invasive species control, herbicide applications, and mowing) throughout the lifetime of the facility; and
- Noise or light disturbance associated with routine facility maintenance and activities (at permanent facilities such as substations) throughout the lifetime of the facility.

Conversion of existing vegetation cover types as a result of permanent access roads, structures, and facilities in previously vegetated areas. The construction of permanent access roads, structures, and facilities (e.g., concrete foundations, gravel lots, fencing, and associated structures) would result in the permanent conversion of existing vegetation cover types for the lifetime of the Project. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would monitor revegetation throughout the lifetime of the Project and leading up to decommissioning. Monitoring would comply with the approved landscape restoration plan, as required by the City of Virginia Beach and the City of Chesapeake. Monitoring would serve as the primary measure for ensuring return of natural habitat functionality following completion of construction and necessary operation;
- Dominion Energy has developed and maintains internal guidance for invasive species management, which is intended to control and prevent the introduction and spread of invasive species; and
- Dominion Energy would limit unauthorized access of Onshore Project personnel and vehicles beyond existing disturbed areas and approved access roads to the extent practicable.

Vegetation disturbance as a result of routine or periodic facility maintenance (e.g., invasive species control, herbicide applications, and mowing) throughout the lifetime of the facility. Ongoing maintenance of ROWs may be required for continued access and would likely involve mechanical vegetation removal or application of herbicides periodically throughout the lifetime of the Project. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- Dominion Energy would take protective measures to prevent access to any active operation area, including, but not limited to, security and safety fencing;
- Dominion Energy has developed and maintains internal guidance for invasive species management, which is intended to control and prevent the introduction and spread of invasive species;
- Dominion Energy would plant and seed desirable noninvasive native species within the ROWs to reduce establishment of invasive woody vegetation requiring control;
- Dominion Energy would monitor revegetation throughout the life of the Project and leading up to decommissioning. Monitoring would comply with the approved landscape restoration plan as required by the City of Virginia Beach and City of Chesapeake. Monitoring would serve as the primary measure for ensuring return of natural habitat functionality following completion of construction and necessary operation; and
- Dominion Energy would adhere to all federal, state, and local laws and regulations pertaining to herbicide application. If herbicides are to be used in wetland habitats, wetland-safe herbicide would be used to avoid unintended impacts to sensitive wetland wildlife and vegetation.

Noise or light disturbance associated with routine facility maintenance and activities (at permanent facilities such as substations) throughout the lifetime of the facility. O&M of permanent facilities, such as substations and ROWs, would potentially generate noise and light that would potentially disturb wildlife for the lifetime of the Project. The following measures would be employed to avoid, minimize, and/or mitigate impacts:

- During operations, the Project will be in compliance with relevant City of Virginia Beach and City of Chesapeake noise requirements. If the final design engineering requires sound mitigation measures, they will be implemented within the Project footprint, as necessary (see Section 4.1.4, In-Air Acoustic Environment).
- 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 to avoid disruption to nocturnal avian and bat species; and
- Dominion Energy would limit unauthorized access of Onshore Project Area personnel and vehicles beyond existing disturbed areas and approved access roads to the extent practicable.

Decommissioning

Impacts from decommissioning the Project are expected to be similar to or less than those experienced during construction, without the need for tree clearing. However, following decommissioning activities, the impacted areas would be seeded and stabilized in accordance with the requirements of the VAR10 Construction General Permit, then left to return to pre-Project conditions. Therefore, avoidance, minimization, mitigation, and monitoring measures proposed to be implemented during decommissioning are expected to be similar to those experienced during construction, as described above. Decommissioning techniques are expected to advance during the lifetime of the Project. A full decommissioning plan would be provided to the appropriate regulatory agencies for approval prior to any decommissioning activities, and potential impacts would be re-evaluated at that time.

4.2.2.3 Summary of Avoidance, Minimization, and Mitigation Measures

Dominion Energy proposes to implement the following measures to avoid, minimize, and/or mitigate the potential impact-producing factors described (Table 4.2-9). Dominion Energy will also implement any additional avoidance, minimization, and mitigation measures included in permits and approvals issued for the Project by the USACE, VMRC, and VDEQ. Dominion Energy would continue discussions and engagement with the appropriate regulatory agencies and environmental non-governmental organizations throughout the life of the Project to develop an adaptive mitigation approach that provides the most flexible and protective mitigation measures.

Table 4.2-9. Summary of Avoidance, Minimization, and Mitigation Measures

Project Stage	Location	Impact	Avoidance, Minimization and/or Mitigation
Construction; Decommissioning	Onshore Project Area	Vegetation removal associated with installation of all Onshore Project Components The inadvertent release of drilling fluids to the surface during horizontal directional drilling (HDD) activities within environmentally sensitive areas Noise and light activities associated with construction equipment and other noise-generating activities associated with construction Impedance to local migration of terrestrial biota (such as reptiles and amphibians) from installation and placement of erosion- and sediment-control measures such as staggered silt fencing or stabilization matting Accidental releases of petroleum products from construction vehicles or equipment Potential for erosion into adjacent vegetation and wildlife habitat Conversion of existing vegetation cover types (e.g. forested to herbaceous)	• Dominion Energy would collocate Onshore Project Components in or adjacent to existing ROWs, existing roads, previously disturbed areas, and other urbanized locations to the maximum extent practicable; • Dominion Energy would seed and stabilize construction areas involving temporary vegetation clearing with an appropriate grass seed mix (in urban areas) or native seed mix (in natural areas) and in accordance with Virginia Erosion and Sediment Control Law and Regulations (Virginia Department of Environmental Equity [VDEQ] 2014) and the Virginia Erosion and Sediment Control; Handbook (VDEQ 1992); • Dominion Energy would prepare and submit a mitigation planting plan to the City of Virginia Beach for approval to address unavoidable temporary impacts that would occur within sensitive ecological areas (such as within the Southern Rivers Watershed), or Dominion Energy would provide financial compensation for any unavoidable impacts. The City of Virginia Beach may require native plantings; • Dominion Energy would plant or seed larval host plants and forage plants in the Interconnection Cable Routes after construction efforts have been completed in order to avoid and minimize impacts to pollinator species. A list of regionally appropriate species as well as regional suppliers of native seed mixes are available from the U.S. Department of Agriculture Natural Resources Conservation Service (2020); • Dominion Energy would develop and implement an inadvertent release plan with use of non-toxic

Project Stage	Location	Impact	Avoidance, Minimization and/or Mitigation
		where the onshore routes are not collocated with existing road corridors or utility rights of way (ROWs) Permanent fragmentation of habitat as a result of clearing, particularly of large contiguous forested wetland habitats Colonization and establishment of invasive vegetation in formerly undisturbed areas due to clearing Impacts to locally rare or sensitive species and natural communities	drilling fluids to be reviewed and approved by the appropriate regulatory entities; • Dominion Energy would coordinate with the U.S. Fish and Wildlife Service (USFWS), Virginia Department of Wildlife Resources (VDWR), and Virginia Natural Heritage Program to ensure potential impacts to threatened and endangered (T&E) species are avoided and minimized to the maximum extent practicable; Dominion Energy would evaluate time-of-year restrictions for applicable T&E species via coordination with the USFWS, VDWR, and Virginia Natural Heritage Program; • Dominion Energy would limit lighting associated with construction vehicles and work zones when possible to reduce interaction with or disturbance of wildlife species such as bats and insectivorous birds; • Dominion Energy would initiate coordination with the VDWR and Virginia Natural Heritage Program to evaluate potential impacts to T&E reptile and amphibian species, including the canebrake rattlesnake; • Dominion Energy would install staggered silt fencing in areas surrounding wetlands, waterbodies, and areas with the potential to contain T&E species, rare natural communities, and habitat for reptiles and amphibians. Staggered gaps would ensure reptiles and amphibians could continue to move relatively unrestricted through the Onshore Project Area. This strategy would be employed on a site-specific basis following coordination with VDWR and the Virginia Natural Heritage Program; • Dominion Energy would, when applicable, employ snake-friendly erosion-control blankets containing natural or biodegradable fibers or loose-weave netting in areas surrounding wetlands, waterbodies, and areas with the potential to contain habitat for reptiles and amphibians; • Additional mitigation strategies would be adhered to in accordance with VDWR consultation regarding impacts to canebrake rattlesnake habitat if determined necessary following review and comment of the Canebrake Rattlesnake Habitat Assessment Report by VDWR; • Dominion Energy would restrict vehicular access to paved roads, approved road crossings, and designated construction areas; • Dominion Energy would manage accidental spills or releases of oils through a spill prevention, control, and countermeasures plan approved by the appropriate regulatory entity; • Dominion Energy would develop and implement erosion and sediment control plans in

Project Stage	Location	Impact	Avoidance, Minimization and/or Mitigation
			compliance with Dominion Energy's VDEQ-approved Standards and Specifications for Erosion and Sediment Control (ESC) and Stormwater Management (SWM) for Electric Transmission Line Development and appurtenant facilities such as substations and switching stations; • Dominion Energy would prepare and maintain a stormwater pollution prevention plan (SWPPP) in compliance with Virginia Pollution Discharge Elimination System VAR10 Construction General Permit. A permit would be required because the land-disturbing activity would exceed 1.0 acre (0.4 hectare). As a component of the permit, the SWPPP would be prepared and maintained throughout Project construction and retained for 3 years following construction completion as required by Virginia Law; • Dominion Energy would restrict construction access to existing paved roads or access roads constructed for stream or waterbody crossings. Where possible, restrict access to avoid alteration of soil properties (compaction) that may result in unintended impacts; • Dominion Energy would use temporary timber mats (or trestles where high organic soil content is present) in wetlands, using 8 to 12 inch (20 to 30 cm)-thick timber, for heavy machinery movement and to avoid unintended impacts to wetland soils; • Dominion Energy has developed and maintains internal guidance for invasive species management to prevent the introduction and spread of invasive vegetation into natural communities via maintained ROWs and recently disturbed locations. Replanting would be an approved use of native species only, and all plans would be guided by desktop and on-site evaluation of invasive species present in the area; • Dominion Energy would develop and implement a landscape restoration plan in compliance with applicable local and regional ordinances, paying specific attention to re-seeding and replanting with native plant stock; • Dominion Energy would revegetate temporary access areas with native plants and/or an appropriate native seed mix; • Dominion Energy would develop standard BMPs to reduce the spread of invasive species to previously uncolonized areas that would be incorporated into the invasive species control plan and implemented during construction. Resources detailing BMPs to prevent the introduction and spread of invasive species are recommended by the U.S. Department of Agriculture (USDA) National Invasive Species Information Center (NISIC), and a

Project Stage	Location	Impact	Avoidance, Minimization and/or Mitigation
			comprehensive guide was published by the University of Georgia in 2011 (USDA NISIC 2020; Moorhead et al. 2011). Examples of applicable BMPs include: ○ Cleaning of construction and transporting equipment, as needed, prior to entering the Onshore Project Area; ○ Cleaning of equipment and vehicles used within areas infested with invasive species prior to leaving such areas; ○ Siting staging areas in locations that are free of invasive species; ○ Avoiding the cleaning of equipment, vehicles, or clothing in the vicinity of waterways; and ○ Disposing of plant materials appropriately that are removed during cleaning practices discussed above; • Dominion Energy would coordinate with the USFWS, VDWR, and the Virginia Natural Heritage Program to avoid impacts to rare and T&E species or natural communities to the greatest extent practicable, and to identify additional minimization and mitigation measures if necessary; • Dominion Energy has developed and maintains internal guidance for invasive species management to prevent the introduction and spread of invasive species and to facilitate restoration of disturbed habitats; and • Dominion Energy would develop a compensatory mitigation plan, where permanent conversion of wetlands is unavoidable, to include on-site mitigation where practical, off-site mitigation, or purchase of mitigation credits or payment of an in-lieu fee mitigation as appropriate. This mitigation plan would be further refined as a component of the U.S. Army Corps of Engineers permitting package.
Operations and Maintenance	Onshore Project Area	Conversion of existing vegetation cover types as a result of permanent access roads, structures, and facilities in previously vegetated areas Vegetation disturbance as a result of routine or periodic facility maintenance (e.g., invasive species control, herbicide applications, and mowing) throughout the lifetime of the facility Noise or light disturbance associated with routine facility maintenance and activities (at permanent facilities such as	• Dominion Energy has developed and maintains internal guidance for invasive species management to control and prevent the introduction and spread of invasive species; • Dominion Energy would limit unauthorized access of Onshore Project personnel and vehicles beyond existing disturbed areas and approved access roads to the extent practicable; • Dominion Energy would plant and seed desirable noninvasive native species within the ROWs to reduce establishment of invasive woody vegetation requiring control; • Dominion Energy would adhere to all federal, state, and local laws and regulations pertaining to herbicide application. If herbicides are to be used in wetland habitats, use wetland-safe herbicide to avoid unintended impacts to sensitive wetland wildlife and vegetation;

Project Stage	Location	Impact	Avoidance, Minimization and/or Mitigation
		substations) throughout the lifetime of the facility	• During operations, the Project will be in compliance with relevant City of Virginia Beach and City of Chesapeake noise requirements. If the final design engineering requires sound mitigation measures, they will be implemented within the Project footprint, as necessary; • 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, to avoid disruption to nocturnal avian and bat species; • Dominion Energy would take protective measures to prevent access to any active operation area including, but not limited to, security and safety fencing; • Dominion Energy would monitor revegetation throughout the life of the Onshore Project and leading up to decommissioning. Monitoring would comply with the approved landscape restoration plan and invasive species control plan, as required by the City of Virginia Beach and the City of Chesapeake, as well as an invasive species control plan. Monitoring would serve as the primary measure for ensuring return of natural habitat functionality following completion of construction and necessary operation; and • Dominion Energy would employ vegetation control methods, including application of herbicides for maintenance of ROWs that would comply with all applicable federal, state, and local laws and regulations.

4.2.3 Avian and Bat Species

This section describes the avian and bat species (and their habitats) known or expected to be present, traverse, or incidentally occur through and around the Project Area. Potential impacts to avian and bat resources resulting from construction, O&M, and decommissioning of the Project are discussed. This section also describes avoidance and minimization, and, as necessary, mitigation measures proposed by Dominion Energy.

This section builds upon other resources, assessments, and reports that further inform the assessment and analysis within the section, including the following:

- In-Air Acoustic Environment (Section 4.1.4);
- Wetlands and Waterbodies (Section 4.2.1);
- Terrestrial Vegetation and Wildlife (Section 4.2.2);
- Land Use and Zoning (Section 4.4.3);
- Sediment Transport Analysis (Appendix J);
- Avian and Bat Impact Assessment (Appendix O-1);
- Offshore Bat Acoustic Survey (Appendix O-2); and
- Northern Long-eared Bat Presence/Absence Mist Netting Survey (Appendix O-3).

This section was prepared in accordance with the BOEM site characterization requirements at 30 CFR § 585.626(3) and BOEM's Guidelines for Providing Avian Survey Information for Renewable Energy Development on the Outer Continental Shelf (BOEM 2020a). Dominion Energy contracted Biodiversity Research Institute to conduct an exposure and risk assessment to assess the potential offshore effects to bat and avian species from the construction and O&M of the Project, which is provided as Appendix O-1, Avian and Bat Impact Assessment. Additional avian and bat assessments were conducted including an offshore bat acoustic survey, provided in Appendix O-2, and an onshore northern long-eared bat presence/absence mist netting survey, which is provided in Appendix O-3, as well as aerial nest surveys and an onshore bat acoustic survey.

4.2.3.1 Affected Environment

The coastal and offshore waters and airspace of the Offshore Project Area include habitat where avian and bat species could be directly or indirectly affected by the construction, O&M, and decommissioning of the Project. The Onshore Project Area and Components are located along or adjacent to existing public roadways, urbanized areas, agricultural lands, and natural landscapes in the cities of Virginia Beach and Chesapeake, Virginia.

Appendix O-1 analyzes the likelihood that birds and bats may be present (i.e., exposure) in the Offshore Project Area and Onshore Project Area. Exposure is defined as the extent of overlap between a species' seasonal or annual distribution and the Project Area. For species where site-specific data was available, a semi-quantitative exposure assessment was evaluated based on (1) high-resolution digital video aerial surveys conducted as part of the Mid-Atlantic Baseline Studies (MABS) project (Williams et al. 2015); (2) boat surveys conducted as part of the MABS project (Williams et al. 2015); (3) version 2 of the Marine-life

Data and Analysis Team (MDAT) marine bird relative density and distribution models (Curtice et al. 2016); (4) individual tracking studies; and (5) records in the Northwest Atlantic Seabird Catalog. See details in Appendix O-1 including definitions of exposure categories and further details on the data used in the assessment.

Appendix O-2, Offshore Bat Acoustic Survey presents results from eight geophysical and geotechnical survey vessels that were equipped with full spectrum bat detectors from April 2020 to May 2021. A total of 592 bat passes were recorded in the Offshore Project Area across approximately 411 detector-nights. The recorded passes were from the silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*)/Seminole bat (*Lasiurus seminolus*), hoary bat (*Lasiurus cinereus*), unidentified high frequency species, and unidentified low frequency species. Eastern red bats and Seminole bats are included in a single group because their echolocation calls are indistinguishable from each other during manual vetting; however, eastern red bats are more common both onshore and offshore. Results did not document *Myotis* species in the Offshore Project Area. All bat species confirmed were from migratory tree bats, but some cave species may be present in the unidentified high and low frequency groups for bat passes that are too low quality to distinguish the species, as described in Appendix O-2. During the survey period, eight bats were visually observed roosting on survey vessels during the day and night or flying around them during the day. Hoary bat, eastern red bat, and silver-haired bat were all observed, as were two that could not be identified. Six bats were observed in the fall of 2020 and two eastern red bats in the spring of 2021. Of these visual observations, four were observed while in the Lease Area, one offshore, one while docked in Norfolk, and two were unknown (see Appendix O-2 for more details). No federally listed bat species were documented in the Offshore Project Area during this survey effort. Based on the video evidence, there were no bat collisions with the turbines during the study period. Weather data is being collected to compare with the bat occurrences.

Appendix O-3, Northern Long-eared Bat Presence/Absence Mist Netting Survey presents the results from surveys conducted along the Onshore Project Area. Mist netting surveys conducted from June 9, 2022 to July 2, 2022 (115 net nights) captured 110 bats representing eight species: big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis)*, southeastern myotis (*Myotis austroriparius)*, tri-colored bat (*Perimyotis subflavus)*, little brown bat (*Myotis lucifugus)*, northern long-eared bat (*Myotis septentrionalis)*, evening bat (*Nycticeius humeralis)*, and Rafinesque's eastern big-eared bat (*Corynorhinus rafinesquii*). Three lactating female northern long-eared bats **(**NLEBs) were captured and fitted with radio transmitters. One day roost was found for one of the lactating females outside the footprint of the Project.

Avian Species

Onshore Project Area

Given the mobility of birds, a variety of species have the potential to occur within the Onshore Project Area throughout the year. An official list of threatened and endangered species that may occur in the proposed Onshore Project Area, or that may be affected by the proposed project, was requested using the USFWS Information for Planning and Consultation (IPaC) system. Three bird species were identified including the federally threatened piping plover (*Charadrius melodus*), federally threatened red knot (*Calidris canutus; rufa* subspecies), and federally endangered roseate tern (*Sterna dougallii*). Additional information on habitat types is included in Sections 4.2.1, Wetlands and Waterbodies; 4.2.2, Terrestrial Vegetation and

Wildlife; and 4.4.3, Land Use and Zoning. Below is a description of each Onshore Project Components, available habitat identified in a desktop study, and the birds expected to utilize the habitat based upon eBird records (further details are provided in Appendix O-1). The eBird database is a program launched by the Cornell Lab of Ornithology and the National Audubon Society that utilizes citizen science to report bird observations using standardized protocols (Sullivan et al. 2009). The eBird data is available in real time across an expansive geographic area.

The Offshore Export Cable would transition to shore using trenchless installation and terminate at the Cable Landing Location at the proposed Parking Lot, west of the firing range at SMR. Adjacent to the Cable Landing Location, dunes and dune grass, scrub-shrub, and wetlands 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*), but the parking lots do not provide important habitat for avian species.

Four species were detected in the eBird database within 12 mi (20 km) of the Project Area that are listed under the federal ESA: piping plover, red knot, roseate tern, and red-cockaded woodpecker (*Leuconotopicus borealis*). In addition, the USFWS IPaC database was queried using a polygon around the City of Virginia Beach. Because red-cockaded woodpecker distribution within Virginia is restricted to two breeding locations and neither eBird nor IPaC report any sightings from the immediate Onshore Project, they are not expected to occur within the Onshore Project Area, although surveys would be needed for confirmation. Furthermore, during aerial nest surveys performed in March 2022 and March 2023, suitable habitat for red-cockaded woodpecker was not observed. While piping plover, roseate tern, and red knot may utilize the beach near the Cable Landing Location during migration (they are unlikely to be present in other Onshore Project Areas), the beach is not expected to be disturbed because trenchless installation will be used. State-threatened peregrine falcon (*Falco peregrinus*) is only expected to migrate through the region so impacts to the species are considered low at the Onshore Project Areas. See Appendix O-1 for a detailed discussion of listed species.

The Onshore Export Cable, which is proposed to be installed underground, originates from the Cable Landing Location and 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 water, developed, forested, shrub/scrub, agricultural, and wetland, that may support avian species, such as 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 would support a variety of species throughout the year, such as the northern cardinal, Carolina chickadee (*Poecile carolinensis*), Carolina wren (*Thryothorus ludovicianus*), mourning dove, and blue jay.

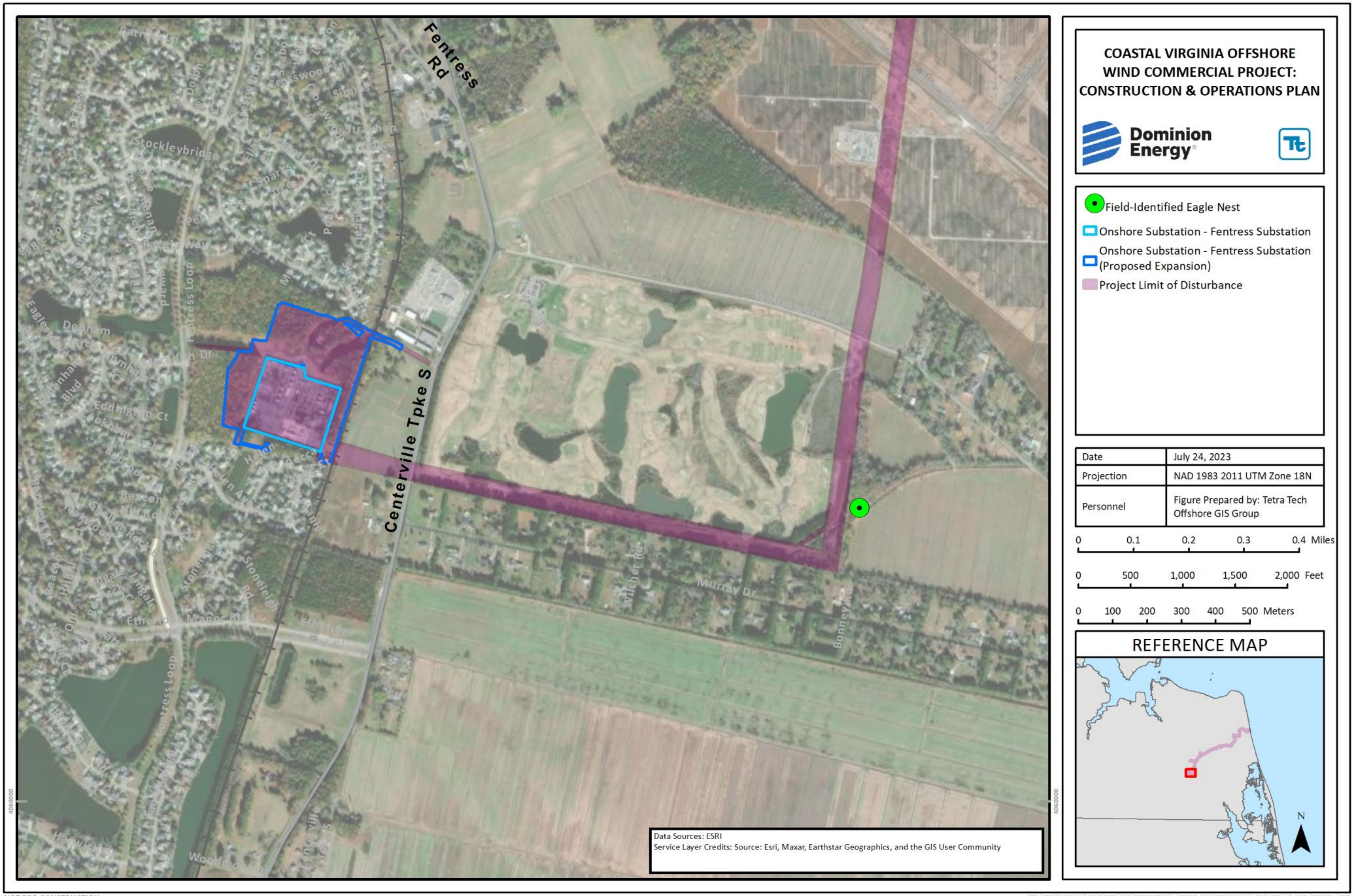
The Harpers Switching Station would be constructed on a parcel north of Harpers Road (Interconnection Cable Route Option 1, Preferred Option). The Harpers Switching Station operational footprint is anticipated to be approximately 46.5 ac (18.8 ha), including any associated stormwater facilities, parking areas, relocation of golf course facilities, etc., and the Harpers Switching Station is expected to be constructed on a combination of existing developed areas, as well as undeveloped areas, composed of a mix of forest and woody wetlands. Some vegetation clearing would be required. Alternatively, the Chicory Switching Station

(Interconnection Cable Route Option 6) would be constructed north of Princess Anne Road and would collect power to transition to the Interconnection Cable. The Chicory Switching Station operational footprint is anticipated to be approximately 35.5 ac (14.4 ha), including any associated stormwater facilities, and is located in an area of mixed forest and vegetation clearing will be required.

Two possible Interconnection Cable Route Options would extend from the Common Location north of Harpers Road to the Onshore Substation: Interconnection Cable Route Option 1 would utilize overhead transmission lines, and Interconnection Cable Route Option 6 would utilize a hybrid of overhead and underground transmission lines. The underground sections of the routes would be primarily collocated with existing roadways, and the overhead transmission lines would be primarily collocated within either roadways or existing transmission corridors to varying degrees. The Interconnection Cable Route Options would pass through several habitat types, including open water, developed, forested, shrub/scrub, agricultural field, and wetland.

There are three broad portions of the Interconnection Cable Route Options. The first portion would run from Harpers Road up to the forested and wetland habitat adjacent to the North Landing River, which primarily passes through a mix of urban developed areas and agricultural land. The second portion would pass through a relatively undisturbed area of mixed forest, wetlands, and riverine habitat associated with the North Landing River (i.e., Gum Swamp) and was identified in the Coastal Virginia Ecological Value Assessment (VCZMP 2020) as having "very high" ecological value. The third portion would pass through a mix of agricultural land and wetlands adjacent to a canal. While each of the sections would provide breeding and wintering habitat for birds, the central portion around the North Landing River likely would provide habitat for the greatest diversity of birds and those identified as Species of Greatest Conservation Need (SGCN), including the belted kingfisher (*Megaceryle alcyon*), black-crowned night-heron (*Nycticorax nycticorax*), king rail (*Rallus elegans*), and marsh wren (*Cistothorus palustris*). Site-specific surveys may be needed in portions of the Interconnection Cable Route Options that pass through undisturbed areas; see Table 4.2-13. The Onshore Substation is largely characterized by an existing substation with a small amount of forested area and only provides minimal habitat for avian species.

Aerial nest surveys along the Onshore Project Area were conducted in 2022 and 2023 to determine the status of known nests and document new or unknown nests of raptors and wading birds. Four active bald eagle (*Haliaeetus leucocephalus*) nests were observed during the 2022 aerial flights. Of the four nests observed in 2022, only three were confirmed active in 2023. The closest nest (nest BAEA1) was observed approximately 140 ft (0.14 m) from the centerline of the Interconnection Cable Route near the Fentress Substation in a loblolly tree (Figure 4.2-7). Dominion Energy does not anticipate disturbance to this nest at this time; however, due to the location of the nest in proximity to construction activities, an application was submitted to USFWS on April 25, 2023 for a Nest Disturbance Permit.



NOT FOR CONSTRUCTION

Figure 4.2-7. Bald Eagle Nest Near the Onshore Project Area

Table 4.2-10 lists the most common (75th quantile) birds identified in the eBird database within a 12 mi (20 km) buffer of the Onshore Project Components (due to variable effort in eBird, and the mobility of most bird species, 20 km was selected to estimate the species that could be present). Appendix O-1 provides a list of the SGCN and their associated habitats and all birds identified in the eBird database within 12 mi (20 km) of the Onshore Project Components.

Table 4.2-10. Common Bird Species, Listed High to Low in Order of Number of eBird Records, Potentially Exposed to the Onshore Project Components According to the eBird Database

Common Name a/	Scientific Name a/	Primary Habitat	General Breeding Habitat	Conservation Status
Northern cardinal	*Cardinalis cardinalis*	Terrestrial	Shrubland, artificial/terrestrial forest	MBTA
Carolina chickadee	*Poecile carolinensis*	Terrestrial	Artificial/terrestrial forest, shrubland	MBTA
Carolina wren	*Thryothorus ludovicianus*	Terrestrial	Artificial/terrestrial forest, shrubland	MBTA
Great blue heron	*Ardea herodias*	Marine, Freshwater	Forest, marine intertidal, wetlands (inland)	MBTA
American crow	*Corvus brachyrhynchos*	Terrestrial	Artificial/terrestrial forest	MBTA
Mourning dove	*Zenaida macroura*	Terrestrial	Artificial/terrestrial, shrubland	MBTA
Double-crested cormorant	*Phalacrocorax auritus*	Marine, Freshwater	Marine neritic, wetlands (inland)	MBTA
American robin	*Turdus migratorius*	Terrestrial	Artificial/terrestrial forest, shrubland	MBTA
Northern mockingbird	*Mimus polyglottos*	Terrestrial	Shrubland	MBTA
European starling	*Sturnus vulgaris*	Terrestrial	Artificial/terrestrial forest, shrubland	—
Canada goose	*Branta canadensis*	Freshwater Wetlands	Artificial/terrestrial grassland, wetlands (inland)	MBTA
Blue jay	*Cyanocitta cristata*	Terrestrial	Artificial/terrestrial forest	MBTA
Mallard	*Anas platyrhynchos*	Freshwater Wetlands	Artificial/terrestrial grassland, wetlands (inland)	MBTA
Ring-billed gull	*Larus delawarensis*	Marine, Freshwater	Coastal beach grassland, wetlands (inland), urban development	MBTA
Red-winged blackbird	*Agelaius phoeniceus*	Terrestrial, Freshwater	Wetlands (inland)	MBTA
Great egret	*Ardea alba*	Marine, Freshwater	Forest, wetlands (inland), marine intertidal	MBTA
Tufted titmouse	*Baeolophus bicolor*	Terrestrial	Artificial/terrestrial forest, shrubland	MBTA
Turkey vulture	*Cathartes aura*	Terrestrial	Artificial/terrestrial forest, desert, grassland, shrubland	MBTA
House finch	*Haemorhous mexicanus*	Terrestrial	Shrubland, artificial/ terrestrial forest, grassland	MBTA
Song sparrow	*Melospiza melodia*	Terrestrial	Artificial/terrestrial forests, shrubland, wetlands (inland)	MBTA
Red-bellied woodpecker	*Melanerpes carolinus*	Terrestrial	Artificial/terrestrial forest, savanna	MBTA
Common grackle	*Quiscalus quiscula*	Terrestrial	Artificial/terrestrial forest, shrubland, wetlands (inland)	MBTA
Brown pelican	*Pelecanus occidentalis*	Marine	Marine neritic, marine coastal/supratidal	MBTA

Common Name a/	Scientific Name a/	Primary Habitat	General Breeding Habitat	Conservation Status
Fish crow	*Corvus ossifragus*	Marine, Terrestrial	Grassland, wetlands (inland), marine intertidal	MBTA
Great black-backed gull	*Larus marinus*	Marine	Marine coastal/supratidal, marine neritic	MBTA
American goldfinch	*Spinus tristis*	Terrestrial	Artificial/terrestrial forest, grassland, shrubland	MBTA
Downy woodpecker	*Dryobates pubescens*	Terrestrial	Artificial/terrestrial forest	MBTA
Eastern bluebird	*Sialia sialis*	Terrestrial	Artificial/terrestrial forest, shrubland	MBTA
Osprey	*Pandion haliaetus*	Marine	Artificial/aquatic and marine, marine coastal/supratidal, marine neritic	MBTA
Herring gull	*Larus argentatus*	Marine	Artificial/aquatic and marine, marine coastal/supratidal, marine intertidal, marine neritic, wetlands (inland)	MBTA
Eastern towhee	*Pipilo erythrophthalmus*	Terrestrial	Artificial/terrestrial forest, shrubland	MBTA
Laughing gull	*Leucophaeus atricilla*	Marine	Marine coastal/supratidal, marine intertidal, marine neritic	MBTA SGCN
Brown thrasher	*Toxostoma rufum*	Terrestrial	Shrubland, forest	MBTA SGCN
Bald eagle	*Haliaeetus leucocephalus*	Marine, Freshwater, Terrestrial	Wetlands (inland), artificial/aquatic and marine, forest, marine intertidal, marine neritic, wetlands (inland)	MBTA BGEPA
Pine warbler	*Setophaga pinus*	Terrestrial	Conifer forest	MBTA
Yellow-rumped warbler	*Setophaga coronata*	Terrestrial	Forest	MBTA
Rock pigeon	*Columba livia*	Terrestrial	Artificial/terrestrial, caves and subterranean habitats (non-aquatic), rocky areas (e.g., Inland cliffs, mountain peaks)	—
Boat-tailed grackle	*Quiscalus major*	Terrestrial	Marine coastal/supratidal, wetlands (inland)	MBTA
Gray catbird	*Dumetella carolinensis*	Terrestrial	Shrubland, artificial/terrestrial forest	MBTA SGCN
Northern flicker	*Colaptes auratus*	Terrestrial	Artificial/terrestrial forest	MBTA SGCN
Chipping sparrow	*Spizella passerina*	Terrestrial	Artificial/terrestrial forest, shrubland	MBTA
Belted kingfisher	*Megaceryle alcyon*	Marine, Freshwater	Wetlands (inland), coastal banks, exposed hillsides	MBTA SGCN
Pileated woodpecker	*Dryocopus pileatus*	Terrestrial	Artificial/terrestrial forest, wetlands (inland)	MBTA
Tree swallow	*Tachycineta bicolor*	Terrestrial, Freshwater	Wetlands (inland), artificial/terrestrial cavities	MBTA
Brown-headed cowbird	*Molothrus ater*	Terrestrial	Nest parasite	MBTA
Red-tailed hawk	*Buteo jamaicensis*	Terrestrial	Artificial/terrestrial forest	MBTA
White-breasted nuthatch	*Sitta carolinensis*	Terrestrial	Artificial/terrestrial forest cavities	MBTA
Brown-headed nuthatch	*Sitta pusilla*	Terrestrial	Conifer forest	MBTA
Sanderling	*Calidris alba*	Marine	Migrant only—breeds in the high arctic	MBTA SGCN

Common Name a/	Scientific Name a/	Primary Habitat	General Breeding Habitat	Conservation Status
Killdeer	*Charadrius vociferus*	Terrestrial	Wetlands (inland), artificial/terrestrial, wetlands (inland), open spaces	MBTA
White-throated sparrow	*Zonotrichia albicollis*	Terrestrial	Winter resident only—forest, shrubland	MBTA
Royal tern	*Thalasseus maximus*	Marine	Marine intertidal, marine neritic	SGCN MBTA
Pied-billed grebe	*Podilymbus podiceps*	Freshwater	Wetlands (inland), rarely coastal	MBTA
Lesser black-backed gull	*Larus fuscus*	Marine	Marine coastal/supratidal, marine intertidal, marine neritic, wetlands (inland)	MBTA
Black vulture	*Coragyps atratus*	Terrestrial	Artificial/terrestrial forest, grassland, shrubland	MBTA
Cooper's hawk	*Accipiter cooperii*	Terrestrial	Forest	MBTA
Field sparrow	*Spizella pusilla*	Terrestrial	Artificial/terrestrial forest, grassland, shrubland	MBTA
Wood duck	*Aix sponsa*	Freshwater	Forest, wetlands (inland), wetlands (inland)	MBTA
Forster's tern	*Sterna forsteri*	Marine	Marine neritic, wetlands (inland)	MBTA SGCN
Common yellowthroat	*Geothlypis trichas*	Freshwater, Terrestrial	Wetlands (inland), marine intertidal, shrubland	MBTA
Common loon	*Gavia immer*	Marine Oceanic	Winter resident only	MBTA
Listed Species				
Piping plover	*Charadrius melodus*	Coastal	Coastal sandy beaches and dunes	MBTA FT, ST
Red knot	*Calidrus canutus rufa*	Coastal	Migrant only—breeds in the high Artic	MBTA FT, ST
Roseate tern	*Sterna dougallii*	Coastal	Coastal sandy beaches and dunes	MBTA FE, SE
Peregrine falcon	*Falco peregrinus*	Terrestrial and Offshore	Cliff ledges and tall anthropogenic structures	MBTA ST

a/ See full list in Appendix O-1, Avian and Bat Impact Assessment.

Note: FE = Federal Endangered, FT = Federal Threatened, BGEPA: Bald and Golden Eagle Protection Act, MBTA: Migratory Bird Treaty Act, SE= State Endangered, ST = State Threatened, SGCN = Species of Greatest Conservation Need

Offshore Project Area

A diverse range of avian species may pass through the Offshore Project Area, including migrant, coastal, and marine birds according to Mid-Atlantic Baseline Studies (Table 4.2-11). 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. For marine birds, the Lease Area is generally low in bird abundance due to its distance from shore (Figure 4.2-8), while the Offshore Export Cable Route Corridor likely would have higher abundances related to proximity to shore.

Table 4.2-11. Bird Species Potentially Exposed to the Offshore Project Components

Taxonomic Group	Species	Aerial Survey	Boat Survey	Conservation Status
Dabblers, Geese, and Swans				
Brant	*Branta bernicla*	•	•	MBTA SGCN
Canada goose	*Branta canadensis*		•	MBTA
Green-winged teal	*Anas crecca*		•	MBTA
American coot	*Fulica americana*		•	MBTA
Coastal Diving Ducks				
Bufflehead	*Bucephala albeola*		•	MBTA
Common goldeneye	*Bucephala clangula*		•	MBTA
Sea Ducks				
Surf scoter	*Melanitta perspicillata*	•	•	MBTA
White-winged scoter	*Melanitta fusca*	•	•	MBTA
Black scoter	*Melanitta americana*	•	•	MBTA
Long-tailed duck	*Clangula hyemalis*		•	MBTA
Red-breasted merganser	*Mergus serrator*		•	MBTA
Grebes				
Horned grebe	*Podiceps auritus*	•	•	MBTA
Red-necked grebe	*Podiceps grisegena*		•	MBTA
Shorebirds				
Wilson's plover	*Charadrius wilsonia*		•	SE, BCC, MBTA
Semipalmated plover	*Charadrius semipalmatus*		•	MBTA
Whimbrel	*Numenius phaeopus*		•	SGCN, BCC, MBTA
Ruddy turnstone	*Arenaria interpres*		•	MBTA
Sanderling	*Calidris alba*		•	SGCN, MBTA
Dunlin	*Calidris alpina*		•	SGCN, MBTA
Least sandpiper	*Calidris minutilla*		•	MBTA
White-rumped sandpiper	*Calidris fuscicollis*		•	MBTA
Semipalmated sandpiper	*Calidris pusilla*		•	BCC, MBTA
Lesser yellowlegs	*Tringa flavipes*		•	MBTA
Phalaropes				
Red-necked phalarope	*Phalaropus lobatus*		•	MBTA
Red phalarope	*Phalaropus fulicarius*		•	MBTA
Skuas and Jaegers				
Pomarine jaeger	*Stercorarius pomarinus*	•	•	MBTA
Parasitic jaeger	*Stercorarius parasiticus*	•	•	MBTA

Taxonomic Group	Species	Aerial Survey	Boat Survey	Conservation Status
Auks				
Dovekie	*Alle*	•	•	MBTA
Common murre	*Uria aalge*		•	MBTA
Thick-billed murre	*Uria lomvia*		•	MBTA
Razorbill	*Alca torda*	•	•	MBTA
Atlantic puffin	*Fratercula arctica*	•	•	MBTA
Small Gulls				
Sabine's gull	*Xema sabini*	•	•	MBTA
Bonaparte's gull	*Chroicocephalus philadelphia*	•	•	MBTA
Little gull	*Hydrocoloeus minutus*		•	MBTA
Medium Gulls				
Black-legged kittiwake	*Rissa tridactyla*		•	MBTA
Laughing gull	*Leucophaeus atricilla*	•	•	SGCN, MBTA
Ring-billed gull	*Larus delawarensis*	•	•	MBTA
Large Gulls				
Herring gull	*Larus argentatus*	•	•	MBTA
Lesser black-backed gull	*Larus fuscus*	•	•	MBTA
Great black-backed gull	*Larus marinus*	•	•	MBTA
Small Terns				
Least tern	*Sternula antillarum*		•	SGCN, BCC, MBTA
Black tern	*Chlidonias niger*	•	•	MBTA
Medium Terns				
Roseate tern	*Sterna dougallii*		•	MBTA, FE, SE
Common tern	*Sterna hirundo*	•	•	SGCN, MBTA
Forster's tern	*Sterna forsteri*		•	SGCN, MBTA
Royal tern	*Thalasseus maximus*	•	•	SGCN, MBTA
Large Terns				
Caspian tern	*Hydroprogne caspia*	•	•	MBTA
Loons				
Red-throated loon	*Gavia stellata*	•	•	SGCN, BCC, MBTA
Common loon	*Gavia immer*	•	•	MBTA
Shearwaters and Petrels				
Northern fulmar	*Fulmarus glacialis*	•	•	MBTA
Cory's shearwater	*Calonectris diomedea*	•	•	MBTA
Sooty shearwater	*Ardenna grisea*	•	•	MBTA
Great shearwater	*Ardenna gravis*	•	•	MBTA

Taxonomic Group	Species	Aerial Survey	Boat Survey	Conservation Status
Manx shearwater	*Puffinus*	•	•	MBTA
Audubon's shearwater	*Puffinus lherminieri*			MBTA
Storm-Petrels				
Wilson's storm-petrel	*Oceanites oceanicus*	•	•	MBTA
Leach's storm-petrel	*Oceanodroma leucorhoa*			MBTA
Gannet				
Northern gannet	*Morus bassanus*	•	•	SGCN, MBTA
Cormorants				
Double-crested cormorant	*Phalacrocorax auritus*	•	•	MBTA
Pelicans				
Brown pelican	*Pelecanus occidentalis*	•	•	MBTA
Heron and Egrets				
Great blue heron	*Ardea herodias*	•	•	MBTA
Green heron	*Butorides virescens*		•	SGCN, MBTA
Snowy egret	*Egretta thula*	•		SGCN, MBTA
American bittern	*Botaurus lentiginosus*	•		BCC, MBTA
Raptors				
Black vulture	*Coragyps atratus*		•	MBTA
Osprey	*Pandion haliaetus*	•		MBTA
Woodpeckers				
Northern flicker	*Colaptes auratus*		•	SGCN, MBTA
Swallows				
Purple martin	*Progne subis*		•	MBTA
Barn swallow	*Hirundo rustica*	•	•	MBTA
Kingfishers				
Belted kingfisher	*Megaceryle alcyon*	•		SGCN, MBTA
Goatsuckers				
Common nighthawk	*Chordeiles minor*	•		MBTA
Songbirds				
Red-breasted nuthatch	*Sitta canadensis*		•	MBTA
Golden-crowned kinglet	*Regulus satrapa*		•	MBTA
Ruby-crowned kinglet	*Regulus calendula*		•	MBTA
American robin	*Turdus migratorius*		•	MBTA
Cedar waxwing	*Bombycilla cedrorum*	•	•	MBTA
American pipit	*Anthus rubescens*		•	MBTA
Dark-eyed junco	*Junco hyemalis*		•	MBTA
Red-winged blackbird	*Agelaius phoeniceus*		•	MBTA
Brown-headed cowbird	*Molothrus ater*		•	MBTA

Taxonomic Group	Species	Aerial Survey	Boat Survey	Conservation Status
Northern waterthrush	*Parkesia noveboracensis*		•	MBTA
Tennessee warbler	*Oreothlypis peregrina*		•	MBTA
Mourning warbler	*Geothlypis philadelphia*		•	MBTA
American redstart	*Setophaga ruticilla*		•	MBTA
Blackpoll warbler	*Setophaga striata*		•	MBTA
Black-throated blue warbler	*Setophaga caerulescens*		•	MBTA
Palm warbler	*Setophaga palmarum*		•	MBTA
Yellow-rumped warbler	*Setophaga coronata*		•	MBTA
Baltimore oriole	*Icterus galbula*	•		MBTA

BCC = Bird of Conservation Concern, FE =Federal Endangered, FT =Federal Threatened, MBTA = Migratory Bird Treaty Act, SGCN = Species of Greatest Conservation Need, SE = State Endangered, ST = State Threatened

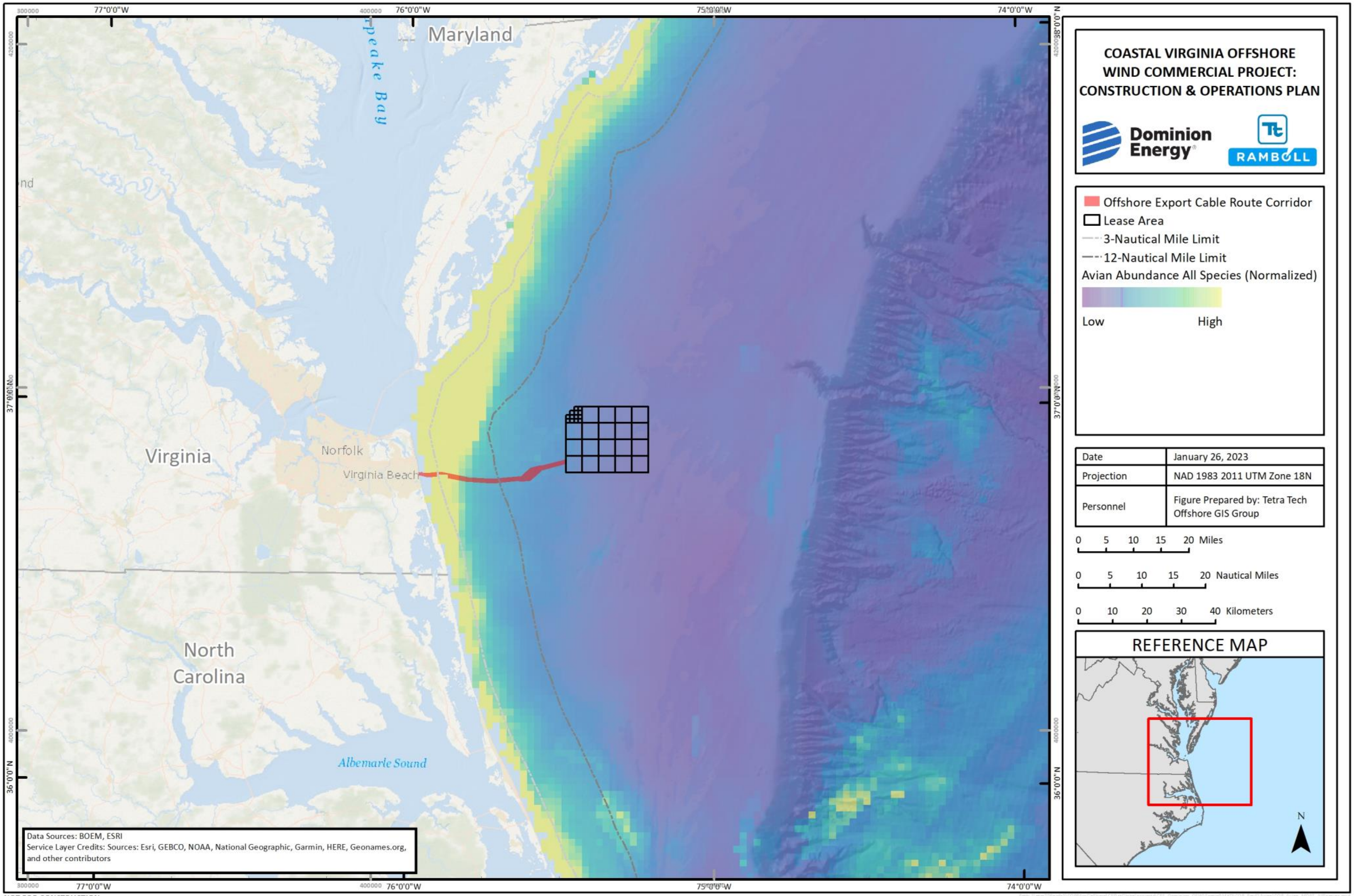


Figure 4.2-8. Bird Abundance Estimates (all birds) from the Marine-life Data and Analysis Team Models

Migratory Non-Marine Birds

There is a variety of migratory birds that have the potential to pass through the Offshore Project Area. Appendix O-1 provides a detailed qualitative exposure assessment (minimum, low, medium, and high) using available literature and data. A summary is provided below.

- *Coastal waterbirds*: Coastal waterbirds (e.g., grebes and waterfowl) use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. Exposure is considered to be minimal because most coastal waterbirds spend a majority of the year in freshwater aquatic systems and near-shore marine systems, and there is little to no use of the Lease Area during any season.
- *Shorebirds*: Shorebirds (e.g., oystercatchers, sandpipers, and plovers) are coastal breeders and foragers and generally avoid straying out over deep waters during breeding. Few shorebird species breed locally on the U.S. Atlantic Coast; most shorebirds that pass through the region are northern or Arctic breeders that migrate along the U.S. East Coast on their way to and from wintering areas. Since the inshore edge of the Lease Area is 27 mi (44 km) from the nearest coast, most migrating shorebirds are likely flying above 1,000 ft (304 m) at the time that they reach the Lease Area. Exposure is considered to be minimal because few were observed offshore, and none in the Lease Area, so exposure would be limited to migration. Piping plover and red knot, both listed under the Endangered Species Act (ESA), are discussed in detail in Appendix O-1 and are expected to have limited exposure, which would be restricted to migration. Further studies and data could add to the modeled assessment and the understanding of potential impacts.
- *Wading birds*: Most long-legged wading birds (e.g., herons and egrets) breed and migrate in coastal and inland areas. Like the smaller shorebirds, wading birds are coastal and interior wetland breeders and foragers that generally avoid straying out over deep waters (Kushlan and Hafner 2000). Tracking and survey data indicate some individual great blue herons can migrate offshore. Exposure is considered to be minimal to low because wading birds spend a majority of the year in freshwater aquatic systems and near-shore marine systems.
- *Raptors*: Among the raptors, peregrine falcons are the most likely to be encountered in offshore settings (Cochran 1985; DeSorbo et al. 2012; DeSorbo et al. 2018). Ospreys (*Pandion haliaetus*) exhibit a wing morphology that enables open water crossings (Kerlinger 1985) and some individual birds will fly offshore (Bierregaard 2019); however, satellite telemetry data from ospreys breeding in New England and the mid-Atlantic suggest these birds generally follow coastal or inland migration routes and are unlikely to be exposed to the Lease Area. Since tracking data and species accounts indicate that falcons may pass through offshore waters of Virginia, and there is potential that falcons could be exposed to the Lease Area, exposure level was considered low. The general morphology of both bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) dissuades long-distance movements in offshore settings (Kerlinger 1985). These two species generally rely upon thermal formation, which develops poorly over the open ocean, during long-distance movements. Therefore, eagle exposure is considered minimal.
- *Songbirds*: Songbirds almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine system except during migration. Many North American breeding songbirds migrate to tropical regions. On their migrations, songbirds generally travel at night and at high

altitudes where favorable winds can aid them along their trip. Exposure is considered to be minimal to low because they do not use the offshore marine system as habitat, and there is little evidence of songbird use of the Lease Area outside of the migratory periods.

Marine Birds

Marine bird distributions are generally more pelagic (far offshore) and widespread than coastal birds. A total of 83 marine bird species are known to regularly occur off the Mid-Atlantic Bight of the U.S. (Nisbet et al. 2013). Many of these marine bird species use the Offshore Project Area during multiple time periods, either seasonally or year-round, including loons, storm-petrels and shearwaters, gannets, gulls, terns, and auks. The IPaC database indicated that jaegers, gulls, loons, storm-petrels, and northern gannet (*Morus bassanus*) may be present in the Offshore Project Area and adjacent waters. This database generates a list of those birds reported as occurring in the 6 mi (10 km) grid cell(s) that a given project intersects, and that have been identified as warranting special attention because they are a Birds of Conservation Concern (BCC) species in that area. Appendix O-1 provides a detailed exposure assessment, which includes an exposure ranking of minimal, low, medium, and high, for each of these groups. The categories represent the proportion of a species group population exposed to the Lease Area based upon local (MABS surveys) and regional (MDAT models) datasets. The MDAT models provide seasonal predictions of abundance and were developed to support Atlantic marine renewable energy planning (Curtice et al. 2016; Winship et al. 2018). The MDAT analysis integrates survey data (1978–2016) from the Atlantic Offshore Seabird Dataset Catalog[1] with a range of environmental variables to produce long-term average annual and seasonal models. The sections below present the likelihood of occurrence for each major taxonomic group based on the exposure assessment conducted in Appendix O-1:

- *Sea ducks*: Sea ducks (specifically scoters and long-tailed duck [*Clangula hyemalis*]) are northern or Arctic breeders that use the U.S. Atlantic OCS heavily in winter. Most sea ducks forage on mussels and/or other benthic invertebrates and generally winter in shallow inshore waters or out over large offshore shoals where they can access prey. Exposure is considered to be minimal because the sea duck annual exposure score was minimal to low; the average counts of sea duck within the Offshore Project Area were lower than the MABS digital aerial survey area, and the literature indicates that sea duck exposure would be primarily limited to migration or travel between wintering sites.
- *Auks*: The auk species (e.g., puffins, murres, and razorbills [*Alca torda*]) present in the region of the Offshore Project Area are generally northern or Arctic breeders that winter along the U.S. Atlantic OCS. Exposure is considered to be minimal because annual exposure scores for auks ranged from minimal to low; the average counts of auks within the Offshore Project Area were generally lower than those of the MABS digital aerial survey area.
- *Gulls, skuas, and jaegers:* Multiple species of gulls, skuas, and jaegers observed in the MABS surveys could be exposed to the Project. The regional MDAT abundance models show that these birds have a wide distribution, ranging from near shore (gulls) to offshore (skuas and jaegers). Exposure varied by species, but overall is considered to be minimal to low.

[1] https://coast.noaa.gov/digitalcoast/data/atloffshoreseabird.html

- *Terns:* A total of seven tern species were observed in MABS digital aerial and boat-based surveys. Terns generally restrict themselves to coastal waters during breeding, although some species reach farther offshore and may pass through the Offshore Project Area during migration. Exposure for terns, including the federally listed roseate tern (see Appendix O-1) is considered to be minimal because the annual exposure score for terns as a group was minimal and the mean densities within the Offshore Project Area were lower than the MABS digital aerial survey area.
- *Loons:* The common loon (*Gavia immer*) and red-throated loon (*Gavia stellata*) breed on inland freshwater lakes and ponds during the summer; both species use the U.S. Atlantic OCS during winter, with migration periods in the spring and fall. Exposure is considered to be low because, although loons may pass through the Lease Area during spring and fall migration, they are estimated to have low relative exposure during the winter.
- *Petrels, Shearwaters, and Storm-Petrels:* Few species in the petrels, shearwaters, and storm-petrels group breed in the northern hemisphere. A number of species in this group that breed in the southern hemisphere, however, visit the northern hemisphere during the austral winter (boreal summer) in vast numbers. Exposure for petrels and shearwaters is considered to be minimal, and exposure of storm-petrels is considered medium. The black-capped petrel (*Pterodroma hasitata*) is an ESA candidate species and exposure is considered to be minimal because these birds primarily use the OCS edge (see Appendix O-1).
- *Gannets, Cormorants, and Pelicans:* The northern gannet uses the U.S. Atlantic OCS during winter and migration. They breed in southeastern Canada and winter along coasts of the mid-Atlantic region and the Gulf of Mexico and exposure is considered low. The double-crested cormorant is the most likely species of cormorant to be exposed to the Offshore Project Area, but exposure is considered to be minimal and no cormorants were observed within the Lease Area during the MABS digital aerial surveys. Pelicans are coastal breeders and foragers and generally confine their movements to shallow coastal waters and exposure is considered to be minimal.

Bat Species

Below is a summary of the detailed analysis conducted for the Project as summarized in Appendix O-1, which provides definition of exposure levels, additional information on methods, and species accounts.

Onshore

There are 17 species of bats known to occur in the state of Virginia; 14 of those species have been documented within or adjacent to the Onshore Project Area (Table 4.2-12). These species can be divided into two major groups based on their wintering strategy: cave-hibernating bats and migratory tree bats (Fleming 2019). Both groups of bats are nocturnal insectivores that use a variety of forested and open habitats for foraging during the summer (Barbour and Davis 1969). Cave-hibernating bats migrate from summer habitat to winter hibernacula in the mid-Atlantic region (Maslo and Leu 2013). Tree bats migrate to southern parts of the U.S. (Cryan 2003), with some species likely present year-round in Virginia (Timpone et al. 2011).

Table 4.2-12. Bat Species Present in the Project Area and Their Conservation Status

Common Name a/	Scientific Name	Federal Status a/	State Status a/	Observation Information
Cave-hibernating bats				
Little brown bat	*Myotis lucifugus*	—	E	Recent studies have suggested the presence of coastal populations in Virginia (St. Germain et al. 2017, De La Cruz and Ford 2018, 2020).
Northern long-eared bat (NLEB)	*Myotis septentrionalis*	E b/	T	Six NLEB Maternity Roosts documented in June 2015 by the Virginia Department of Wildlife Resources (VDWR) are located within 2 miles (mi) (3 kilometers [km]) of the Onshore Project Area. These data are available through the VDWR NLEB Winter Habitat and Roost Tree Application (VDWR 2020c). The Information for Planning and Consultation (IPaC) database also documented species presence in the Onshore Project Area. Presence/absence mist netting surveys conducted along the Onshore Project Area in June and July 2022 captured three lactating female NLEBs, which were fitted with radio transmitters. One day roost was found for one of the lactating females outside of the Project limits.
Indiana bat	*Myotis sodalis*	E	E	Recent studies have documented presence of Indiana bats in the coastal plain of Virginia (Silvis et al. 2017, De La Cruz and Ford 2020), including possible year-round activity (De La Cruz and Ford 2018).
Southeastern myotis	*Myotis austroriparius*	—	—	This species has been identified in the forested areas bordering Birdneck Road (Tetra Tech 2019).
Tri-colored bat	*Perimyotis subflavus*	—	E	Two Virginia Fish and Wildlife Information Service (VaFWIS) species observations within 2 mi (3 km) of the Project Area were documented in June 2018. The Virginia Natural Heritage Data Explorer documents 19 state-wide occurrences of this species. Species has been identified in the forested areas bordering Birdneck Road (Tetra Tech 2019). c/
Big brown bat	*Eptesicus fuscus*	—	—	Species presence documented in the VDWR Wildlife Action Plan.
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	—	E	Two VaFWIS species observation within 2 mi (3 km) of the Project Area, August 2012. VNHDE documents 44 statewide occurrences of this species.
Brazilian free-tailed bat	*Tadarida brasiliensis*	—	—	Species presence documented in the VDWR Wildlife Action Plan.
Migratory tree bats				
Evening bat	*Nycticeius humeralis*	—	—	Species presence documented in the VDWR Wildlife Action Plan (VDWR 2018)
Eastern red bat	*Lasiurus borealis*	—	—	
Seminole bat	*Lasiurus seminolus*	—	—	
Hoary bat	*Lasiurus cinereus*	—	—	
Silver-haired bat	*Lasionycteris noctivigans*	—	—	
Northern yellow bat	*Lasiurus intermedius*	—	—	

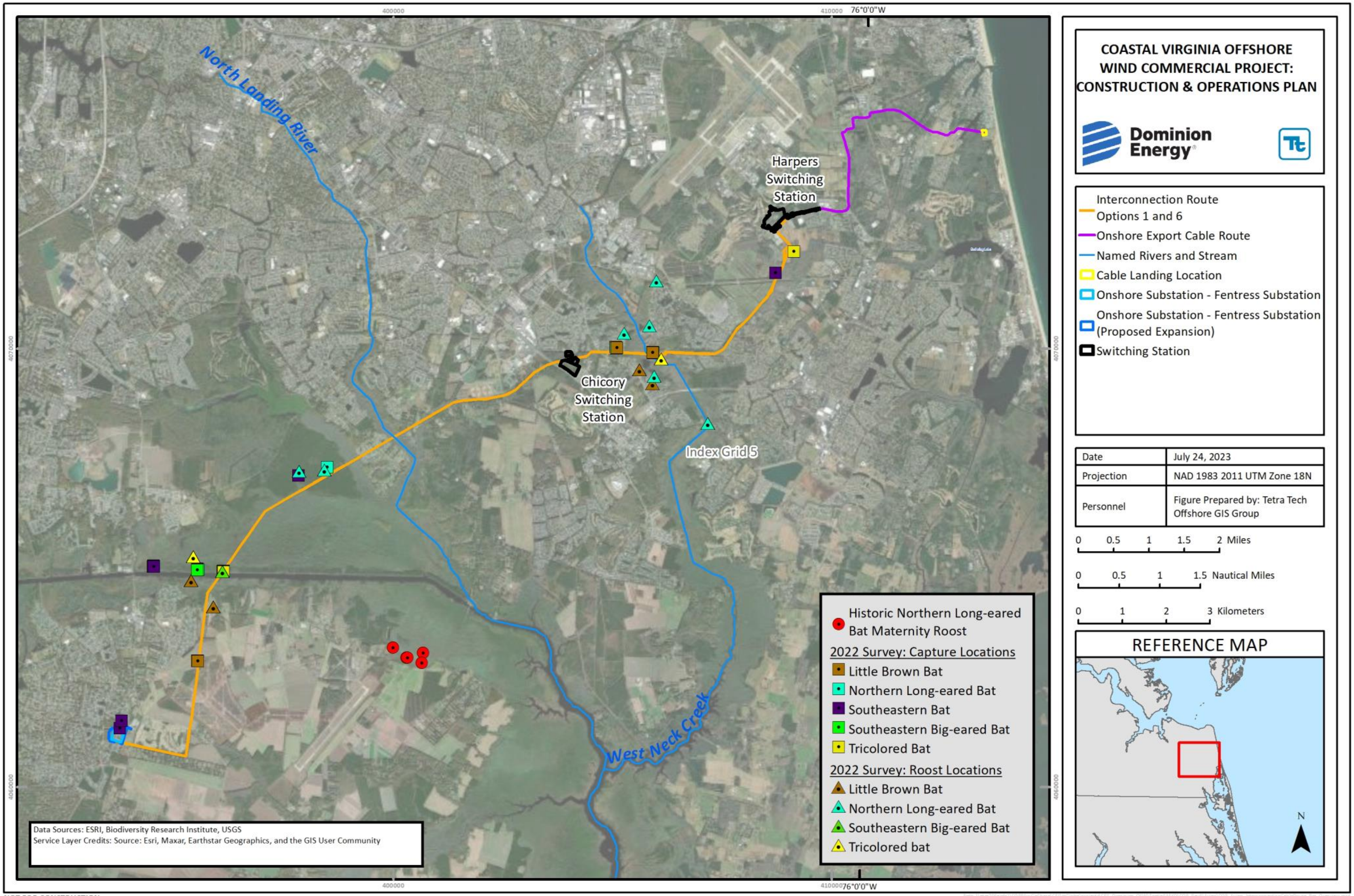
Common Name a/	Scientific Name	Federal Status a/	State Status a/	Observation Information

Notes:
a/ E = Endangered; T = Threatened
b/ The USFWS published the final rule reclassifying the NLEB to endangered, which went into effect on March 31, 2023.
c/ Proposed rule to list the tri-colored bat as endangered was published in September 2022.
Source: Virginia Department of Wildlife Resources 2018, Virginia Department of Wildlife Resources 2020c

Two federally listed bat species may be present in the Onshore Project Area; NLEB is found throughout the state of Virginia, while the ranges of the Indiana bat (*Myotis sodalis*) do not typically include the eastern part of the state (Timpone et al. 2011, 2020b, 2020c). However, recent studies have documented presence of Indiana bats in the coastal plain of Virginia (Silvis et al. 2017; De La Cruz and Ford 2020), including possible year-round activity (De La Cruz and Ford 2018), and a maternity colony was recently discovered in Caroline County, a first record in the Virginia coastal plain (St. Germain et al. 2017). In addition, the NLEB and Indiana bat also are listed as state threatened and endangered species, respectively (VDWR 2018). Based on this available information, these federally protected bat species are considered to have the potential to occur in or near the Onshore Project Area. There are historical records of maternity colonies of NLEBs occurring at Naval Auxiliary Landing Field Fentress (Figure 4.2-9), south of the Interconnection Cable Route Options (Tetra Tech 2019).

NLEB presence/absence mist netting surveys conducted in 2022 along the Onshore Project Area confirmed species presence and located maternity colonies of NLEB (see Appendix O-3). Mist netting surveys conducted from June 9, 2022 to July 2, 2022 (115 net nights) captured 110 bats representing eight species (big brown bat, eastern red bat, southeastern myotis, tri-colored bat, little brown bat, NLEB, evening bat, and Rafinesque's eastern big-eared bat). Three lactating females were captured and radio-transmitted near the Interconnection Cable Route Options (see Appendix O-3). A single loblolly pine (*Pinus taeda*) maternity roost was used by a female NLEB for at least 4 days of the 7-day monitoring period). This roost was located about 220 ft (67 m) from the Interconnection Cable Route Options (see Appendix O-3).

The Cable Landing Location would be located in a proposed parking lot, which is highly unlikely to provide important habitat for any bat species. Previous bat mist netting efforts in the vicinity of the Onshore Export Cable Route, particularly along Birdneck Road and near the SMR Beach Parking Lot, 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 Birdneck Road (Tetra Tech 2019). Acoustic analysis in this same area had no confirmed NLEB calls; while 16 passes were identified as Indiana bat by KPro software, presence was not confirmed during manual vetting (Tetra Tech 2019). While the calls of Indiana bats and little brown bats are nearly indistinguishable, even by manual review, recent studies have suggested the presence of coastal populations in Virginia (St. Germain et al. 2017; De La Cruz and Ford 2018, 2020), and thus the absence of this species cannot be assumed. While bats may be present in habitat adjacent to the Onshore Export Cable Route, exposure is expected to be limited (see Appendix O-1 and Appendix O-3) because the route is underground and primarily collocated with existing roads; therefore, tree or vegetation clearing would be minimal beyond existing ROWs.



Source: VDWR 2020c; Tetra Tech 2016b

Figure 4.2-9. Northern Long-eared Bat Maternity Roosts and Capture Locations Near the Interconnection Cable Route Options

As described above in the Avian Onshore Project Area section, the Switching Station Options are located primarily in developed areas associated with an existing golf course or small areas of mixed forest. There is some likelihood that bats could utilize the forested areas for foraging and roosting and open field areas for foraging at the Switching Station locations during the bat active period (generally April to October) as well as potentially during the winter if non-hibernating populations persist in this area based on previous bat surveys conducted near the Switching Station locations (Tetra Tech 2016a, 2016b, 2019).

The existing habitat present along the Interconnection Cable Route Options contain suitable bat habitat (e.g., roads, transmission corridors); pass through several areas designated as high or very high ecological value (VCZMP 2020); and are in areas with documented NLEB maternity roosts. Mist netting surveys along the Onshore Project Area in 2022 confirmed the presence of NLEB (Appendix O-3). The nearest known hibernacula occur in the coastal plain south of Virginia Beach in the Dismal swamp. Previous to this finding, the nearest known hibernacula was located in the mountains along the western and northwestern borders of Virginia over 200 mi (320 km) away. Maternity roosts and active detections (mist net captures and acoustic recordings) have been reported for NLEBs in areas around Virginia Beach, with the nearest reported maternity roosts located in close proximity to the Interconnection Cable Route Options, within 0.04 mi (0.06 km). In addition, historical maternity roosts were found at the Naval Auxiliary Landing Field Fentress, within 2.6 mi (4.2 km) of the Interconnection Cable Route Options. Three NLEB mist net captures and a maternity roost were discovered during summer 2022 near the Interconnection Cable Route Options (Figure 4.2-9). In addition, recent acoustic studies have documented year-round use by both NLEBs and Indiana bats in nearby areas (e.g., Great Dismal Swamp National Wildlife Refuge, Princess Anne Wildlife Management Area), suggesting the presence of non-hibernating, overwintering populations and highlighting the coastal plain as a potentially important refuge for several bat species affected by white-nose syndrome (De La Cruz and Ford 2018, 2020).

Offshore

While there is uncertainty on the specific movements of bats offshore in Virginia, bats have been documented in the marine environment in the U.S. (Grady and Olson 2006; Cryan and Brown 2007; Johnson et al. 2011; Hatch et al. 2013; Pelletier et al. 2013; Stantec 2016; Dowling and O'Dell 2018) and in Europe (Boshamer and Bekker 2008; Ahlén et al. 2009; Lagerveld et al. 2015; Lagerveld et al. 2020). Bats have been observed to temporarily roost on structures on nearshore islands (Dowling et al. 2017) and there is evidence of bats, particularly eastern red bats, migrating offshore (Hatch et al. 2013).

Cave-hibernating bats in Virginia overwinter regionally, hibernate in caves, mines, and other structures, and feed primarily on insects in terrestrial and fresh-water habitats. These species generally exhibit lower activity in the offshore environment than the migratory tree bats (Sjollema et al. 2014). However, acoustic detectors in the Gulf of Maine and Great Lakes documented higher than expected proportions of *Myotis* calls, suggesting that individuals of this genus are capable of, and may frequently make, long-distance, offshore flights (Stantec 2016). The same study reported very little offshore activity of *Myotis* species in the mid-Atlantic. In a separate mid-Atlantic study, the maximum distance *Myotis* bats were detected offshore was 7.2 mi (11.5 km; Sjollema et al. 2014). The Project's offshore bat acoustic survey (April 14, 2020 through May 15, 2021) did not result in any detections of *Myotis* species in the Offshore Project Area (Appendix O-2). All bat species confirmed were from migratory tree bat species, but some cave-hibernating species may be present in the unidentified high- and low-frequency groups. As shown by these studies and the local data, the use of coastline as a migratory pathway by cave-hibernating bats is likely limited to the fall migration period. For these reasons, exposure to the Offshore Project Area is considered minimal to low for cave-hibernating bats in general.

Tree bats generally migrate to the southwestern and southern parts of the U.S., including coastal regions, to overwinter (Cryan 2003; Cryan et al. 2014a) and have been documented in the offshore environment (Hatch et al. 2013). Eastern red bats were detected in the Mid-Atlantic Bight up to 25.9 mi (41.8 km) offshore by high-resolution video aerial surveys (Hatch et al. 2013). The bats were all observed in September to the north of the Offshore Project Area off of Delaware and Maryland. Eastern red bats have been detected migrating from Martha's Vineyard, Massachusetts, late in the fall, and one bat was tracked as far south as Maryland (Dowling et al. 2017). This particular bat made a single-night jump from Martha's Vineyard to Cape May, New Jersey—a straight-line journey of approximately 280 mi (450 km) that could possibly have taken the bat up to 62 mi (100 km) from shore if it traveled in a direct path (Dowling et al. 2017). These results are supported by historical observations of eastern red bats offshore as well as acoustic and survey results (Hatch et al. 2013; Peterson et al. 2014; Sjollema et al. 2014).

During the 2020–2021 acoustic survey, 411 detector-nights were sampled within the Offshore Project Area from April 14, 2020 to May 15, 2021 and showed no presence of federally listed species (Appendix O-2). A total of 592 bat passes was recorded in the Offshore Project Area, with a mean of 1.07 bat passes per detector night. Species in the Offshore Project Area included only long-distance migratory tree bats: eastern red bat/Seminole bat (0.36 bat passes per detector night), silver-haired bat (0.12 bat passes per detector night), and hoary bat (0.01 bat passes per detector night). Although the acoustic signatures of eastern red bat cannot be distinguished from Seminole bat, the activity documented in this survey likely represents eastern red bat because they are Virginia's most common tree bat, and are commonly documented offshore (Hatch et al. 2013, Dowling et al. 2017, VDWR 2021).

Bat passes were recorded at low levels in the spring and summer, and slightly higher yet still low levels during the fall migratory period (85 percent, August 15 through November; Appendix O-2). Bat passes were distributed across the Offshore Project Area and although concentrations of passes occur, they often represent single nights with multiple bat passes and not repeated use of the same area over many nights. Twelve groups of over ten continuously recorded bat passes total 409 bat passes or 69 percent of all bat passes recorded in the Offshore Project Area. This suggests a small number of individual bats contributing large amounts of bat activity. Bats were documented day and night roosting on the vessels within the Offshore Project Area.

In land-based surveys, bat activity levels are known to be affected by temperature and wind speed. Temperature is generally positively correlated with bat activity (Arnett et al. 2007; Wolbert et al. 2014) and high wind speed negatively correlated with bat activity (Arnett et al. 2007). However, this study did not find any significant correlation between temperature or wind speed and bat activity, which could be due to the different conditions recorded at the offshore weather buoy and at the vessel locations within the Lease Area, or simply that bat activity was unaffected by temperature or wind speed near the vessels (Appendix O-2). There was a significant correlation between bat activity and hour of the night with a pulse of activity between eight and ten in the evening and again between two and six in the morning. Additional weather parameters are being collected to compare to bat activity offshore.

The findings from this study are consistent with current understanding of bat activity offshore and demonstrate low levels of bat activity (averaging 1.07 bat passes per detector night: range 0.00 to 5.49) within the area proposed for development and concentrated during the fall migration period (Appendix O-

2). For comparison, activity rates in onshore pre-construction wind farm surveys averaged 1.89 bat passes per detector night with a range of 0.53 to 6.27 bat passes per detector night (Solick et al. 2020).

4.2.3.2 Impacts Analysis for Construction, Operations and Maintenance, and Decommissioning

The potential impacts resulting from the construction, O&M, and decommissioning of the Project are based on the maximum design scenario from the PDE (see Section 3, Description of Proposed Activity).

The potential effects associated with construction and O&M of the Project were evaluated using a risk assessment framework. For the Onshore Project Area, the assessment focused on the habitats that would potentially be disturbed and the bat and bird species that may occupy each major habitat type. For the Offshore Project Area, the framework used a weight-of-evidence approach and combined an assessment of exposure and behavioral vulnerability within the context of the literature to establish potential risk. Exposure was evaluated using a variety of data sources as discussed in Appendix O-1. Behavioral vulnerability was evaluated based on the literature (Furness et al. 2013; Wade et al. 2016), and vulnerability score for the WTGs being considered by the Project (methods are discussed in detail in Appendix O-1).

Construction

During construction, the potential impact-producing factors for avian and bat resources include installation of the Project Components. For the Offshore Project Components, the primary impact-producing factors are above water and include vessels, lighting, WTGs, and Offshore Substations. For the Onshore Project Components, the primary impact-producing factors are vegetation clearing and habitat modification, which may result in reduced foraging and breeding habitat. Other impact-producing factors include temporary disturbance from construction and O&M activities, displacement from breeding (and foraging) habitat, collision with construction equipment, electrocution on energized equipment, and onshore habitat conversion. Dominion Energy proposes to implement measures as appropriate to avoid, minimize, and mitigate impacts during Project construction described in Table 4.2-13, below. The following impacts may occur as a consequence of the impact-producing factors identified above:

- Short-term attraction to, and potential collision with, Project-related vessels and partially installed Offshore Project Components;
- Short-term disturbance of, and displacement from, offshore habitat; and
- Disturbance of, and displacement from, onshore habitat.

Short-term attraction to, and potential collision with, Project-related vessels and partially installed Offshore Project Components. Birds can potentially be attracted to and collide with construction equipment, vessels, WTGs, or Offshore Substations being installed. During construction, the lighting of construction vessels and Offshore Project Components may attract birds and increase collision risk, particularly migrating songbirds during poor weather conditions. However, the risk of increased collision for birds, including federally listed species, due to attraction to lighting will be short term (Fox et al. 2006). To mitigate impacts from lighting, Dominion Energy would use BMPs identified by BOEM COP guidelines (BOEM 2020c) and would comply with FAA and USCG requirements for lighting while, to the extent practicable, using lighting technology (e.g., low-intensity strobe lights) that minimizes impacts on avian and bat species. Dominion Energy currently documents all avian mortalities using the USFWS Injury and Mortality Reporting system and would document any dead or injured birds or bats found on Project vessels or structures during the construction stage of the Project and would submit an annual report by January 31 of each year to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) . The report will 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 will be reported to the USGS Bird Band Laboratory. Any occurrence of dead ESA birds or bats will 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.

Dominion Energy would develop and obtain DOI concurrence on an avian and bat monitoring program during construction with clear goals, monitoring questions, and methods, including monitoring that focuses on areas of uncertainty such as bird and bat presence offshore. Dominion Energy would submit annual monitoring reports to BOEM and BSEE after each full year of monitoring within 6 months of completion of the last avian survey.

Bats may be attracted to the Offshore Project Components, including lighted vessels as they are moving through the Offshore Project Area or through partially installed WTGs in the Lease Area. Bats at onshore wind facilities have exhibited higher attraction and more frequent approaches to turbines when the blades are not spinning (Cryan et al. 2014b), so attraction may be stronger during the construction period prior to operation of turbines. However, stationary objects are not generally considered a collision risk for bats (BOEM 2014) because of the bats' use of echolocation (Johnson et al. 2004; Horn et al. 2008); therefore, individual bats are unlikely to collide with construction equipment or Offshore Project Components during construction. Furthermore, exposure to construction and installation infrastructure is temporary, so population-level impacts to non-listed species are unlikely, and individual impacts to federally-listed species also are unlikely because NLEBs and Indiana bats would have limited-to-no exposure to the Offshore Project Area. The same measures to avoid/minimize/mitigate short-term attraction to, and potential collision with, Project-related vessels and partially installed Offshore Project Components described above for birds also would be protective of bats.

Short-term disturbance of, and displacement from, offshore habitat. Construction in the Offshore Project Area may result in short-term disturbance to birds (or displacement from their habitats) because individuals avoid construction vessels and Offshore Project Components being installed, resulting in temporary displacement from foraging areas. Installation of the Offshore Export Cable would result in temporary disturbance, suspension, and transport of sediment. As described in Appendix J, Sediment Transport Analysis, the disturbance would be confined to a relatively small area of the Offshore Export Cable Route at any given time and is expected to result in only temporary displacement from foraging habitat and prey for seabirds. Federally listed birds are not expected to be displaced from important foraging areas because their exposure to the Lease Area would be primarily during migration.

Bats, including federally listed species, are not expected to be impacted by in-water activities because marine habitat does not provide optimal roosting habitat. If bats avoid construction equipment, they are not expected to be displaced from critical foraging areas. Overall, any exposure of birds and bats to construction activities is considered limited, temporary, and localized (Fox and Petersen 2019); therefore, impacts to bat and bird populations are unlikely. The same measures to avoid/minimize/mitigate short-term disturbance of, and displacement from, offshore habitat described above for birds also would be protective of bats.

Disturbance of, and displacement from, onshore habitat. Construction in the Onshore Project Area would result in the conversion or fragmentation of existing vegetation cover types (e.g., forested to herbaceous) where the Onshore Export Cable Route is not collocated with existing road corridors or utility ROWs. These activities may result in disturbance to birds and bats (or displacement from their habitats), in the same manner as outlined in Section 4.2.2, Terrestrial Vegetation and Wildlife.

At the Cable Landing Location, coastal disturbance during construction would be short-term and limited because it would be located in a proposed parking lot, and the use of trenchless installation would avoid direct disturbance of the beach or sensitive dune habitats. Noise and vibration generated by construction equipment and trenchless installation may temporarily displace some birds and bats, including federally listed species if present within nearby habitat, but are expected to return once construction activity is completed. Dominion Energy would avoid potential effects to birds by using trenchless installation in coastal areas at the Cable Landing Location; collocating the Onshore Export Cable Route with existing roads as much as possible; and timing construction activities to avoid critical periods when endangered and threatened species may be affected, to the extent practicable.

Temporary impacts to birds and bats from construction activities in the Onshore Export Cable Route Corridor are expected to be limited because the cable would be buried underground to limit disturbance to habitat. The Onshore Export Cable would terminate at a Common Location north of Harpers Road. Federally listed birds are unlikely to be present in the disturbed areas, but federally listed bats have the potential to be present. In anticipation of necessary tree clearing, bat mist surveys have been performed and submitted to USFWS for review. As previously noted, mist netting surveys along the Onshore Project Area in 2022 confirmed the presence of NLEB (Appendix O-3).

The Interconnection Cable Route would be constructed as either overhead or a combination of overhead/underground (hybrid) transmission lines with varying degrees of tree and vegetation clearing within sensitive habitats depending on which Interconnection Cable Route Option is selected (see Lengths of Route Options in (Section 3, Description of Proposed Activity). The Interconnection Cable Route Options would pass through areas containing forested wetlands (accounting for between approximately 25 and 29 ac [10 and 12 ha]) identified as containing valuable natural habitat (see Section 4.2.1, Wetlands and Waterbodies). To the extent practicable, Dominion Energy would collocate the Interconnection Cable Route within or adjacent to existing transmission line corridors and ROWs, timing construction activities to avoid critical periods when endangered and threatened species may be affected and to avoid impacts to nesting birds.

The clearing stage of construction has the greatest potential for disturbance to birds and bats if conducted during the nesting/maternity season (e.g., March to August). Tree cutting would impact the habitat of a variety of bird and bat species, including federally listed NLEBs. Total estimated tree clearing for the Project is 117 ac (47 ha) with Interconnection Cable Route Option 1, and 101 ac (41 ha) with Interconnection Cable Route Option 6. Construction in agricultural and other open areas are likely to have the least extent of impacts as bird nesting densities are typically lower in areas with a regular disturbance regime, and disturbance of nesting habitat will only be temporary along the route. Tree/vegetation clearing would avoid trees favorable for bat maternity roosting locations, and would be conducted outside of the breeding/roosting season to avoid nesting birds and bat maternity roosting locations, to the extent practicable (Figure 4.2-9, see buffer requirements below).

Dominion Energy also has developed additional measures specifically targeted at minimizing impacts to birds and bats during construction:

Dominion Energy has developed and implemented a pre-construction avian and bat work plan. The plan involved agency consultation with VDWR, USFWS, and other stakeholders and included the following:

- Dominion Energy conducted a presence/absence survey for NLEBs (mist net) along the Onshore Project Area from June 9, 2022 to July 2, 2022 (Appendix O-3);
- Dominion Energy conducted an eagle/osprey/raptor nest survey along the Interconnection Cable Route Options in March 2022. One bald eagle nest was observed within 660 ft (201 m) of the Project Area;
- Where surveys indicate the presence of species of conservation concern, Dominion Energy would work with VDWR and USFWS to minimize potential impacts prior to construction;
- Dominion Energy would maintain a minimum no-tree-clearing buffer around any known NLEB maternity roosts in compliance with applicable regulations related to NLEBs;
- Dominion Energy would develop avoidance and minimization measures in coordination with the VDWR, USFWS, and appropriate regulatory agencies to ensure protection of threatened and endangered species or to address the potential for incidental take, that may occur within the Project Area; and
- Dominion Energy would ensure that avoidance, minimization, and mitigation measures protective of wetlands, vegetation, and other wildlife species discussed in Section 4.2.1, Wetlands and Waterbodies, and Section 4.2.2, Terrestrial Vegetation and Wildlife, also would be protective of bird and bat species and their habitats.

The Onshore Substation would serve as the POI. Proposed construction activities include the expansion of the existing substation footprint from approximately 11.7 ac (4.7 ha) to an additional 20.4 ac (8.3 ha), for a total of approximately 32.1 ac (12.99 ha). Stormwater management facilities associated with the Onshore Substation will encompass 6.2 ac (2.5 ha) of the 32.1 ac (12.99 ha). The existing substation is associated with fragmented forest habitat with mixed residential use; therefore, depending upon the number of trees that need to be removed, impacts are expected to be limited. Dominion Energy would apply the same avoidance, minimization, and mitigation measures at the Onshore Substation as described for the Onshore Project Components specifically targeted at minimizing impacts to birds and bats.

Operations and Maintenance

During O&M, the potential impact-producing factors to offshore birds and bats would be the presence of Offshore WTGs, and O&M activities, causing habitat loss due to displacement and mortality due to collision (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Milman 2016). Throughout the O&M stage of the Project, the potential impact-producing factors to onshore birds and bats may include the presence of overhead Interconnection Cables, maintenance of the Interconnection Cable Routes, and displacement from Interconnection Cable Route Corridors. Dominion Energy would implement measures as appropriate to avoid, minimize, and mitigate impacts during Project O&M. A detailed assessment for species groups (i.e., shorebirds, wading birds, songbirds, raptors, seabirds, etc.) are provided in Appendix O-1. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project O&M. The following impacts may occur as a consequence of the factors identified above:

- Long-term risk of collision with WTGs and Offshore Substations;
- Long-term displacement from the Lease Area due to presence of WTGs and Offshore Substations;
- Long-term attraction to and displacement from Project-related maintenance vessels;
- Long-term risk of collision with overhead Interconnection Cables; and
- Long-term displacement from onshore habitats at Onshore Project Components.

Long-term risk of collision with WTGs and Offshore Substations. Collision mortality with WTGs has been documented as a potential effect on birds and bats capable of flying within the rotor-swept zone (RSZ) of operating WTGs (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Milman 2016;). The lighting associated with WTGs and the Offshore Substations may result in attraction of birds and increased risk of collision (Montevecchi 2006). These effects are variable by taxonomic group, but can be minimized by using BMPs, such as low-intensity strobe lights (BOEM 2020c). To mitigate the potential for collision with WTGs and Offshore Substations during the O&M stage of the Project, Dominion Energy would use BMPs identified by BOEM COP Guidelines (BOEM 2020c) 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 to birds and bat species. Additionally, while not required by FAA guidance, Dominion Energy will implement an Aircraft Detection Lighting System (ADLS) to minimize the number of hours/day aviation lighting is in full effect.

Coastal waterbirds and wading birds are unlikely to be impacted by collision due to limited exposure. Raptors are attracted to high perches to survey for potential prey, and falcons can be attracted to WTGs (Krijgsveld et al. 2011; Hill et al. 2014; Skov et al. 2016;); however, peregrine falcon mortalities have not been documented at European offshore wind developments. If exposed to offshore WTGs, some songbirds may be vulnerable to collision. In some instances, songbirds may be able to avoid colliding with offshore WTGs (Petersen et al. 2006), but they are known to collide with illuminated terrestrial and marine structures (Fox et al. 2006). Movement during low-visibility periods creates the highest collision risk conditions (Hüppop et al. 2006). Overall, collisions with WTGs could impact individual migratory birds, but population-level impacts are not expected because the distance the Project would be from shore would limit population-level exposure. Piping plovers and red knots, which are federally listed as endangered, are generally expected to migrate at flight heights above the WTGs, although they may fly at lower altitudes in poor weather and during short-distance flights. Plovers and red knots also have good visual acuity and maneuverability in the air (Burger et al. 2011), and while there remains uncertainty on avoidance rates and flight altitudes, there is little evidence to suggest that either species is particularly vulnerable to collisions during migration.

Of the marine birds, gulls rank at the top of collision vulnerability assessments because they can fly within the RSZ (Johnston et al. 2014) and have been documented to be attracted to turbines (Vanermen et al. 2015) and because individual birds have been documented to collide with turbines (Skov et al. 2018). Terns are considered to have some vulnerability to collision (Garthe and Hüppop 2004; Furness et al. 2013), but are expected to often fly below the RSZ, reducing the risk of colliding with WTGs. Cormorants also may be vulnerable to collision because they have been documented to be attracted to WTGs (Krijgsveld et al. 2011; Lindeboom et al. 2011) and may fly through the RSZ. Sea ducks, auks, loons, petrels (including black-capped petrel), shearwaters, and storm-petrels are generally not considered vulnerable to collision because they avoid WTGs (Furness et al. 2013). While northern gannets have been demonstrated to avoid WTGs (Garthe et al. 2017), they may be vulnerable to collision because they have the potential to fly within the RSZ (Furness et al. 2013; Garthe et al. 2014; Cleasby et al. 2015). Northern gannets also represent the largest population within the pilot lease area during boat surveys, which would translate to a higher risk than less observed birds. The federally listed roseate tern has limited exposure to the Offshore Project Area and often flies below the RSZ, reducing collision risk. The Final Vineyard Wind 1 Biological Assessment prepared by BOEM for USFWS estimated that roseate tern mortality from collision would be zero and that the likelihood of collision fatalities would be "insignificant and discountable" (BOEM 2019). Overall, collisions with WTGs may impact individual, non-listed marine birds (gulls in particular), but population-level impacts are not expected because the species vulnerable to collision have minimal-to-low exposure (see Section 4.2.3.1, Affected Environment, and Appendix O1). Dominion Energy would use bird-deterrent devices during construction and operation. To minimize attracting birds to operating turbines and offshore substations, Dominion Energy would utilize bird-deterrent devices. The quantity, location, and type of bird-deterrent devices would be based on BMPs applicable to the appropriate operation and safe installation of the devices and the locations of bird-deterrent devices would be included in the as-built documentation Dominion Energy must submit with the FDR.

Bats are not expected to regularly forage in the Lease Area but may be present during migration (BOEM 2012, 2020). During migration, bats may be attracted to the Offshore Project Components by lighted maintenance vessels, turbines, and substations. The primary potential impact of the Offshore Project Components to bats is mortality or injury resulting from collision with WTGs and, based on collision mortalities documented at terrestrial wind farms, all bats with potential to occur within the Lease Area are vulnerable to collision. In Europe, there is some evidence to suggest that bats forage over the surface of the ocean and, when foraging around obstacles (i.e., lighthouses and WTGs), they increase their altitude (Ahlén et al. 2009). In addition to foraging behavior, fatality risk in the offshore environment also may be influenced by flight height during migration. Bats migrating over the Baltic Sea have been observed frequently flying below 33 ft (10 m; Ahlén et al. 2009), and bats observed during ship-based surveys in the North Sea flew at heights between 16 and 66 ft (5 and 20 m; Lagerveld et al. 2014). Brabant et al. (2018) reported that offshore acoustic bat activity recorded at nacelle height is significantly less than at lower heights, although high-altitude flight offshore (particularly during migration) has been reported in the eastern U.S. (Hatch et al. 2013) and is likely a common occurrence elsewhere (Hüppop and Hill 2016). Fatality risk to offshore wind infrastructure also may be influenced by exploratory behavior around WTGs (Ahlén et. al. 2009), attraction to red aviation lighting (Voigt et al. 2018), and daytime roosting opportunities (Lagerveld et al. 2017).

The exposure of cave-hibernating bats to the Lease Area is expected to be minimal to low because cave-hibernating bats are rarely encountered offshore and would only occur on rare occasions during migration. Therefore, population-level impacts to cave-hibernating bats are unlikely during O&M of the Project. Furthermore, the Project is expected to pose little to no risk to federally listed individual NLEBs and Indiana bats offshore because these cave-hibernating species are highly unlikely to forage or migrate offshore.

Migratory tree bats have the potential to pass through the Lease Area, but overall, a small number of bats are expected in the Lease Area (BOEM 2020b) given its distance from shore (BOEM 2012). While there is evidence of bats visiting WTGs close to shore (2.5 to 4.3 mi [4 to 7 km]) in the Baltic Sea (enclosed by land; Ahlén et al. 2009; Rydell and Wickman 2015) and bats are demonstrated to be vulnerable to collisions, bats entering the Lease Area are expected to occur in low numbers (relative to the population), primarily during late summer/fall migration. Therefore, population-level impacts are unlikely.

Exposure of birds and bats to WTGs and Offshore Substations has been minimized by siting the Offshore Project Components in a Lease Area designated by BOEM as a Wind Energy Area (WEA). Dominion Energy would develop and obtain DOI concurrence on a post-construction avian and bat monitoring plan with clear goals, monitoring questions, and methods, including monitoring that focuses on areas of uncertainty such as bird and bat presence offshore. Dominion Energy would consider reducing collision risk through the use of cut-in speeds to avoid spinning blades during low wind conditions when birds and bats are likely to migrate.

Dominion Energy would submit annual monitoring reports to BOEM and BSEE after each full year of monitoring within 6 months of completion of the last avian survey. Dominion Energy would submit post-construction quarterly progress reports during the implementation of the avian and bat monitoring plan to BOEM and USFWS by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. During operations, Dominion Energy would submit to BOEM and BSEE an annual report with monthly operational data in tabular format. Dominion Energy will store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices, which will remain accessible to DOI and USFWS upon request for the duration of the Lease, and will work with BOEM to ensure the data are publicly available.

Dominion Energy would document any dead or injured birds or bats found on Project vessels or infrastructure (offshore and onshore) during construction, O&M, or decommissioning, in an annual report by January 31 of each year to BOEM and BSEE. The report will 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 will be reported to the USGS Bird Band Laboratory. Any occurrence of dead ESA birds or bats will 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.

Long-term displacement from the Lease Area due to presence of WTGs and Offshore Substations. Habitat displacement due to the presence of Offshore Project Components may affect birds (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Milman 2016). Non-marine migratory birds are not expected to be particularly vulnerable to displacement because these species are not using the offshore environment as a primary foraging area. Habitat displacement impacts also are unlikely for bats for the same reason.

Of the marine birds, sea ducks, particularly scoters, have been identified as being vulnerable to habitat displacement (Marine Management Organisation [MMO] 2018). Avoidance behavior to wind projects can lead to habitat displacement, resulting in effective habitat loss (Petersen and Fox 2007; Percival 2010; Langston 2013). However, for some species, this displacement may cease several years after construction (Petersen and Fox 2007; Leonhard et al. 2013). Due to a sensitivity to disturbance from boat traffic and a high habitat specialization, auks also are considered vulnerable to displacement (Furness et al. 2013; Dierschke et al. 2016; Wade et al. 2016). Similarly, loons are consistently identified as being vulnerable to displacement (Garthe and Hüppop 2004; Furness et al. 2013; MMO 2018;) because of a strong avoidance response, which can be initiated from as far away as 10 mi (16 km) from a wind energy facility (Mendel et al. 2019). Northern gannets are also considered to be vulnerable to displacement because studies indicate northern gannets actively avoid offshore wind developments in areas that would otherwise be favorable habitat (Krijgsveld et al. 2011; Cook et al. 2012; Hartman et al. 2012; Vanermen et al. 2015; Dierschke et al. 2016; Garthe et al. 2017).

Petrels, shearwaters, and storm-petrels are not generally considered vulnerable to habitat displacement (Furness et al. 2013), although this species group did receive a low-to-medium displacement score, and storm-petrels received a medium exposure score. However, since the MDAT models indicate storm-petrels are primarily concentrated along the OCS-break and in the Gulf of Maine, the birds are unlikely to be displaced from important foraging areas, and population-level impacts are unlikely. Jaegers and gulls generally rank low in vulnerability to displacement assessments (; Krijgsveld et al. 2011; Lindeboom et al. 2011; Furness et al. 2013). Displacement in terns is uncertain (Wade et al. 2016) because it has not been well studied, but terns have been shown to avoid smaller turbines at the Horns Rev facility (Petersen et al. 2006; Cook et al. 2012). Cormorants are not considered to be vulnerable to displacement, and while pelican interaction with offshore WTGs is not well studied, these species are expected to have limited exposure to the Lease Area and are not expected to be displaced from important foraging habitat. Overall, displacement is unlikely to cause population-level impacts because most seabirds would have limited exposure to the Lease Area.

Federally listed species (e.g., red knot, piping plover, and roseate tern), the protected golden and bald eagles, and the black-capped petrel, which is a candidate species, are expected to have limited exposure, and thus risk to individuals is unlikely. Furthermore, these birds would only be passing through the Lease Area during migration and would not be expected to be displaced from important foraging areas. Dominion Energy would limit risks of long-term displacement of offshore bird species to the extent practicable.

Long-term attraction to and displacement from Project-related maintenance vessels. The presence of maintenance vessels and associated activities may temporarily displace birds or pose a collision hazard. However, impacts to populations of non-listed species and individual federally listed species are unlikely because each maintenance activity would be limited in duration. Bats may be attracted to maintenance vessels servicing the Offshore Project Components, particularly if insects are drawn to the lights of the vessels; as discussed above, bats, including federally listed species, are not likely to collide with vessels. Potential impacts would be further minimized by reducing lighting on O&M vessels, to the extent practicable.

Long-term risk of collision with overhead Interconnection Cables. The Interconnection Cable Route would include new 230-kV overhead cables, which have the potential to create collision and electrocution hazard for birds (Loss et al. 2014; Bevanger 1994); can reduce breeding performance (Janiszewski et al. 2015); and create a barrier effect between habitats (Benítez-López et al. 2010). Overhead transmission lines are generally not considered a hazard for bats (including federally listed species). Dominion Energy would reduce potential impacts of the overhead lines by complying with Avian Power Line Interaction Committee (APLIC)[2] best practices to reduce collision and electrocution to the extent practicable.

Long-term displacement from onshore habitat at Onshore Project Components. As described above in construction impacts, the conversion of previously undisturbed habitat is expected to cause long-term displacement of bats (including listed species) and potential long-term displacement of SGCN birds. Potential impacts would be reduced through mitigation measures described below.

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[2] https://www.aplic.org/

During O&M, the planned long-term maintenance activities have the potential to cause temporary habitat modification (e.g., ground disturbance), but disturbance would generally be similar to or less than the construction of the overhead Interconnection Cables (i.e., would impact smaller areas for short durations and maintain already cleared areas, rather than newly cleared areas). Overhead transmission lines are generally not considered a hazard for bats. Some bird species that use open or shrubland habitats could benefit from the habitat conditions created by the proposed Project in the maintained ROWs. Thus, onshore O&M activities are not expected to have any specific long-term impacts.

Decommissioning

Impacts from decommissioning the Project are expected to be similar to or less than those experienced during construction. Decommissioning techniques are expected to advance during the lifetime of the Project. A full decommissioning plan will be provided to the appropriate regulatory agencies for approval prior to decommissioning activities, and potential impacts will be re-evaluated at that time.

4.2.3.3 Summary of Avoidance, Minimization, and Mitigation Measures

Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate the potential impact-producing factors described (Table 4.2-13). Dominion Energy will continue discussions and engagement with the appropriate regulatory agencies throughout the life of the Project to develop an adaptive mitigation approach that provides the most flexible and protective mitigation measures.

Table 4.2-13. Summary of Avoidance, Minimization, and Mitigation Measures

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
Construction; Decommissioning	Offshore Project Area	Short-term attraction to, and potential collision with, Project-related vessels and partially installed Offshore Project Components Short-term disturbance of, and displacement from, offshore habitat	• Dominion Energy would develop avoidance and minimization measures in coordination with the Virginia Department of Wildlife Resources (VDWR), the U.S. Fish and Wildlife Service (USFWS), the Bureau of Ocean Energy Management (BOEM), and appropriate regulatory agencies to ensure protection of threatened and endangered species or to address the potential for incidental take that may occur within the Project Area; • To mitigate impacts from lighting, Dominion Energy would use best management practices (BMPs) identified by BOEM's Construction and Operations Plan (COP) guidelines (BOEM 2020c) and would comply with Federal Aviation Administration (FAA) and U.S. Coast Guard (USCG) requirements for lighting while, to the extent practicable, using lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian and bat species; • Dominion Energy would document any dead or injured birds or bats found on Project vessels or structures during the construction stage of the Project and would submit an annual report to BOEM and the USFWS; and • Dominion Energy would develop and obtain DOI concurrence on an avian and bat monitoring program during construction with clear goals, monitoring questions, and methods, including monitoring that focuses on

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
			areas of uncertainty such as bird and bat presence offshore.
	Onshore Project Area	Disturbance of, and displacement from, onshore habitat	• Dominion Energy would avoid potential effects to birds and bats by using trenchless installation techniques in coastal areas at the Cable Landing Location; collocating the Onshore Export Cable Route with existing roads as much as possible; and timing construction activities to avoid critical periods when endangered and threatened species may be affected to the extent practicable; • The Harpers or Chicory Switching Stations would be constructed within either previously developed areas associated with an existing golf course or small areas of mixed forest and woody wetland. Some tree and vegetation clearing will be required, but will be minimized to the extent practicable; • To the extent practicable, Dominion Energy would collocate the Interconnection Cable Route within or adjacent to existing transmission line corridors and rights-of-way, timing construction activities to avoid critical periods when endangered and threatened species may be affected; • Tree/vegetation clearing would avoid trees favorable for bat maternity roosting locations and would be conducted outside of the breeding/roosting season to avoid nesting birds and bat maternity roosting locations to the extent practicable; • Dominion Energy conducted presence/absence surveys for bats (acoustic and/or mist-net) along the Onshore Project Area during summer 2022, pursuant to discussions with VDWR, USFWS, and appropriate regulatory agencies ; • Dominion Energy conducted an eagle/osprey/raptor/owl nest survey along the Interconnection Cable Route in March 2022 along the Onshore Project Area, pursuant to discussions with VDWR, USFWS, and appropriate regulatory agencies; • Where surveys indicate the presence of species of conservation concern, Dominion Energy would work with the VDWR and USFWS to minimize potential impacts prior to construction; • Dominion Energy would maintain a minimum no-tree-clearing buffer of 150 ft (45 m) around any known NLEB maternity roosts; • Dominion Energy would develop avoidance and minimization measures in coordination with the VDWR, USFWS, and appropriate regulatory agencies to ensure protection of threatened and endangered species or to address the potential for incidental take that may occur within the Project Area; and • Dominion Energy would ensure avoidance, minimization, and mitigation measures

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
			protective of wetlands, vegetation, and other wildlife species discussed in Section 4.2.1, Wetlands and Waterbodies, and Section 4.2.2, Terrestrial Vegetation and wildlife, and also would be protective of bird and bat species and their habitats.
Operations and Maintenance	Offshore Project Area	Long-term risk of collision with Wind Turbine Generators (WTGs) and Offshore Substations Long-term displacement from the Lease Area due to presence of WTGs and Offshore Substations Long-term attraction to and displacement from Project-related maintenance vessels	• To mitigate the potential for collision with WTGs and Offshore Substations during O&M stage of the Project, Dominion Energy would use BMPs identified by BOEM's COP guidelines (BOEM 2020c) 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. Additionally, while not required by FAA guidance, Dominion Energy will implement an Aircraft Detection Lighting System (ADLS) to minimize the number of hours/day aviation lighting is in full effect; • To continue the advancement of the understanding of avian and bat activity in the offshore environment, Dominion Energy will continue operation of one Acoustic Thermographic Offshore Monitoring system (ATOMTM) two additional years to inform the development of the CVOW Commercial Project as the CVOW Pilot WTGs are installed adjacent to the west side of the CVOW Commercial lease; • Dominion Energy will provide Motus Wildlife Tracking tags to the USFWS, which is currently studying the movements of piping plovers in the region. The specific deployment location will be determined in consultation with the USFWS; • Dominion Energy will purchase Satellite Tags to be attached to Rufa red knots (*Calidris canutus*; rufa subspecies). These tags will provide accurate data on Rufa red knot movements onshore, offshore, and flight heights that can be related to weather data. The deployment location will be determined in consultation with USFWS; • Dominion Energy will fund a research project to study the Whimbrel (*Numenius phaeopus*). This study will be implemented by The Nature Conservancy and Center for Conservation Biology, and will include purchasing Satellite Tags, The Nature Conservancy and Center for Conservation Biology staff time associated with project implementation including data analysis, seasonal staff capacity to implement field work, seasonal housing and travel costs, field supplies, and tagging technology; • Dominion Energy plans to upgrade the current Motus network/antennas on both CVOW Pilot WTG platforms to a "dual-mode" (166 and 434 MHz) system with one station prioritized for 434 MHz and the other prioritized for 166 MHz in accordance with the updated USFWS

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
			guidance document. This antenna upgrade will increase the monitoring range from approximately 2 kilometers to approximately 15 kilometers and will remain in place for 2 years; • Dominion Energy would use bird-deterrent devices during construction and operation to minimize attracting birds to operating turbines and offshore substations. The quantity, location, and type of bird-deterrent devices would be based on BMPs applicable to the appropriate operation and safe installation of the devices, and the locations of bird-deterrent devices would be included in the as-built documentation Dominion Energy must submit with the FDR; • Dominion Energy would develop and obtain DOI concurrence on a post-construction monitoring plan with clear goals, monitoring questions, and methods, including monitoring that focuses on areas of uncertainty such as bird and bat presence offshore; • Dominion Energy would install automated radio telemetry receiver stations (i.e., Motus towers) on select offshore structures; • Dominion Energy would document any dead or injured birds or bats found on Project vessels or infrastructure (offshore and onshore) during construction, O&M, or decommissioning, in an annual report by January 31 of each year to BOEM and the USFWS; and • Potential impacts would be further minimized by reducing lighting on O&M vessels to the extent practicable.
	Onshore Project Area	Long-term risk of collision with overhead Interconnection Cables	• Dominion Energy would reduce potential impacts of the overhead lines by complying with Avian Power Line Interaction Committee (https://www.aplic.org/) best practices to reduce collision and electrocution.
		Long-term displacement from onshore habitat at Onshore Project Components	

4.2.4 Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat

This section describes the marine habitats and species known or expected to occur within and surrounding the Offshore Project Area. Potential impacts of construction, O&M, and decommissioning of the Project on benthic resources (on and within the seafloor) and pelagic resources (in open waters from seafloor to sea surface) are discussed. This section also describes avoidance and minimization, and, as necessary, mitigation measures proposed by Dominion Energy.

This section of the COP draws on other assessments relevant to benthic and pelagic resources, including but not limited to the sections and appendices below:

- Physical and Oceanographic Conditions (Section 4.1.1);
- Water Quality (Section 4.1.2);
- Commercial and Recreational Fishing (Section 4.4.6);
- Marine Transportation and Navigation (Section 4.4.7);
- Public Health and Safety (Section 4.4.12);
- Marine Site Investigation Report (Appendix C);
- Benthic Resource Characterization Report (Appendix D);
- Essential Fish Habitat Assessment (Appendix E);
- Sediment Transport Analysis (Appendix J);
- Oil Spill Response Plan (Appendix Q);
- Underwater Acoustic Assessment (Appendix Z);
- Offshore Electric and Magnetic Field Assessment (Appendix AA);
- Fisheries Mitigation and Monitoring Plan (Appendix V-2); and
- Construction Mitigation and Monitoring Plan (Appendix FF).

The Offshore Project Area includes the 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, O&M, and decommissioning of the Project (see Section 1, Introduction). The Commonwealth of Virginia has jurisdiction over state and tidal waters within 3 nm (5.6 km) of shore. The VMRC manages fisheries in these waters and shares responsibility for some managed species with the NOAA Fisheries and/or the Atlantic States Marine Fisheries Commission (ASMFC).

NOAA Fisheries and Fishery Management Councils created under the Magnuson-Stevens Fisheries Conservation and Management Act jointly manage fishery resources in the federal portion of the Offshore Project Area. Relevant Fishery Management Councils include the Mid-Atlantic Fishery Management Council (MAFMC) and the South Atlantic Fishery Management Council (SAFMC), which regulate commercially and recreationally valuable species and stocks through fishery management plans (FMPs) and designate essential fish habitat (EFH) and habitat areas of particular concern (HAPC). Seafloor, water, and sediment-water interfaces necessary for spawning, breeding, growth, and maturity are designated as EFH (16 U.S.C. §1802[10]). Jurisdiction is determined by species rather than location, as fish cross administrative boundaries (see Table 4.2-16).

This section was prepared in accordance with BOEM's site characterization requirements in 30 CFR § 585.626; BOEM's *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019a); and BOEM's *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019b).

Data required to complete this analysis were taken from publicly available sources and engagement with local commercial and recreational fishermen (described further in Section 4.4.6, Commercial and Recreational Fishing). In addition, Dominion Energy performed an initial benthic reconnaissance survey in August 2020 to support preliminary characterization of benthic resources in the entire Lease Area and a large portion of the Offshore Export Cable Route Corridor. Sediment grab samples and drop-down video images were collected along the Offshore Export Cable Route Corridor and within the Lease Area (see Appendix D, Benthic Resource Characterization Report). The results of the HRG surveys were used to develop the habitat characterization maps included in Appendix E, EFH Assessment, which documents no evidence of complex or biogenic habitat within the Offshore Project Area, based on the criteria in the NOAA Fisheries (2021a) recommendations.

4.2.4.1 Preliminary Resource Characterization

To support the characterization of fish and invertebrate resources, Dominion Energy conducted full-coverage site-specific surveys and compiled data from publicly available sources, including:

- EPA 2012 (National Coastal Condition Report IV);
- Federal Register; NOAA Fisheries 2018 (Commercial Fisheries Landings);
- NOAA Fisheries 2020a (EFH Mapper);
- VDEQ 2020 (Water Quality Assessment Integrated Report);
- Fisheries Management Plans and Stock Status Reports (sourced from ASMFC, MAFMC, North Carolina Department of Environmental Quality, North Carolina Division of Marine Fisheries, North Carolina Wildlife Resources Commission, NOAA Fisheries, and SAFMC);
- Regional resource reports and surveys (e.g., Guida et al. 2017; Northeast Fishery Science Center [NEFSC] 2020a, b); and
- Peer-reviewed literature.

Dominion Energy's site-specific benthic, geophysical, and geotechnical surveys, which commenced in April 2020 and were completed in August 2021, covered the entire Lease Area and the Offshore Export Cable Route Corridor.

A site-specific geophysical survey was used to support the characterization of seabed conditions within the entire Lease Area and the Offshore Export Cable Route Corridor, provided in Appendix C, Marine Site Investigation Report. Sediment grab samples were analyzed for gain size distribution, total organic carbon, and benthic infauna (identified and classified according to the Coastal and Marine Ecological Classification Standard [FGDC 2012]). Digital imagery was reviewed to characterize key habitat types, macroinvertebrates, and fishes. Details of the benthic survey campaign is provided in Appendix D, Benthic Resource Characterization Report and are available for viewing on the CVOW EFH Assessment Web Application (Tetra Tech 2021).

Dominion Energy augmented site-specific geophysical, geotechnical, and benthic surveys with data collected by federal and state fisheries agencies, expert reviews, reports from commercial and recreational fishing representatives, and the NOAA Fisheries EFH Mapper tool and source documents to characterize the distribution and relative abundance of fishes and invertebrates in the Offshore Project Area:

- Beam trawls and grab samples summarized by BOEM for preliminary habitat characterization (Guida et al. 2017);
- NEFSC seasonal trawls and beam trawls (2003–2020); and
- Other regionally specific reports and publications.

Dominion Energy reviewed available fisheries, fish habitat, and non-fisheries datasets, surveys, and reports (e.g., FMPs, Stock Status Reports, regional analyses of species assemblages) to identify key species and life stages of fishes and invertebrates potentially occurring in the Offshore Project Area.

4.2.4.2 Affected Environment

The coastal and offshore waters of the Offshore Project Area include benthic and pelagic habitat where plankton, benthic invertebrates, and fishes could be directly or indirectly affected by the construction, O&M, and decommissioning of the Project. This assessment excludes existing ports and construction and staging areas where activities similar to those for the Project are already permitted.

Species assemblages expected to occur in the Offshore Project Area are those characteristic of the Mid-Atlantic Bight; in addition, historically southern species are reported to be expanding northward in Virginia's offshore waters in response to increased sea temperatures and a northwest shift in the Gulf Stream (Pinsky et al. 2013; Andres 2016). Dominion Energy's site-specific occurrence data is augmented by recent regional reports and published literature to characterize benthic and pelagic resources known or expected to occur in the Offshore Project Area.

Fishes and macroinvertebrates managed under the Magnuson-Stevens Fisheries Conservation and Management Act or other fishery programs occur throughout the Offshore Project Area. The entire area is mostly designated as EFH for at least one species or life stage. Additional information on designated EFH for managed species is provided in Appendix E, EFH Assessment.

This section describes baseline conditions of benthic and pelagic resources in the Offshore Project Area, as follows:

- Baseline conditions, including typical habitats and life stages of species known or expected to occur;
- Fishes and macroinvertebrates;
- T&E species; and
- Effects of climate change on the distributions of fishes and invertebrates in the region.

Benthic and Pelagic Habitats

Benthic Habitat

The marine benthic environment consists of all seafloor substrates, physical features, and associated organisms (i.e., infauna burrowed into seafloor sediments and epifauna living atop substrate surfaces) on the continental shelf beginning at the shoreline (BOEM 2014). The softbottom sediments off the Virginia coast are reflective of the rest of the Mid-Atlantic Bight, characterized by fine sand and punctuated by gravel and silt/sand mixes (Milliman 1972; Steimle and Zetlin 2000). Offshore Project Area substrates are consistent with this regional pattern and include unconsolidated sediments composed of gravel (greater than 2,000 micrometers [µm]), sand (62.5–2000 µm), silt (4–62.5 µm), clay (less than 4 µm), and shell debris (Williams et al. 2006). Physical processes generate benthic features at various spatial scales, including large shoals, medium sand waves, and smaller sand ripples (McBride and Moslow 1991). The complex interplay between latitude, water depth, prevailing currents, wave energy, and proximity to river discharge influences the existence, shape, and size of these habitat-forming features. Such features influence benthic and demersal (i.e., associated with the seafloor) species distributions and are therefore essential to understanding community assemblages in the Offshore Project Area (Diaz et al. 2003; Scharf et al. 2006; Slacum et al. 2006).

During August 2020, Dominion Energy conducted a reconnaissance-level benthic survey consisting of towed video and grab samples to characterize the benthic habitat, organisms, and water quality within the entire Lease Area and a large portion of the Offshore Export Cable Route Corridor. An underwater camera system (digital color video and time-lapse still photos in oblique and plan-view orientation) was mounted to a frame, scaling laser, and lighting as shown in Figure 4.2-10. There was also a time-lapse still image camera fixed to the 0.04 m^2 Young-modified Van Veen grab sampler.

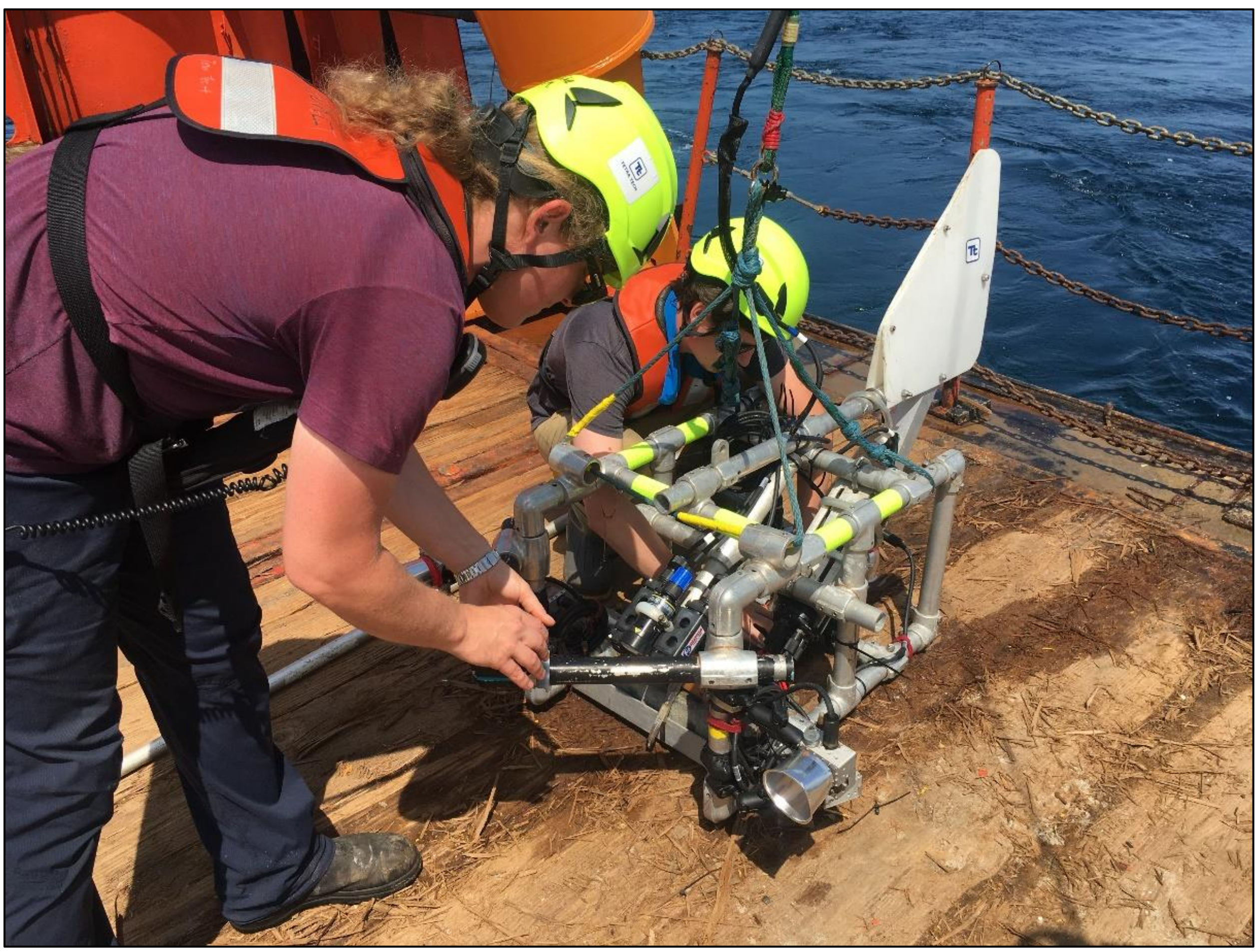

Figure 4.2-10. Towed Video Frame Used During the Survey, Equipped with Cameras and Lighting

Dominion Energy's benthic survey included 74 benthic grab sample sites; 50 with collocated 1,969-ft (600-m) towed video transects. Footage along these transects includes continuous video and high-resolution still photos collected by forward and downward-facing cameras. Images were analyzed for benthic habitat and demersal species characterization. The grab samples were processed for grain size, total organic content, and benthic infauna (sieved through a 500 µm sieve), as described in Tetra Tech (2020). Sample stations within the Lease Area and Offshore Export Cable Route Corridor are shown in Figure 4.2-11 and Figure 4.2-12. The maps include locations from prior surveys (including the CVOW Pilot Project, formerly VOWTAP). Because of their proximity to/presence within the Project, these data were used to characterize the benthic resources of the Offshore Project Area. Grain size data from Dominion Energy's grab samples are summarized in Figure 4.2-13. Extensive seabed characterization was conducted as part of the Marine Site Investigation Report (Appendix C), with further habitat classification as part of the EFH Assessment (Appendix E), including CMECS habitat maps.

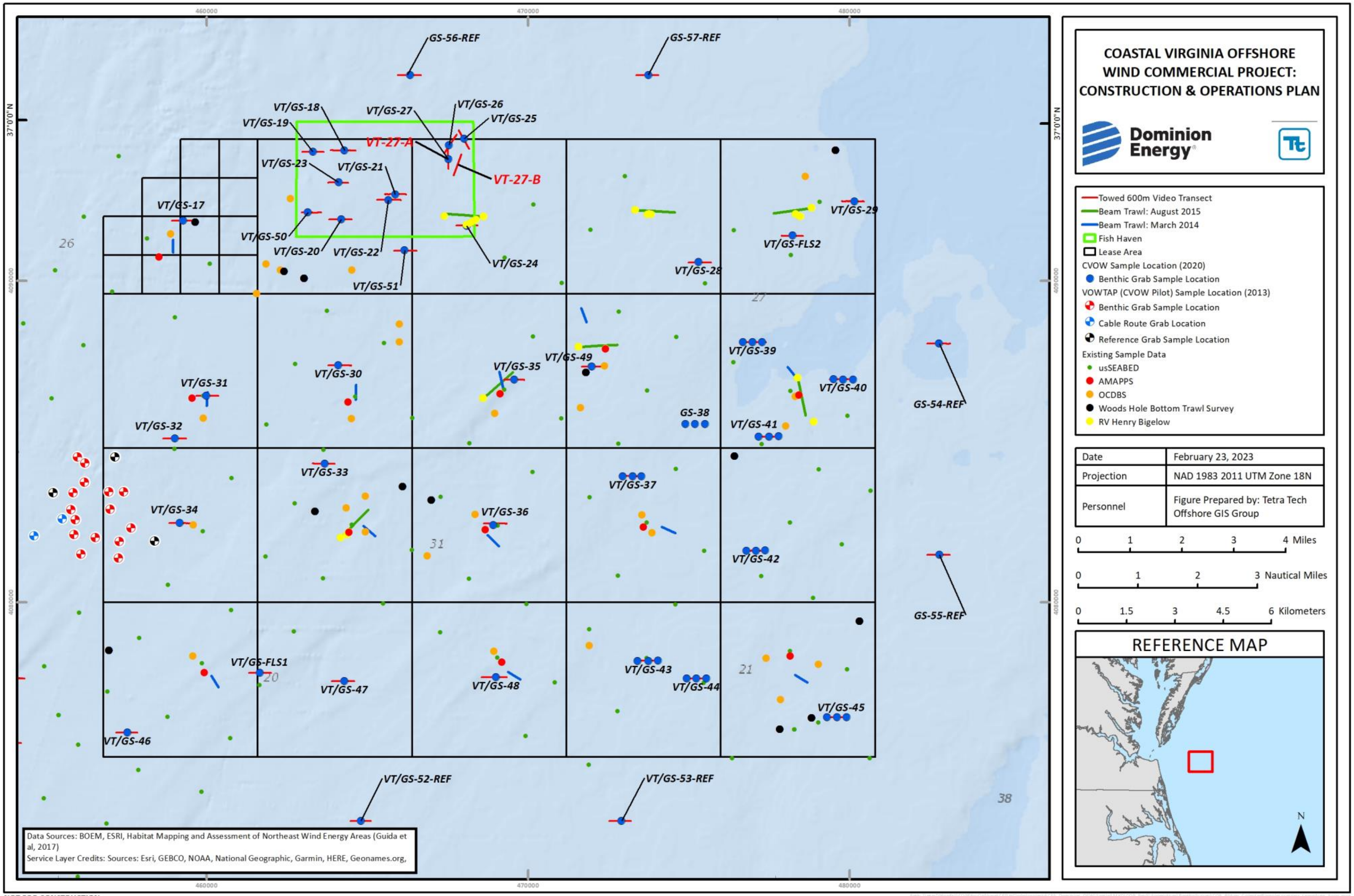

Figure 4.2-11. 2020 Benthic Survey Locations and Prior Survey Locations Relevant to the Project—Lease Area

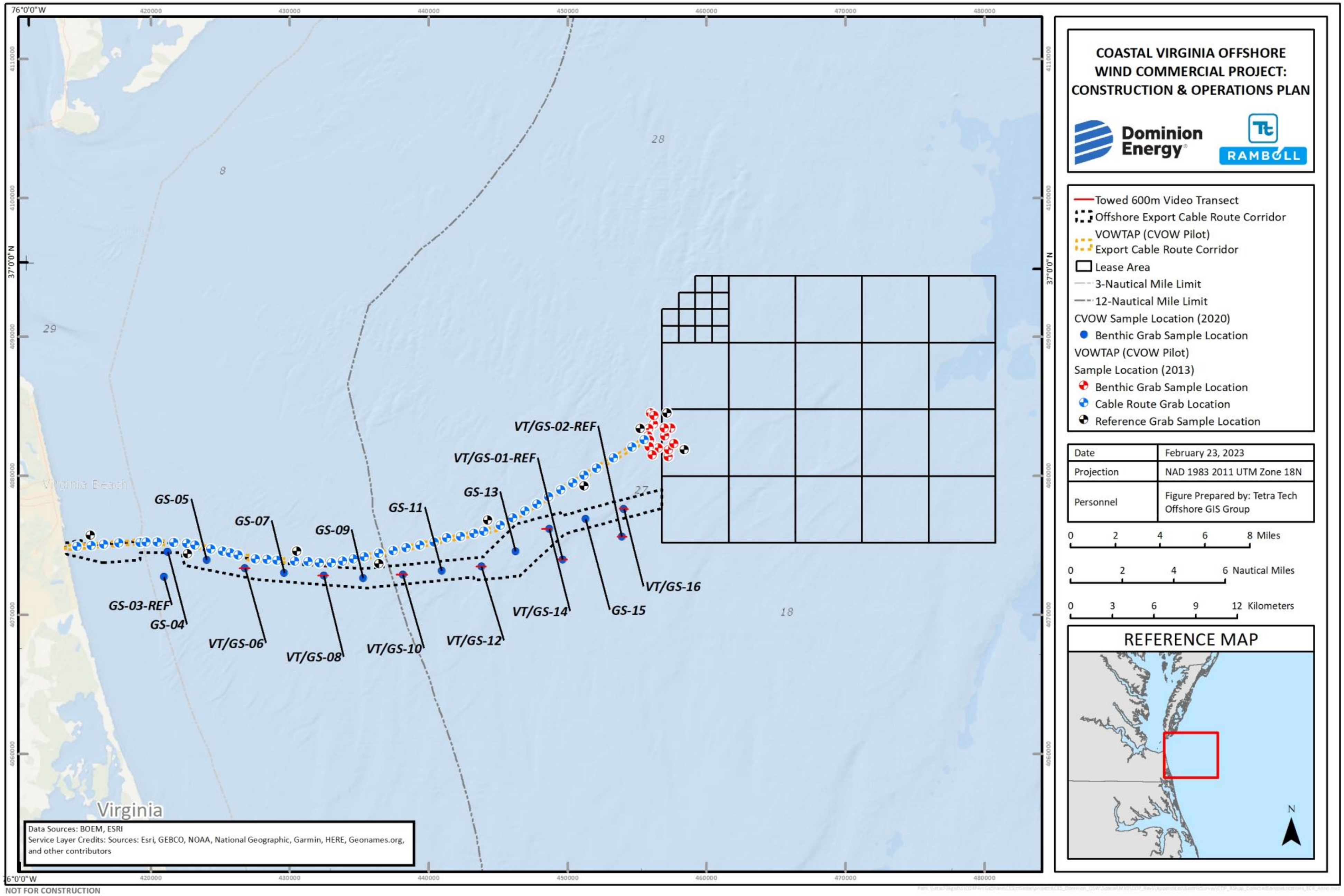

Figure 4.2-12. 2020 Benthic Survey Locations and Prior Survey (CVOW Pilot Project) Locations Relevant to the Project—Offshore Export Cable Route Corridor

Note: Grey-shaded locations inside the red-outlined box on the left side of the graph are from the Offshore Export Cable Route Corridor; others are from the Lease Area.

Figure 4.2-13. Distribution of Grain Sizes—All Samples

Video footage and still images were analyzed from the towed video transects and grab sample locations. From these images, a total of 26 taxa were identified (Table 4.2-14 and Figure 4.2-14). The lion's mane jellyfish (*Cyanea capillata*) was present in the greatest number of transects (96.0 percent of all survey transects), followed by the sand dollar (*Echinarachnius parma*) (58.0 percent of transects) and northern searobin (*Prionotus carolinus*) (28.0 percent of transects). Presence of sand tracks, Naticid egg collars, Rajid egg cases, Cephalopod egg mops, burrows, mounds, and siphon holes provided further evidence of benthic activity throughout the Offshore Project Area.

Table 4.2-14. Summary of Organisms Observed in Video Transect Imagery (ranked by percent presence)

Organism	Scientific Name	Common Name	Transects Containing Organisms				Percent Presence in Transects
			Lease Area		Offshore Export Cable Route Corridor		
			Samples	References	Samples	References	
Cnidarian	*Cyanea capillata*	lion's mane jellyfish	35	5	6	2	96.0%
Echinoderm	*Echinarachnius parma*	sand dollar	19	5	4	1	58.0%
Fish	*Prionotus carolinus*	northern sea robin	12	2	5	1	28.0%
Fish	*Anchoa mitchilli*	bay anchovy	8	0	1	0	18.0%
Fish	*Urophycis regia*	spotted hake	8	0	1	0	18.0%
Arthropod	*Cancer irroratus*	Atlantic rock crab	7	0	1	0	14.0%
Echinoderm	*Echinoida* sp.	urchin	6	1	1	0	14.0%
Echinoderm	*Asteroidea* sp.	sea star	7	0	0	0	14.0%
Mollusk	*Neverita lewisii*	moon snail	4	1	0	0	10.0%
Fish	*Centropristis striata*	black sea bass	4	0	0	0	8.0%
Arthropod	*Libinia emarginata*	spider crab	4	0	0	0	8.0%
Fish	*Micrpogonias undulatus*	Atlantic croaker	3	0	1	0	8.0%
Fish	*Ammodytes americanus*	sand lance	3	0	0	0	6.0%
Cnidarian	*Aurelia aurita*	moon jellyfish	3	0	0	0	6.0%
Mollusk	*Busycon carica*	whelk	2	0	1	0	6.0%
Arthropod	*Limulus polyphemus*	horseshoe crab	2	0	1	0	6.0%
Fish	*Raja eglanteria*	clearnose skate	3	0	0	0	6.0%
Fish	*Trichiurus lepturus*	cutlassfish	2	0	1	0	6.0%
Ctenophore	*Beroe ovata*	comb jellyfish	2	0	0	0	4.0%
Arthropod	*Coenobitidae* sp.	hermit crab	2	0	0	0	4.0%
Arthropod	*Ovalipes ocellatus*	lady crab	2	0	0	0	4.0%
Fish	*Peprilus triacanthus*	Atlantic butterfish	2	0	0	0	4.0%

Organism	Scientific Name	Common Name	Transects Containing Organisms				Percent Presence in Transects
			Lease Area		Offshore Export Cable Route Corridor		
			Samples	References	Samples	References	
Fish	*Lagodon rhomboides*	pinfish	1	0	0	0	2.0%
Mollusk	*Mercenaria mercenaria*	quahog	0	0	1	0	2.0%
Mollusk	*Mytilus edulis*	blue mussel	0	0	1	0	2.0%
Fish	*Stenotomus chrysops*	scup	1	0	0	0	2.0%

An EXO2® water quality sonde was fixed to the grab sampler for the duration of the survey and collected continuous data during each drop/retrieval at each grab sample station. Each of the parameters measured were within expected ranges for the Mid-Atlantic Bight. Table 4.2-15 summarizes the water quality parameters, standardized to a depth of 62.3 ft (19 m), which represented the near-bottom portion of the water column, without influence of the grab sampler interacting with the seafloor.

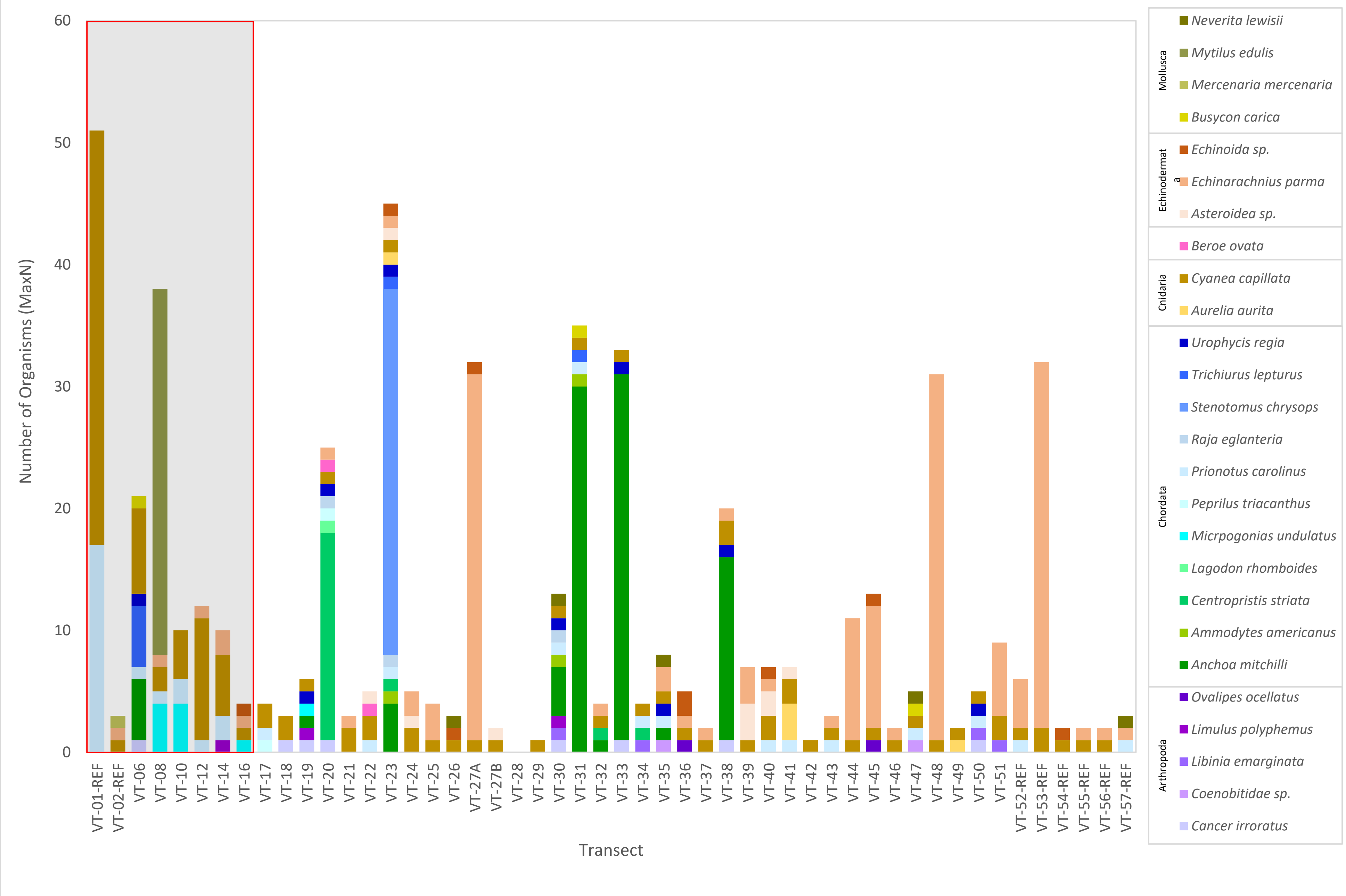

Figure 4.2-14. Demersal and Organisms Observed in 600-m Towed Video Transects

Note: Grey-shaded locations in the red box on the left side of the graph are from the Offshore Export Cable Route Corridor; others are from the Lease Area; no images are available at VT03 and VT04 due to turbidity.

Table 4.2-15. Summary of Water Quality Parameters in the Lease Area and a large portion of the Offshore Export Cable Route Corridor Measured at 19 m Depth (or near-bottom) during the Benthic Survey

Water Quality Parameter	Mean	Minimum	Maximum
Temp (°C)	15.2	12.6	19.2
Salinity (PSU)	32.4	31.9	32.8
Dissolved Oxygen (mg/L)	8.1	6.7	8.7
Dissolved Oxygen (% sat)	99.1	86.9	101.8
pH	7.98	7.83	8.04

Prior to these surveys, Dominion Energy conducted geophysical and benthic surveys within the CVOW Pilot Project Research Lease Area directly adjacent to the Offshore Project Area (Tetra Tech 2015). Hard-bottom substrates and structured reefs are rare in the Mid-Atlantic Bight and both habitat types were absent from the CVOW Pilot Project Research Lease Area surveys. Geophysical data and underwater imagery analysis identified exclusively softbottom habitats within this area as corroborated by the 2020 Benthic Survey results. However, artificial reef habitat does occur in the northern portion of the Lease Area (Fish Haven), as well as charted shipwrecks that function as artificial reef habitat in other locations of the Offshore Project Area and adjacent waters (Figure 4.2-15). Triangle Reef consists of several large, scuttled World War II-era ships (tankers and transport ships), tires, cable spools, and other materials within the Fish Haven since the 1970s to facilitate an artificial reef development within the Fish Haven (Lucy 1983; VMRC 2020a). See Appendix F, Marine Archaeological Resources Assessment for information on shipwrecks identified within the Lease Area and Offshore Export Cable Route Corridor.

Sand ridges are common in the Mid-Atlantic Bight and are often covered with smaller similar forms, such as sand waves, megaripples, and ripples (Figure 4.2-16), see Appendix C, Marine Site Investigation Report and Appendix E, EFH Assessment). Such features identified within both the CVOW Pilot Project Research Lease Area and the present Offshore Project Area provide habitat for benthic infaunal organisms typical of this region. The dominant benthic infauna within the CVOW Pilot Project Research Lease 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, representing approximately 66 percent of the total. Annelids were second in total biomass of the combined dataset (17 percent), and crustaceans represented approximately 11 percent of the combined total biomass (Tetra Tech 2015).

Numerous sources report that the Offshore Project Area is dominated by fine sand and coarse sand, with isolated patches of mud in the center and to the west and gravel to the east (Cutter and Diaz 1998; Greene et al. 2010; Fugro 2013; Guida et al. 2017). The lack of natural hard substrate within the Offshore Project Area is further supported by the results of previous hydrographic surveys in this region (Poppe et al. 2005). The Offshore Project Area bottom topography is characterized by a sedimentary fan, shelf valley tributaries to the north and east, and a series of sand ridges trending northeast-southwest (Guida et al. 2017). The slopes in the Offshore Project Area match these observed ridge and depression patterns and generally fall within 1.2 degrees, while rugosity is virtually zero throughout the area (Guida et al. 2017).

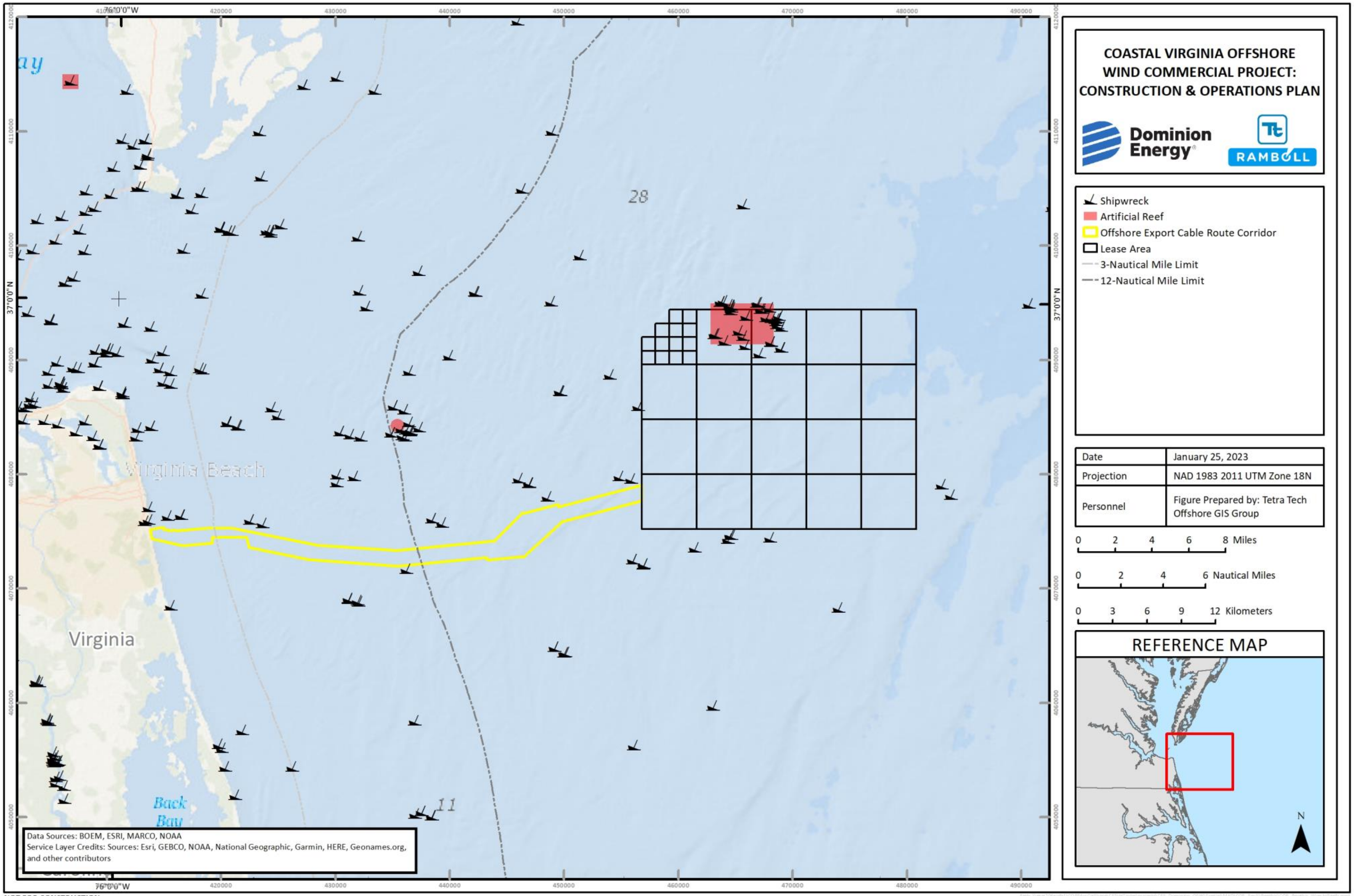

Figure 4.2-15. Charted Shipwrecks and Artificial Reefs in the Offshore Project Area

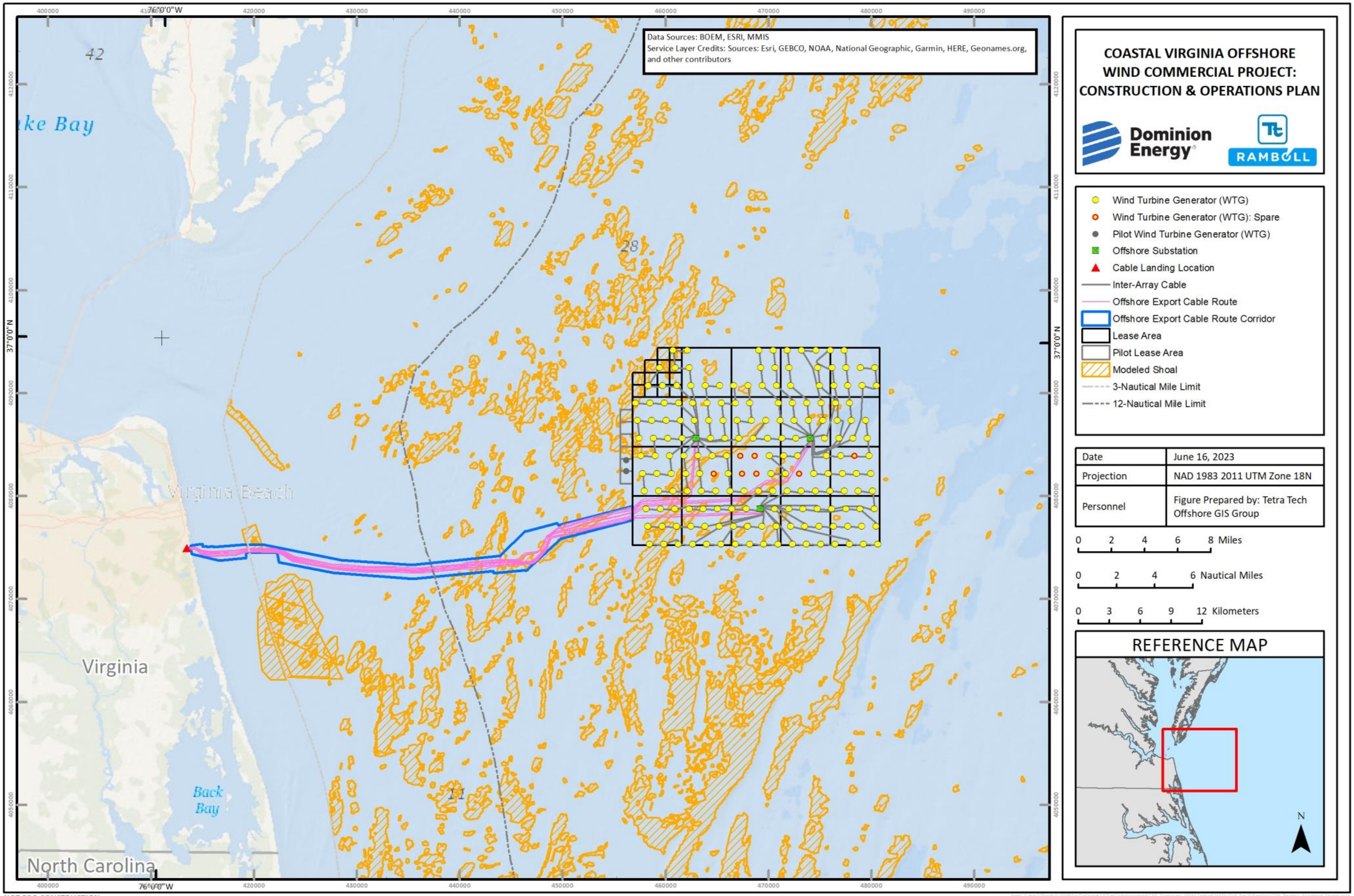

Figure 4.2-16. Modeled Shoals in the Offshore Project Area

The primary morphological features of the Mid-Atlantic Bight shelf include shoal massifs, scarps, sand ridges, and swales. Sand waves primarily occur on the inner shelf, often on the sides of sand ridges. Ripples and megaripples are perhaps the most dynamic of these sand formations and occur on sand waves or separately on the inner or central shelf. Megaripples tend to survive for less than a season; they can quickly form during a storm and reshape the upper 19.6 in to 39.4 in (50 cm to 100 cm) of the sediments within a few hours. Ripples, which usually have lengths of about 0.4 in to 59 in (1 cm to 150 cm) and heights of a few centimeters, also are found everywhere on the shelf and appear or disappear within hours or days, depending upon storms and currents (BOEM 2014).

The sandy sediments within the Mid-Atlantic Bight support a diverse fauna dominated by polychaete species and, to a lesser extent, mollusks and arthropods (BOEM 2014). Benthic community analyses in the Offshore Project Area varied by season. Epifaunal communities were defined by dwarf surfclams (*Milunia lateralis*), sand shrimp (*Crangon septemspinosa*), and unclassified snails in March surveys and calico scallops (*Argopecten gibbus*), dwarf warty sea slugs (*Pleurobranchaea bubala*), longclaw hermit crabs (*Pagurus longicarpus*), and New England dog whelk snails (*Nassarius trivittatus*) in August surveys (Guida et al. 2017). Infaunal communities were defined by polychaetes and oligochaetes in March surveys and a variety of taxa in August surveys (Guida et al. 2017). Across both survey seasons, communities were largely composed of non-core taxa (i.e., taxa not occurring in 80 percent of samples), suggesting high infaunal diversity (Guida et al. 2017). These findings are consistent with the conclusions of older published reports on benthic infauna in coastal and offshore Virginia waters (Cutter and Diaz 1998; Diaz et al. 2006). Representative images from Dominion Energy's benthic survey are shown in Figure 4.2-17.

Pelagic Habitat

Pelagic habitats are characterized by physical parameters such as depth, distance from shore, light penetration, temperature, and turbidity. For example, the photic zone falls within the top 650 ft (200 m) of ocean where sunlight penetrates the water column. This zone strongly influences benthic habitats by supporting photosynthetic phytoplankton (e.g., diatoms, dinoflagellates), planktonic eggs and larvae of demersal species, and all life stages of planktivorous species (NOAA Fisheries 2017). Physiochemical conditions including dissolved oxygen, currents, pH, and temperature further influence the occurrence and abundance of these marine species (Pineda et al. 2007). Such conditions in the Offshore Project Area are described in Section 4.1.1, Physical and Oceanographic Conditions, and summarized here.

Current patterns, local weather, broad climactic events, and anthropogenic activities can influence dynamic water quality parameters such as conductivity, dissolved oxygen, and pH (see Section 4.1.2, Water Quality). Light penetration, temperature, and similar parameters generally covary with depth, although these relationships may not be linear. Nearshore conditions such as winds, and tidal action influence inner shelf waters (60–100 ft [18–30 m]), while intermediate shelf waters (100–160 ft [30–50 m]) are mostly wind driven and shelf edges (160–330 ft [50–100 m]) are influenced primarily by the southbound Labrador Current and northwest Gulf Stream (Lee et al. 1981; Atkinson and Targett 1983).

NEFSC seasonal trawl CTD data (i.e., conductivity, temperature, and depth data gathered by a sonde instrument) collected from 2003 to 2016 were used to generate water column salinity profiles within the Lease Area (Guida et al. 2017). Salinity was consistently recorded within the euhaline range (29.8-34.0 grams/kilogram), indicating relative stability of this habitat feature (Guida et al. 2017).

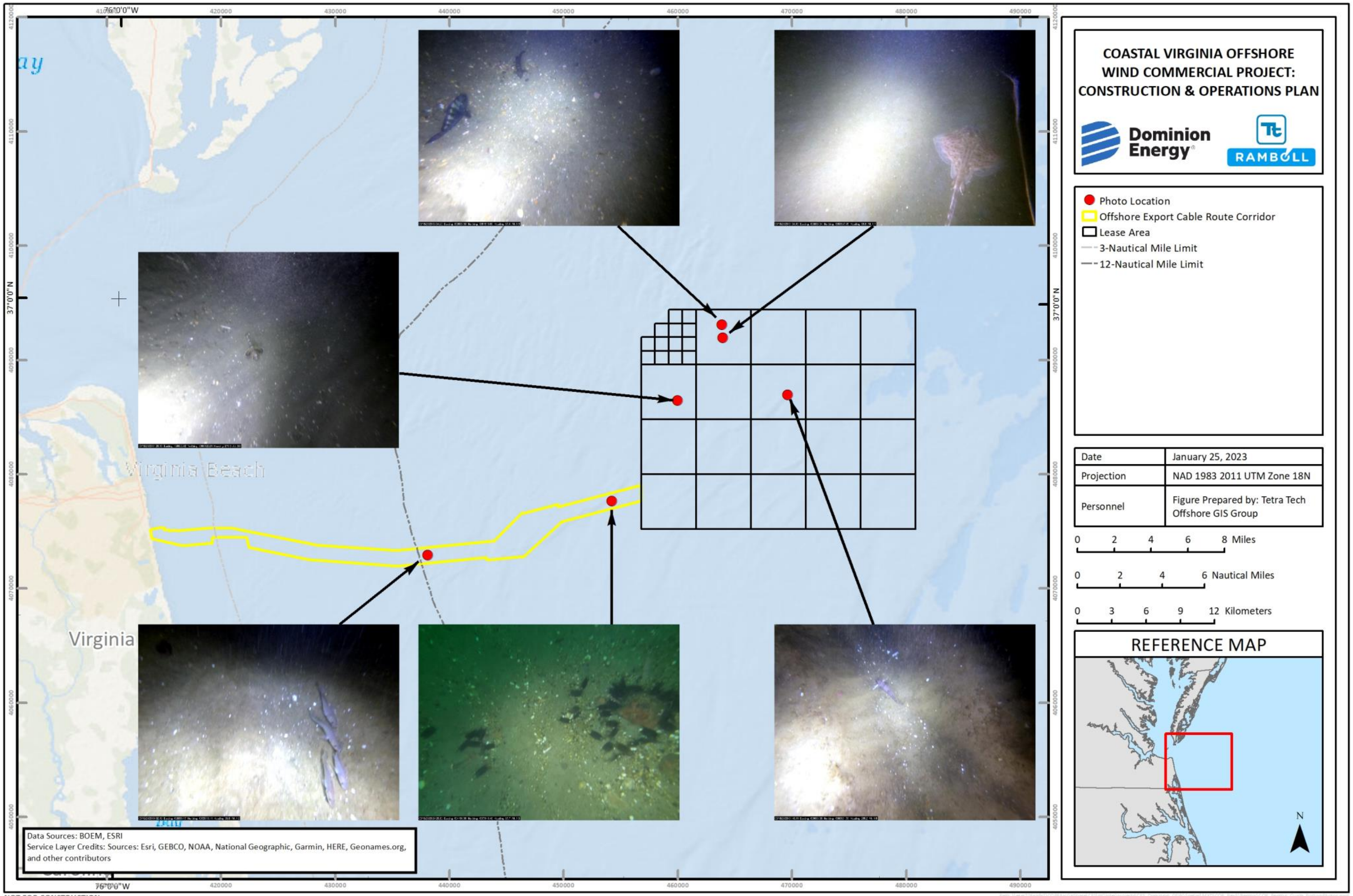

Figure 4.2-17. Representative Plan View Bottom Images in Lease Area and a large portion of the Offshore Export Cable Route Corridor, Collected during the August 2020 Survey

The National Coastal Condition Report IV (EPA 2012) rated the condition of Virginia Beach shorelines near the Cable Landing Location as "poor to fair" and the waters of the Offshore Project Area as "fair to good." Wastewater treatment equipment, stormwater runoff, agricultural runoff, and other anthropogenic factors may indirectly influence dissolved oxygen by yielding occasional algal blooms and subsequent hypoxic events in the nearshore regions of the Offshore Project Area (VDEQ 2020). Waters in the Offshore Project Area are likely to have more consistent dissolved oxygen levels (more than 5 mg/L) adequate for marine organisms (BOEM 2015a). Water quality of the Offshore Project Area is further discussed in Section 4.1.2, Water Quality.

Mean water depth in the Lease Area is approximately 100 ft (30 m), with a range of 60 to 135 ft (18 to 41 m) (Guida et al. 2017). Depths increase seaward along roughly a southwest to northeast gradient, with the shallowest areas in the northwest and southwest corners and deepest areas in the northeast corner. Bathymetric contours are shown in Figure 4.1-7 (Section 4.1.1, Physical and Oceanographic Conditions).

Water temperatures in the Offshore Project Area vary greatly with depth and season. Seasonal variations include a range of 27˚F (15˚C) at the seafloor and a range of 36˚F (20˚C) at the surface (described further in Section 4.1.1, Physical and Oceanographic Conditions; Guida et al. 2017). The month of April marks the initiation of thermal stratification, as ambient temperatures begin to raise surface water temperatures above those of bottom temperatures. Maximum surface-to-bottom thermal gradients include a range of 27˚F (15˚C) in August, followed by vertical turnover in September and October. Temperatures may drop 22˚F (12˚C) throughout the water column by the following January. These seasonal variations can trigger physiological and behavioral responses, including gonadal development and seasonal migrations. Warm temperate species arrive from the south as Virginia's coastal waters warm in the summer; these species are replaced by cold temperate species from the north as water temperatures cool in the winter (BOEM 2014). The thermal cycle redistributes highly mobile benthic and pelagic species and influences settlement timelines for planktonic stages of less mobile benthic and demersal species.

Additional discussion of pelagic habitat is included in Appendix E, EFH Assessment.

Benthic-Pelagic Coupling

The energy transfer that occurs between the seafloor and water column as organisms eat, excrete waste, and decompose is termed benthic-pelagic coupling. Most marine organisms are neither wholly benthic nor wholly pelagic, but many rely on the habitat continuum to support their various life stages. Atlantic sea scallops (*Placopecten magellanicus*), for example, have benthic eggs and planktonic larval stages. After hatching, scallop larvae mature in the plankton for 5 to 6 weeks before transforming into juveniles and settling on benthic substrates. Adults spend the rest of their lives filter-feeding on plankton, enriching the sediment with their wastes, and releasing new generations to repeat the cycle (Munroe et al. 2018).

Together, seafloor substrates and overlying waters provide benthic and pelagic habitat for demersal and pelagic fishes and invertebrates. Phytoplankton thrive in the nutrient-rich photic zone and provide ample foraging opportunities for these broad marine communities. Virginia's coasts are known for abundant phytoplankton populations sustained by nutrients released through the Chesapeake Bay and distributed widely by tides and currents (Boicourt et al. 1987). These phytoplankton serve as essential food for zooplankton (e.g., copepods, larval crustaceans, bivalves, other invertebrates) and ichthyoplankton (fish larvae) that are then consumed by planktivorous pelagic species such as anchovies, kingfishes, mackerel, and jacks (Reiss and McConaughan 1999).

Benthic infauna (e.g., bivalve mollusks, oligochaetes, polychaetes) bury themselves in softbottom sediments with their respiratory and feeding appendages protruding into the water column to feed on plankton and nutrient-rich detritus. Epifauna include both sessile organisms (e.g., sponges, mussels) and mobile organisms (e.g., crustaceans, echinoderms, gastropods).

NOAA Fisheries designates and conserves EFH for species managed under FMPs to minimize adverse effects on and encourage enhancement of habitat caused by fishing or non-fishing activities (BOEM 2014). EFH includes the waters and substrates necessary for species spawning, breeding, feeding, or growth to maturity [16 U.S.C. § 1801(10)], where "necessary" indicates a level required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. Within the Offshore Project Area, EFH may be broadly typified as seafloor, sediment-water interface, and water column habitat (SAFMC 1998; NOAA Fisheries 2017). EFH designations include combinations of specific substrate types, water depths, and foraging habitat, thereby explicitly recognizing the joint contributions of benthic and pelagic habitats, as described further in Appendix E, EFH Assessment.

Demersal Species and Life Stages

The term demersal refers to organisms and life stages oriented both physically and behaviorally toward the seafloor. This includes infaunal and epifaunal invertebrates and fishes that are preferential bottom foragers. Burrowing infaunal organisms (e.g., clams, oligochaetes, polychaetes, amphipods) create microhabitats by filtering water, mixing and redistributing sediment, oxygenating surface sediment, and recycling nutrients (Rutecki et al. 2014). Infaunal organisms are consumed by crustaceans (e.g., crabs), gastropods (e.g., whelks[3] [conch] moon snails), fishes (e.g., flounders, skates), and other demersal predators.

Many demersal species occur year-round in Virginia's coastal waters, although abundances vary with both season and life stage. In the Offshore Project Area, commercially valuable demersal invertebrates and fishes include crabs, mussels, scallops, clams, basses, croakers, dogfish, flounders, hakes, sea robins, skates, and snappers-groupers (BOEM 2014; Guida et al. 2017; NOAA Fisheries 2018). Fish species often aggregate along particular depth gradients in the Mid-Atlantic Bight. The northern searobin and summer flounder (*Paralichthys dentatus*) may aggregate on the inner shelf 59–98 ft (18-30 m); the clearnose skate (*Raja eglanteria*) and little skate (*Leucoraja erinacea*) may occur in intermediate shelf waters 98–164 ft (30-50 m); and eels, hagfishes, and pouts typically occur on the outer shelf 164–328 ft (50-100 m) (Love and Chase 2007; BOEM 2014).

Demersal aggregations also vary seasonally; all dominants collected by NEFSC seasonal trawl surveys aside from skates were seasonal migrants (Guida et al. 2017). Black sea bass (*Centropristis striata*), northern searobin, and scup (*Stenotomus chrysops*) dominated warm season trawls, while clearnose skate, spiny dogfish (*Squalus acanthias*), and summer flounder dominated cold season trawls in the Lease Area (Guida et al. 2017). Seasonal trawl surveys conducted by the Navy within the Offshore Export Cable Route Corridor reflect similar seasonality. Northern searobin, pinfish (*Lagodon rhomboides*), and striped anchovy

[3] Whelk are locally referred to as "conch." To ensure understanding to the reader, this section uses the terms "conch" and "whelk" interchangeably as whelk species of family Buccinidae, in reference to that fishery.

(*Anchoa hepsetus*) dominated warm season trawls, while southern kingfish (*Menticirrhus americanus*) and squids dominated cold season trawls (Navy 2017). Bay anchovies (*Anchoa mitchilli*) and spotted hake (*Urophycis regia*) were present across both seasons (Navy 2017).

Many demersal species rely on overlying pelagic habitats for larval dispersal, foraging, or seasonal migrations (Malek et al. 2014). For example, the life cycle of the dwarf surfclam is similar to the previously described Atlantic sea scallop. Surfclam eggs are fertilized in benthic habitats and the developing larvae subsequently enter pelagic waters where the drift for 1 to 3 weeks before settling on benthic substrates where they complete their lives (Mann et al. 1991). The dwarf surfclam occurs in Offshore Project Area sediments year-round, sustained by zooplankton in overlying waters and preyed upon by demersal crabs and fishes (Guida et al. 2017).

Atlantic croaker (*Micropogonias undulates*) adults are demersal, while the larvae are pelagic; black sea bass, spotted hake and summer flounder have similar pelagic early life stages (MAFMC 2017). Individuals of these species may spawn outside the Offshore Project Area, but the planktonic larvae or free-swimming juveniles recruit to the Offshore Project Area seafloor given the right conditions. The longfin squid (*Doryteuthis pealeii*), present in the Offshore Project Area during the cold season, exhibits the reverse of the pelagic larval/demersal adult life cycle. Adult squid are pelagic but attach their eggs, termed squid mops, to hard substrates, empty shells, and artificial structures. Squid mops, observed in the Offshore Project Area during summer beam trawls, remain on the seafloor for up to 4 weeks before hatching; paralarvae are then released to pelagic habitats where they disperse and feed on zooplankton (Cargnelli et al. 1999a). In contrast, skates, including the clearnose and little skate known to occur in the Offshore Project Area, are demersal throughout their lives and feed almost exclusively on benthic bivalves, crabs, polychaetes, and shrimp (Packer et al. 2003a, b).

Pelagic Species and Life Stages

Most pelagic fishes in the Offshore Project Area are temperate species, but some subtropical-tropical and highly migratory species also occur. The Offshore Project Area receives Labrador Current cold-water influxes from the north and Gulf Stream warm-water influxes from the south. To the south of the Offshore Project Area, Cape Hatteras, NC, demarcates a dynamic ichthyoplankton faunal transition zone between two broad eco-regions: the Mid-Atlantic Bight, which extends from Delaware Bay to Cape Hatteras, and the South Atlantic Bight, which extends from Cape Hatteras to Cape Canaveral (Grothues and Cowen 1999; Hare et al. 2001; Hare et al 2002). Ichthyoplankton from this transition zone are carried north to the Offshore Project Area by prevailing currents. Larval assemblages compose the largest portion of the pelagic fish community in the Offshore Project Area (BOEM 2014). As a result, ichthyoplankton in the Offshore Project Area belong to adult species distributed throughout the entire U.S. Atlantic Coast. The extensive larval distributions of such fishes and invertebrates may be attributed to the ability of their buoyant eggs and larvae to remain suspended in the plankton for weeks to months (Hare et al. 2001; Hare et al. 2002; Navy 2008). These assemblages exhibit seasonality; cold temperate propagules from the north dominate the Offshore Project Area waters in the winter, while warm temperate and tropical propagules from the south dominate Offshore Project Area waters in the summer (Doyle et al. 1993; Grothues and Cowen 1999; Hare et al. 2001).

Virginia's adult coastal pelagic assemblages include bluefish (*Pomatomus saltatrix*), cobia (*Rachycentron canadum*), king and Spanish mackerel (*Scomberomorus cavalla* and *maculatus*, respectively), northern kingfish (*Menticirrhus savatilis*), scup, smooth puffer (*Lagacephalus laevigatus*), spiny dogfish, striped bass (*Morone saxatilis*), weakfish (*Cynoscion regalis*), and other temperate and subtropical-tropical transients. Pelagic fishes can be broadly categorized into horizontal and vertical distributions within the water column. Diversity and abundance of pelagic fishes are correlated with physical complexity (e.g., habitat relief, *Sargassum* floats) and/or a variety of physical and chemical conditions (e.g., currents, upwelling, nutrients, dissolved oxygen, temperature) (Helfman et al. 2009). Pelagic estuarine fish species (e.g., striped bass, bluefish) typically inhabit nearshore waters with salinities ranging from fully marine to fresh, whereas marine species (e.g., tuna, shark) typically remain where salinities average near 30 PSU.

Atlantic mackerel (*Scomber scombrus*), Atlantic menhaden (*Brevoortia tyrannus*), and small herring species are small schooling fishes that compose the dominant coastal pelagic forage species. They share similar life history traits and tend to be short-lived, fast-maturing, highly fecund, and highly variant in abundance patterns (MAFMC 2017). Species abundances often rise and fall asynchronously, and recruitment may exhibit interannual variability that can drive peaks in abundance unrelated to the standing stock of a given species (Bethony et al. 2016). While the larvae and juveniles of many species (e.g., butterfish, squid) are important prey, these same species may transition to predatory foraging as adults. Energy transfer within the pelagic environment is facilitated by these small coastal pelagic forage fishes. Such species consume zooplankton and are subsequently consumed by larger migratory epipelagic fishes (e.g., jack, shark, swordfish, tuna) (BOEM 2014; NOAA Fisheries 2018).

Highly migratory pelagic fishes, such as swordfish (*Xiphias gladius*), tunas, and many shark species are distributed from coastal waters seaward into the open ocean. These species are capable of migrating great distances seasonally (north to south or inshore to offshore), as well as vertically in the water column on shorter timescales. They are known to aggregate at artificial and natural flotsam (e.g., *Sargassum* floats) for foraging and nursery opportunities. Blackfin tuna (*Thunnus atlanticus*), yellowfin tuna (*Thunnus albacares*), and skipjack tuna (*Katsuwonus pelamis*), for example, opportunistically feed upon small fishes attracted to *Sargassum* floats (Moser et al. 1998; Casazza and Ross 2008; Rudershausen et al. 2010). Numerous invertebrates and as many as 80 fish species are closely associated with floating *Sargassum* during one or more life stages. Floating *Sargassum* is therefore designated as EFH for snapper, grouper, and coastal migratory pelagic species (Federal Register 2003).

Essential Fish Habitat and Habitat Areas of Particular Concern

The marine assemblages in the Offshore Project Area include species that are managed for commercial and recreational harvest; species that are not directly harvested but have important ecological functions; and species that are protected under federal and state endangered species statutes. Each of these groups is discussed briefly below.

Fisheries stocks in Virginia are managed by the ASMFC, the MAFMC, and the VMRC. In addition, NOAA Fisheries manages tunas, sharks, and swordfish that may transit through the Offshore Project Area through its Highly Migratory Species Division (NOAA Fisheries 2017). The EFH Mapper and EFH Data Inventory was used to identify EFH for managed fish species in the Offshore Project Area (NOAA Fisheries 2020a). EFH source documents and other textual descriptions of EFH are discussed in Appendix E, EFH

Assessment. Table 4.2-16 summarizes managed species that may occur seasonally or year-round in the Offshore Project Area. EFH for temperate and subtropical-tropical managed species is organized into five life stages: egg, larval, juvenile, adult, and spawning adult. NOAA Fisheries High Migratory Species Division has simplified these life stages to egg, larval, and spawning adult (NOAA Fisheries 2017). Sharks are managed as neonates (newborns and pups less than 1 year), juveniles, and adults (NOAA Fisheries 2017).

Table 4.2-16. 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 a/	*Clupea harengus*	Juvenile, Adult
Atlantic sea scallop	*Placopecten magellanicus*	ALL
Clearnose skate	*Raja eglanteria*	Juvenile, Adult
Monkfish b/	*Lophius americanus*	ALL
Pollock	*Pollachius virens*	Larva
Red hake	*Urophycis chuss*	Adult
Windowpane flounder	*Scophthalmus aquosus*	ALL
Winter skate	*Leucoraja ocellata*	Juvenile
Witch flounder	*Pseudopleuronectes americanus*	Egg, Larva
Yellowtail flounder	*Limanda ferruginea*	Larva
Mid-Atlantic Fishery Management Council		
Atlantic butterfish	*Peprilus triacanthus*	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 chrysops*	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

Common Name	Scientific Name	Essential Fish Habitat (EFH) Life Stages Designated within the Offshore Project Area
Tiger shark	*Galeocerdo cuvier*	ALL
Yellowfin tuna	*Thunnus albacares*	Juvenile, Adult
Atlantic States Marine Fisheries Commission & Virginia Marine Resources Commission		
Amberjack c/	*Seriola dumerili*	N/A—EFH is designated only for federally managed species
American Eel	*Anguilla rostrata*	
American lobster	*Homarus americanus*	
American Shad	*Alosa sapidissima*	
Atlantic Croaker	*Micropogonias undulatus*	
Atlantic Menhaden	*Brevoortia tyrannus*	
Atlantic Sturgeon	*Acipenser oxyrinchus*	
Billfish c/	*Istiophoriformes*	
Black Drum	*Pogonias cromis*	
Blue Crab c/	*Callinectes sapidus*	
Bluefish	*Pomatomus saltatrix*	
Channeled whelk c/	*Busycotypus canaliculatus*	
Cobia	*Rachycentron canadum*	
Grouper c/	Epinephelinae	
Horseshoe Crab	*Limulus polyphemus*	
Jonah Crab	*Cancer borealis*	
Red Drum	*Sciaenops ocellatus*	
River Herring	*Clupeidae*	
Sheepshead c/	*Archosargus probatocephalus*	
Spadefish c/	*Chaetodipterus faber*	
Spot	*Leiostomus xanthurus*	
Spotted Seatrout	*Cynoscion nebulosus*	
Striped Bass	*Morone saxatilis*	
Tautog	*Tautoga onitis*	
Tilefish c/	Malacanthidae	
Weakfish	*Cynoscion regalis*	

a/ joint management with ASMFC
b/ joint management by NEFMC and MAFMC
c/ VMRC only

Fisheries Management Commissions, Councils, and Divisions may also designate HAPC, which are areas of EFH important to the survival of given species. There is no designated HAPC in the Offshore Project Area (NOAA Fisheries 2020a). The nearest HAPC to the Offshore Project Area is Norfolk Canyon, located 21 nm (40 km) from the northeast corner of the Lease Area.

State regulatory bodies further manage fisheries stocks in state waters. The VMRC Fisheries Management Division develops and implements policies affecting saltwater recreational and commercial fisheries in the state's tidal waters. The Division's Fisheries Plans and Statistics Department monitors the state's finfish and shellfish fisheries and develops management plans with assistance from Fisheries Management Advisory Committees composed of representatives of fisheries interest groups. Together, the Department and Committees have developed FMPs for black drum, blue crab, bluefish, shad and river herring, spotted seatrout, Striped Bass, weakfish, and more (VMRC 2020b).

Additionally, the federal CZMA of 1972 encourages coastal states to develop and implement federally approved coastal zone management plans to conserve and enhance coastal habitat and living resources, including fish and invertebrates. The VDEQ CZMP is responsible for CZMA in the Offshore Project Area.

Temporal analyses of baseline fisheries resources and their seasonal fluctuations are corroborated by long-term regional surveys in the Offshore Project Area. However, interpretation of long-term trends in distribution and abundance of key species is confounded by the ongoing northward shift of fisheries distributions in the Mid-Atlantic Bight in response to warming ocean temperatures (Young et al. 2019). Given the large regional shifts of commercially valuable species, the most recent 10–15 years of long-term trawl data may be most representative of current conditions (Guida et al. 2017).

Approximately 600 fish species are resident or transient through the demersal and pelagic habitats of Virginia's coastal waters (BOEM 2014). BOEM and NOAA Fisheries characterized fisheries resources within the Lease Area as having few to no structure-forming fauna, notable seasonal differences in species assemblages, and a relatively taxa-rich system overall (Guida et al. 2017).

Two NOAA NEFSC-sponsored cruises, conducted in March 2014 and August 2015, collected 19 beam trawls in the Lease Area (Figure 4.2-18). The beam trawls yielded a total of 56 distinct taxa (29 in March and 37 in August) (Guida et al. 2017). In March, the most frequently observed fish species were smallmouth flounder (*Etropus microstomus*), spotted hake, and unclassified searobins (100 percent of catches). In August, the most frequently observed fish species were Gulf Stream flounder (*Citharichthys arctifrons*) and northern searobin (greater than 80 percent of catches). Gobies, sand lance, and skates were typical of sandy bottom substrates. Longfin squid egg mops were collected in beam trawls at two stations during August. Spawning squid and squid mops are typically most abundant from May through August (Hendrickson 2018). Although most commercial landings are taken from deeper offshore waters (Hendrickson 2018), approximately 8,922 ac (3,611 ha), of the Offshore Project Area is designated as EFH for squid eggs

NOAA NEFSC seasonal trawl surveys spanning 2003-2016 in the Lease Area corroborated the findings of these beam trawl surveys (Figure 4.2-19). The surveys identified a total of 46 distinct taxa (28 in the warm season and 35 in the cold season) (Guida et al. 2017). Warm seasons were dominated by black sea bass, Northern searobin, and scup, while cold seasons were dominated by clearnose skate, spiny dogfish, and summer flounder. All dominants aside from skates were seasonal migrants, and the two seasons were marked by distinct distributions of biomass, abundance, and catch frequency.

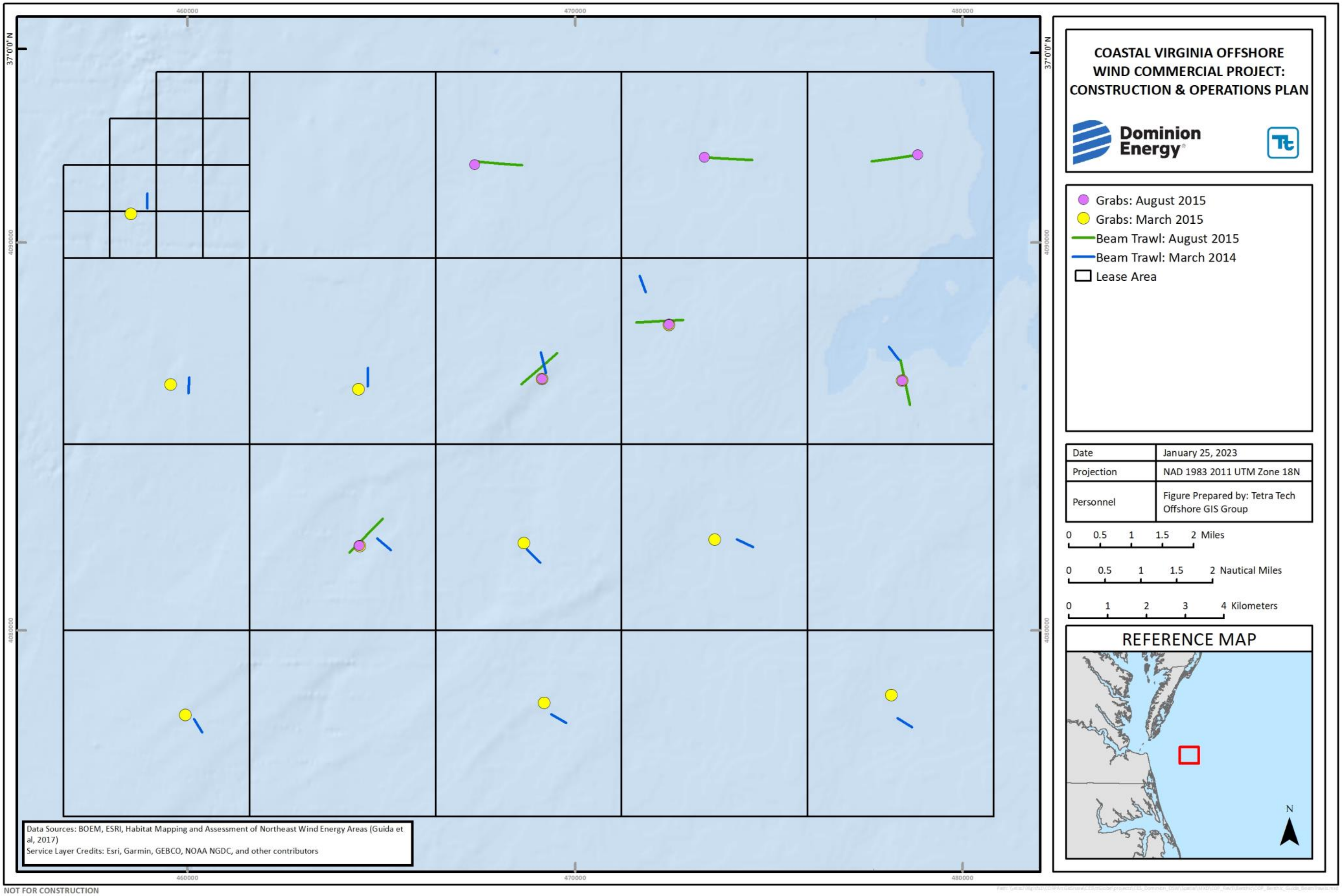

Figure 4.2-18. Locations of Beam Trawls and Benthic Grabs in the Lease Area (from Guida et al. 2017)

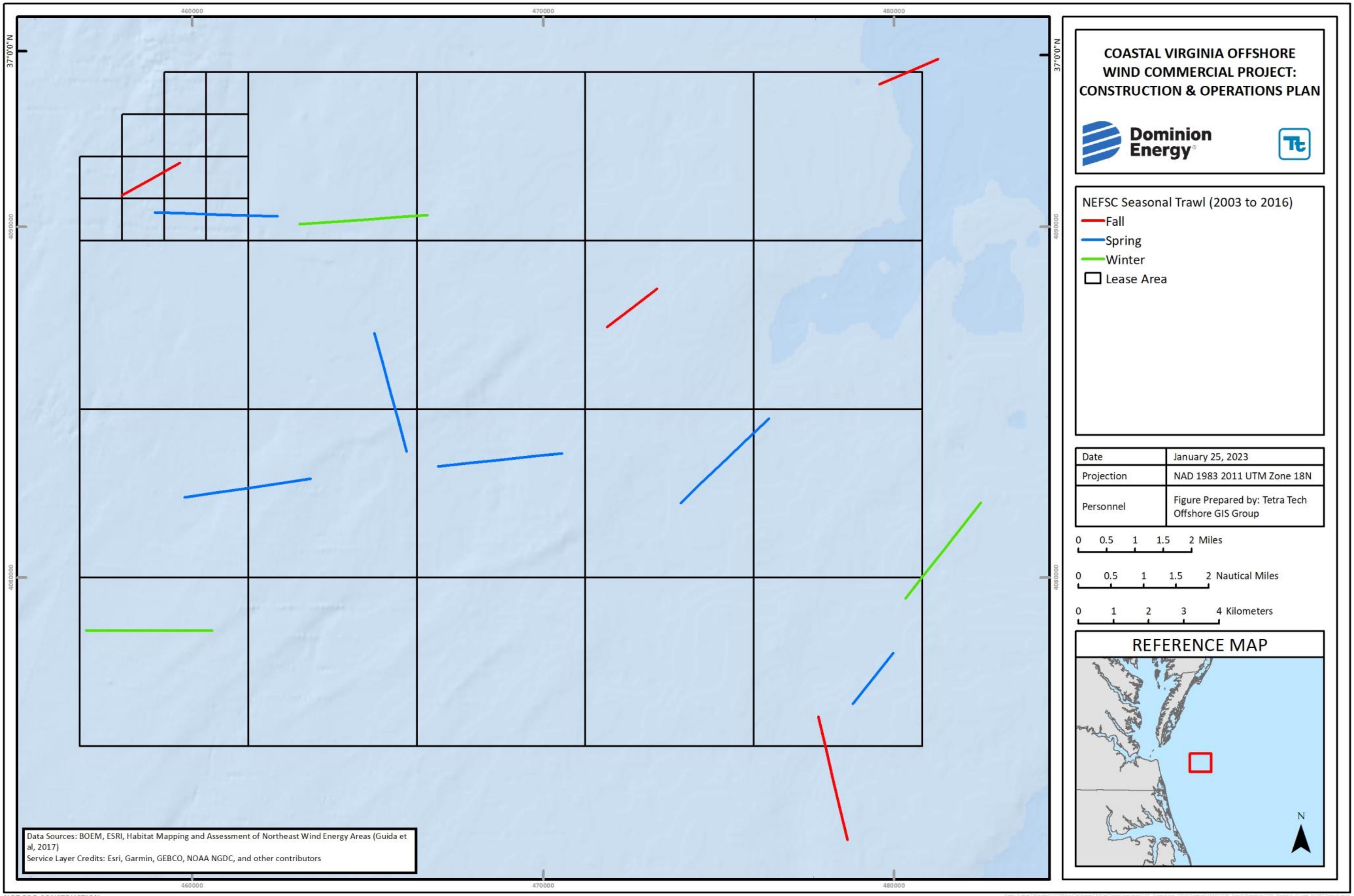

Figure 4.2-19. Locations of NEFSC Seasonal Trawls from 2003 to 2016 (from Guida et al. 2017)

The most recent NEFSC Bottom Trawl Resource Survey Reports were consistent with previous reports in the Offshore Project Area. Fall trawls identified butterfish (*Peprilus triacanthus*), longfin squid, and nontarget species (i.e., unmanaged, non-commercially important species) (NEFSC 2020a). Results indicated high diversity at the end of the warm season (September), with nontarget species comprising as much as 98.3 percent of a given catch. Spring trawls identified bluefish, butterfish, goosefish (*Lophius americanus*), longfin squid, spiny dogfish, summer flounder, windowpane flounder (*Scophthalmus aquosus*), and nontarget species (NEFSC 2020b). Results indicated slightly lower diversity, with nontarget species comprising no more than 38.2 percent of a given catch.

Threatened and Endangered Fish Species

NOAA Fisheries has jurisdiction over two anadromous and three pelagic species protected under the ESA that may occur in the Offshore Project Area.

Atlantic Sturgeon—State and Federally Endangered Species

Five distinct population segments (DPSs, or geographic portions of a species' or subspecies' population) of the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are listed under the ESA (four DPSs as federally endangered, the Gulf of Maine DPS as threatened) (Federal Register 2012). Though these DPSs represent distinct geographic populations along the U.S. Atlantic coast, individuals from all DPSs migrate across the coast and are not easily distinguished visually from one another. Therefore, any Atlantic sturgeon encountered in the Offshore Project Area is considered endangered for the purpose of this analysis. The species is listed as endangered in Virginia under 4 Virginia Administrative Code (VAC) 15-20-130 (Virginia's Legislative Information System 2020). Critical habitat for the Atlantic sturgeon has not been designated in the Offshore Project Area (Federal Register 2017). The Navy, in partnership with BOEM, is conducting ongoing research to determine seasonal presence/absence of Atlantic sturgeon in and around the Virginia WEA and to characterize the habitat use and feeding grounds of observed individuals. To date, several sturgeon have been identified and coordinated through data-sharing networks such as the Atlantic Cooperative Telemetry network. Results will help identify the causal mechanisms for Atlantic sturgeon habitat selection in the offshore environment (Watterson 2020 unpublished).

The anadromous Atlantic sturgeon spends most its adult life in estuarine and marine waters (Stein et al. 2004; Laney et al. 2007). Depending on subpopulation, Atlantic sturgeon may require 5-34 years to mature and can live up to 60 years. Adults may grow to 13 ft (4.2 m) and weigh up to 800 pounds (363 kilograms) (NOAA Fisheries 2020b). Individuals typically forage on benthic invertebrates (e.g., crustaceans, mollusks, worms) (USACE 2015). In the Mid-Atlantic, mature females generally migrate upriver in spring to deposit up to 2 million eggs on gravel or other hard substrates in freshwater rivers (Chesapeake Bay Program 2023). Recent studies have documented fall spawning runs of Atlantic sturgeon in Chesapeake Bay, in addition to the better-known spring runs (NOAA Fisheries 2021b). Their inshore movements are triggered primarily by water temperatures (Breece et al. 2018). Larvae develop into juveniles as they migrate downstream; juveniles remain in brackish waters until they grow to 30-35 in (75-90 cm) and move into nearshore coastal waters (Stein et al. 2004; Erickson et al. 2011). Off Virginia, subadults and adults occur farther offshore in winter, but generally remain within the 50-meter depth contour (NOAA Fisheries 2021b; Rothermel et al. 2020). Recent acoustic tagging research indicates that Atlantic sturgeon in the Virginia region are associated with particular dynamic habitat features that occur during specific seasons, including water temperature, light absorption in marine habitat, and salinity gradients (NOAA Fisheries 2021b). The nearest Atlantic sturgeon spawning areas to the Offshore Project Area are the James and York Rivers, which provide important spawning habitat for the Chesapeake Bay DPS (VIMS 2020).

Principal ongoing threats to the Atlantic sturgeon include vessel strikes, dredging, interaction with fishing gear, and habitat loss (NOAA Fisheries 2021b). The most recent 5-year review concluded that the Atlantic sturgeon population nearest the Project Area (i.e., Chesapeake Bay DPS) has a high potential for recovery because the two main threats (vessel strikes and bycatch) have been identified and are being managed. Given the presence of spawning adults in the James, York, and Nanticoke Rivers, the Atlantic sturgeon is assumed to be present in the Offshore Project Area (NOAA Fisheries 2022).

Federal actions related to the construction and operation of wind farms in marine waters have been proposed or are in development within the Chesapeake Bay DPSs marine range and include Dominion’s Coastal Virginia Offshore Wind Project. Currently, there is not enough information to determine whether and to what extent these are an emerging threat to the Chesapeake Bay DPS. To date, all section 7 consultations completed on offshore wind projects have concluded that the proposed construction, operations, and decommissioning of offshore wind projects are not likely to adversely affect any DPS of Atlantic sturgeon (NOAA Fisheries 2021b).

Shortnose Sturgeon –State and Federally Endangered Species

The shortnose sturgeon (*Acipenser brevirostrum*) is listed as endangered under federal (Federal Register 1967) and Virginia state statutes (4VAC15-20-130; Virginia’s Legislative Information System 2020). The species is subject to the same anthropogenic stressors as Atlantic sturgeon, including pollution, historical overfishing, and dammed rivers (Chesapeake Bay Program 2020).

The anadromous shortnose sturgeon spends most of its life in low-salinity rivers. In Virginia, the species is known to inhabit the Potomac and James Rivers and to occasionally venture into the Chesapeake Bay (Chesapeake Bay Program 2020). Adult shortnose sturgeon rarely enter coastal waters and are not expected to occur in the Offshore Project Area (Chesapeake Bay Program 2020). This species is not considered further in the COP.

Giant Manta Ray—Federally Threatened Species

The giant manta ray (*Manta birostris*) is listed as federally threatened (Federal Register 2018a). It is a filter-feeding pelagic species with small, highly migratory populations distributed throughout tropical, subtropical, and temperate waters (NOAA Fisheries 2020c). Commercial fishing, particularly the industrial purse seine and gillnet fisheries, have contributed to population declines of the giant manta ray (Miller and Klimovich 2017). The species is known to occur off the coast of Virginia and may occasionally transit through the Offshore Project Area (Farmer et al. 2022).

Oceanic Whitetip Shark—Federally Threatened Species

The oceanic whitetip shark (*Carcharhinus longimanus*) is listed as federally threatened (Federal Register 2018b). This large carnivorous pelagic species feeds primarily on bony fishes and cephalopods, but may also opportunistically feed on large pelagic sportfish, sea birds, rays, and other sharks throughout tropical and subtropical waters at depths greater than 590 ft (180 m) (NOAA Fisheries 2020d). Commercial fishing (e.g., pelagic longline, purse seine, gillnet fisheries) contribute to population declines in this species (NOAA Fisheries 2020e). The oceanic whitetip shark may transit through the Offshore Project Area but is not expected to linger.

Scalloped Hammerhead Shark—Federally Threatened Species

The scalloped hammerhead shark (*Sphyrna lewini*) is managed as four distinct DPSs, two of which (Central and Southwest Atlantic DPSs) are listed as threatened (Federal Register 2014). This moderately large carnivorous shark feeds opportunistically on small pelagic species including herring, mackerel, sardines, and squid globally in temperate and tropical waters at depths up to 1,640 ft (500 m) (NOAA Fisheries 2020e). The scalloped hammerhead may transit through the Offshore Project Area but is not expected to linger.

Ecologically Important Forage Species

Virtually all fishes and invertebrates in the Mid-Atlantic serve as prey in at least one life stage, and some maintain that position throughout their lives (MAFMC 2017). Forage invertebrates are among the most abundant species in the Mid-Atlantic region, spanning wide geographic ranges across coastal, offshore, and deep-water habitats (MAFMC 2019). They are generally small, highly productive mostly planktivorous species that provide key energy transfer services throughout the water column (Houde et al. 2014).

Regionally, the MAFMC and SAFMC have proposed measures specific to forage species in consideration of food web dynamics. The MAFMC added unmanaged forage species (e.g., amphipods, copepods, krill, small pelagic forage fishes, other invertebrates less than 1 in [2.5 cm]) as Ecosystem Component species to relevant FMPs for managed stocks in a 2016 omnibus amendment. In doing so, the Council acknowledged the necessity of maintaining an adequate forage base to support ecosystem productivity, structure, and function and to support sustainable fisheries (MAFMC 2017). A similar Fishery Ecosystem Implementation Plan established policy for South Atlantic food webs and ecosystem-based fisheries management (SAFMC 2018). The Plan recommended that the foraging needs of commercially valuable species be evaluated when setting catch limits for forage species.

A single forage species may serve as prey for a wide variety of valuable predators. All fish species listed in the NEFSC database, including species managed by the MAFMC, are known to consume amphipods, annelids, bivalves, cephalopods, crabs, shrimp, and other zooplankton; bluefish and summer flounder are particularly dependent on cephalopods, crabs, and shrimp (NEFSC 2020c). Food web modeling indicates that small commercial pelagic species rely heavily on polychaetes and mollusks (Link et al. 2008, 2009), and the largest direct energy flows for Mid-Atlantic fisheries involve benthic filter feeders (scallops, surfclams, and quahogs) and commercially valuable predators (Houde et al. 2014).

Dominion Energy survey results are consistent with the findings of prior benthic invertebrate surveys conducted in the Offshore Project Area (Cutter and Diaz 1998; Diaz et al. 2006; Guida et al. 2017). Most recently, NEFSC-sponsored cruises obtained a total of 19 beam trawls and 15 benthic grabs across the 2015 cold (March) and warm (August) seasons (Guida et al. 2017). In March, epifaunal communities were defined by dwarf surfclams, sand shrimp, and unclassified snails, while infaunal communities were dominated by polychaetes and oligochaetes. In August, epifaunal communities were defined by calico scallops, dwarf warty sea slugs, longclaw hermit crabs, and New England dog whelk snails, while infaunal communities included a wide variety of taxa (Guida et al. 2017). Overall, communities were largely composed of non-core taxa (i.e., taxa not occurring in 80 percent of samples), suggesting broad infaunal diversity (Guida et al. 2017).

Regional Effects of Climate Change on Distributions of Fishes and Invertebrates

Marine communities in the Offshore Project Area are influenced by changes in physiochemical conditions including temperature, pH, storm frequency and severity, and nutrient availability (see Section 4.1.1, Physical and Oceanographic Conditions). The vulnerability of a given marine organism to such change varies according to its mobility, tolerance range, life history, and other physiological factors in addition to the rate of climate change. Cephalopods, elasmobranchs, and pelagic fishes are likely to undergo adaptive distribution shifts, while benthic macroinvertebrates, diadromous fishes, and groundfish have lower potential for adjusting their location in response to changes in the environment (Hare et al. 2016). Sessile and slow-moving species may have limited abilities to relocate and avoid 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. For example, centers of abundance for 60 percent of benthic macroinvertebrates surveyed from 1990-2010, including the Atlantic surfclam (*Spisula solidissima*) and ocean quahog (*Arctica islandica*), shifted north along the U.S. Atlantic coast (Hale et al. 2017). Climate change also may affect the duration of the pelagic stage and availability of nutritional sources for planktonic larvae, which may affect larval settling and survival (O'Connor et al. 2007; Hare et al. 2016; Rilov 2016; Hale et al. 2017). Some mid-Atlantic species, including Atlantic croaker, black sea bass, butterfish, and longfin squid, may benefit from northern range expansions (Hare et al. 2016). Ultimately, the long-term effects of shifting species distributions and assemblages cannot be predicted at this time but are expected to have positive and adverse effects on various species.

Marked shifts in distributions of marine fishes, including an assemblage-wide northward shift along the U.S. Atlantic coast, have been attributed to increases in ocean temperatures since the mid-20th century (Nye et al. 2009; Lucey and Nye 2010; Pinsky et al. 2013; Bell et al. 2015). Ocean warming exceeds 9˚F (5˚C) in portions of the northwest Atlantic Ocean, roughly 2.5 times the estimated global mean increase. In other portions of the northwest Atlantic, bottom temperatures are predicted to increase even more than surface temperatures, and the largest increase of greater than 7˚C (greater than 4˚C) is expected to occur along the northern coast of North Carolina and Virginia (Saba et al. 2016; Alexander et al. 2020). Furthermore, the destabilization point of the Gulf Stream has moved both shoreward and northward between 35 and 40 degrees north, a region that includes the Offshore Project Area (Andres 2016; Saba et al. 2016). As Virginia's offshore waters warm and the Gulf Stream shifts northwest, there will be an associated shoreward shift in species distributions in addition to existing poleward shifts (Whitfield et al. 2014).

Changes in long-term thermal trends also can influence seasonal movement patterns of marine species. As winter temperatures increase, ranges of highly mobile tropical species may expand into Virginia's offshore waters. Populations of less mobile resident species in the Offshore Project Area (e.g., benthic macroinvertebrates) may decline as temperatures increase. Demersal fishes are affected both by surface and bottom temperatures (Fredston-Hermann et al. 2020). Community compositions of black sea bass, fourspot flounder, and summer flounder may shift in response to early arrival of spring (Friedland et al. 2015). While many species are moving northward, others (e.g., little skate, thorny skate, spiny dogfish, striped bass) seem to be expanding southward (Henderson et al. 2017). Changes in seasonal trends may differentially affect specific life stages. Thermal tolerance is known to change during species life cycles according to the development of aerobic capacities; for example, the immature regulatory capacities of ichthyoplankton make them vulnerable to thermal stress, as well as hypoxia, acidification, and salinity stress (Dahlke et al. 2020). In addition to aerobic stress, thermal shifts can directly impair gonadal development. Because fishes reproduce in response to seasonal cycles, changes in seasonal trends may result in them reproducing at different times or places (Dahlke et al. 2020).

Along the U.S. Atlantic coast, species range shifts may be discussed in terms of leading edge (i.e. the cold or poleward edge) and trailing edge (i.e., the warm or equatorward edge). One study examining 50 years of range edge dynamics discovered differences between leading and trailing edge responses to climate change; species' leading edges tracked surface and bottom temperature isotherms to a greater degree than did trailing edges (Fredston-Hermann et al. 2020). As a result, leading edge assemblages shifted north as a whole, while trailing edge assemblages responded to surface but not bottom temperatures and only exhibited species-specific rather than assemblage-wide shifts. Furthermore, several species (e.g., little skate, winter skate) shifted south at their trailing edge (Fredston-Hermann et al. 2020). Should trailing edge assemblages consistently lag behind leading edge assemblage shifts, widespread increases in range size may be observed, resulting in novel interspecific interactions, food web dynamics, and cascading consequences for ecological communities (Nye et al. 2009; Cheung et al. 2013; Fredston-Hermann et al. 2020).

In the Offshore Project Area, the interaction of invasive species with native species may represent one such cascading consequence. The invasive lionfish is a tropical species complex including *Pterois miles* and *P. volitans* that represents the first major marine fish invasion along the U.S. Atlantic coast (Grieve et al. 2016). These Indo-Pacific species are often characterized as generalist predators but have recently been reported to specialize somewhat on small demersal prey fishes that are nocturnal and solitary (Green et al. 2012; Chappell and Smith 2016; Barker et al. 2018). Cape Hatteras, North Carolina, currently demarcates the northern extent of overwintering lionfish populations, but individual lionfish fishes are occasionally carried as far north as Long Island, New York by Gulf Stream eddies (Hare et al. 2002; Whitfield et al. 2014; Grieve et al. 2016; Barker et al. 2018). Lionfish ranges may expand into the Offshore Project Area as regional waters continue to warm.

Increased concentrations of dissolved CO_2 serve to decrease the pH in the water column in a process known as ocean acidification (Doney et al. 2012). Both atmospheric CO_2 and stormwater runoff, which is composed of relatively acidic freshwater, may result in ocean acidification. Overall annual precipitation and extreme precipitation events are projected to increase along the Virginia coast, bringing increased stormwater runoff from the state's numerous river systems that empty into Chesapeake Bay (Goldsmith et al. 2019). Eutrophication from excess nutrient and carbon inputs may result in enhanced respiration and hypoxia, further acidifying coastal waters (Goldsmith et al. 2019). Many photosynthesizing organisms (e.g., macroalgae, diatoms) respond positively to acidification. Conversely, most marine fishes and invertebrates show adverse effects on hatching success, larval development, metabolic processes, immune response, organ development, acid-base regulation, or calcification when pH decreases (Fay et al. 2017; Saba et al. 2016). Shell development in bivalves (e.g., clams, oysters, scallops) can be inhibited in acidic waters, leading to declines in commercially valuable species (Cooley et al. 2015; Saba et al. 2016). Other adverse effects of acidification on commercially and recreationally valuable species include inhibited growth and survival (larval blue crab); changes to hatching times, swimming behavior, and physiological processes (longfin squid); and tissue damage (Atlantic herring [*Clupea harengus*] and summer flounder) (Giltz and Taylor 2017; Kaplan et al. 2013; Chambers et al. 2014; Frommel et al. 2014). Ocean acidification also may extend beyond direct effects on vulnerable groups secondary interruptions of marine food webs supported by calcifying organisms (Fay et al. 2017).

In addition to influencing acidification, the Chesapeake Bay and associated rivers generate a strong salinity gradient in Virginia's coastal waters (Saba et al. 2016). As annual precipitation and extreme precipitation events increase, net surface freshwater fluxes into coastal waters also will increase, potentially causing salinity decreases in nearshore portions of the Offshore Project Area (Alexander et al. 2020). Changes in salinity have been shown to affect managed species including butterfish, menhaden, and spot (Roberts 2017).

Changes in oceanic conditions are expected to continue to influence marine assemblages within the Offshore Project Area, potentially limiting the effectiveness of studies aimed at distinguishing Project-related effects from regional changes in abundance and distribution of marine organisms in the Offshore Project Area. Establishing baseline conditions and tracking regional shifts will reduce uncertainty in assessment of the Project's long-term effects on benthic resources within the Offshore Project Area.

4.2.4.3 Impacts Analysis for Construction, Operations and Maintenance, and Decommissioning

The potential impacts resulting from the construction, O&M, and decommissioning of the Project are based on the Maximum Layout from the PDE (see Section 3, Description of Proposed Activity). Table 4.2-17 summarizes the footprint of benthic impacts for the Maximum Layout of the Offshore Project Components.

Table 4.2-17. Permanent and Temporary Impacts for Maximum Layout of the Project Component Footprints a/

	Component	Acres (Hectares)
Permanent	WTG Monopile Foundations and Scour Protection b/	191.9 (77.66)
	Offshore Substation Piles and Scour Protection c/	11.4 (4.61)
	Cable Protection (Offshore Trenchless Installation Punch-Out Location, cable crossings) d/	1.19 (0.48)
	Total	**204.49 (82.75)**
Temporary	Inter-Array Cables e/	2,988.8 (1,209.5)
	Offshore Export Cables f/	3,358.51 (1,359.14)
	UXO and Large Marine Debris Clearance and Mitigation g/	1.58 (0.64)
	WTG Work Area h/	3,526.50 (1427.13)
	Cable Protection (Offshore Trenchless Installation Punch-Out Location and cable crossings) i/	8.92 (3.61)
	Maximum Construction footprint for the Offshore Substation j/	3.16 (1.28)
	Anchoring Disturbance – nearshore and offshore construction activities	1,659.2 (671.5)
	Total	**11,546.67 (4,672.78)**

	Component	Acres (Hectares)

Notes: See Section 3 Project Description for detailed project metrics and data.
a/ Permanent impacts will occur within the footprint of temporary construction areas and, as such, temporary and permanent impacts are not additive.
b/ Based on 202 WTGs with 230 ft (70 m) diameter scour protection. Permanent impact area per WTG location is 0.95 ac (0.39 ha).
c/ Based on three Offshore Substations with 4-leg piled jacket foundations with 230 ft (70 m) diameter scour protection per leg.
d/ Cable protection at the Offshore Trenchless Installation Punch-Out Location, if needed, based on maximum of 82 ft (25 m) long by 6.6 ft (2 m) wide concrete mattresses, for a total of approximately 0.012 ac (0.005 ha) at each of the nine punch-out locations. Cable crossings based on bottom protection consisting of two concrete mattresses placed end to end each measuring approximately 20 ft (6 m) in length, by 10 ft (3 m) in width and top protection consisting of seven concrete mattresses placed end to end each measuring approximately 20 ft (6 m) in length by 10 ft (3 m) in width placed perpendicular to the bottom protection for a total of approximately 0.04 ac (161.876 m^2) for each of the 27 cable crossings.
e/ Based on maximum total Inter-Array cable length of 300.7 mi (484 km) multiplied by pre-lay grapnel run width 82 ft (25 m). 66 ft (20 m) width of installation trench will occur within the footprint of the pre-lay grapnel run.
f/ Based on total maximum length of Offshore Export Cables of 337.9 mi (543.8 km) multiplied by number of cables (nine) multiplied by maximum 82 ft (25 m) width of pre-lay grapnel run. 66 ft (20 m) width of installation trench will occur within the footprint of the pre-lay grapnel run.
g/ This value is the total area of temporary disturbance associated with both UXO identification and mitigation and relocation of large marine debris. 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 ft^2 (15 m^2) per mitigation of one UXO. Dominion Energy assumes that 20% of the number of potential UXO in the desktop study will be confirmed as UXO (industry rule of thumb). In this situation, potential UXO and large debris are treated the same and result in approximately 424 objects requiring relocation. It is also assumed that 10% of the targets will be UXO, 10% will be large marine debris, and the rest will be data anomalies, soil magnetic contamination, or debris small enough to be removed by the pre-lay grapnel run. Therefore, it is assumed up to 212 UXO will require mitigation (relocation), which is expected to require an approximate disturbance of 0.79 acres (212 x 161.5 sq ft = 34,238 sq ft = 0.79 ac [0.32 ha]). The seabed disturbance footprint for relocation of large marine debris is anticipated to be approximately 161.5 ft^2 (15 m^2) per relocation of one piece of large marine debris. Dominion Energy has assumed up to 212 pieces of large marine debris will require relocation for a total of 0.79 acres bringing the total benthic disturbance area for UXO and large marine debris to 1.58 ac (0.64 ha).
h/ Based on work area diameter of 984 ft (300 m) around each of the 202 WTG locations.
i/ Temporary impacts in the Offshore Trenchless Installation Punch-Out Location based on installation of up to 12, 42-in diameter goal posts per DSPT casing for a total of 108 goal posts, and one JUV jack-up per DSPT casing (total of nine jack-ups). Temporary impacts at the cable crossing location equal to 0.12 ac (0.005 ha) of impacts associated with cable protection at cable crossings.
j/ Based on maximum 216.5 ft x 255.9 ft (66 m x 78 m) footprint of the Offshore Substation Jacket Foundations, with additional temporary construction impact occurring within a 656.2 ft x 164.0 ft (200 m x 50 m) area adjacent to the western side of each Offshore Substation to support the potential jacking of the JUV.

Construction

During construction, the potential impact-producing factor to benthic resources may include installation of the Offshore Project Components. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project construction. The following impacts may occur as a consequence of the potential impact-producing factor identified above:

- Disturbance of softbottom habitat;
- Disturbance, injury, or mortality of benthic and pelagic species;
- Change in water quality, including turbidity, sediment deposition, and chemical contamination;
- Entrainment of plankton and ichthyoplankton; and
- Increase in underwater noise and vibration.

Disturbance of softbottom habitat. BOEM sited the Lease Area to avoid sensitive hardbottom habitat and Habitat Areas of Particular Concern (BOEM 2014). Based on analysis of the geophysical and geotechnical survey data, which did not identify any boulders larger than 1.6 ft (0.5 m), Dominion Energy does not anticipate the need for seabed preparation activities (i.e., sand wave or boulder removal) beyond UXO mitigation, if needed, and the pre-lay grapnel run.

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 (Kraus and Carter 2018).

Approximately 0.1 percent of the length of Offshore Export Cables would be covered with Cable Protection material to ensure that they remain covered during storms and other events that disturb the seafloor. The Offshore Export Cable Route Corridor would be directed beneath the coastal shoreline by trenchless installation from the Offshore Trenchless Installation Punch-Out location approximately 1,000 to 1,800 ft (305 to 549 m) offshore from the Cable Landing Location (see Section 3, Description of Proposed Activity). Epibenthic species (e.g., horseshoe crab, blue crab, demersal fishes) would experience short-term increases in turbidity and sedimentation (see Appendix J, Sediment Transport Analysis) as well as noise and vibration during Offshore Export and Inter-Array Cable installation.

Studies have demonstrated that cables typically result in minimal damage to resident biota. Andrulewicz et al. (2003) found no difference in benthic diversity, abundance, or biomass on a cable route buried in soft-bottom substrate in the Baltic Sea one year after installation. Kogan et al. (2003, 2006) found no difference in abundance and distribution of 17 benthic taxa within 328 ft (100 m) of a surface-laid coaxial cable and no difference in infaunal communities in 138 sediment cores of varying distances from the cable. In areas of high energy and large sediment supply (e.g., up to 262 ft (80 m) water depth on the continental shelf), benthic habitats typically recover rapidly (several weeks to two years) after cable installation by plowing. Installation by water-jetting causes greater disturbance that may take up to five years to be recovered. Repeated surveys suggest that evidence of physical habitat recovery is a good predictor of biotic community recovery. In most cases studied, benthic habitats and communities recover completely with no signs of long-term impacts of cable burial studied (Kraus and Carter 2018). Due to the localized nature of cable activity, the overall biological impact is likely to be negligible, particularly if the habitat distribution throughout the wider area is homogenous (Vize et al. 2008). A recent BOEM study evaluating recovery of benthic assemblages on the outer continental shelf concluded that sessile species inhabiting sand and gravel substrates where natural disturbances are common generally recover quickly from sand mining and other anthropomorphic disturbances (Niedoroda et al. 2014). Mobile epifauna such as *Cancer* crab and dog whelk (*Nucella* spp.) were displaced by the initial surge created by a large dump of dredged material but returned to the area about 20 minutes later (Roegner et al. 2021).

The softbottom habitat disturbed by the Offshore Export and Inter-Array Cable installation would return to pre-construction conditions within weeks to months of the construction activity. Inter-array and Offshore Export Cable emplacement associated with construction of the WTGs and Offshore Substations would occur during two separate construction seasons within the Lease Area, which would provide a recovery period for benthic 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 beginning 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 Offshore Substation prior to commencement of Inter-Array cable emplacement associated with the next Offshore Substation.

Monitoring at the CVOW Pilot Project demonstrated that holes left by spud cans are backfilling naturally by mobile sands, as described in Section 3. Spatial dimensions and details on WTG Monopile Foundation and Offshore Substation Jacket Foundation PDE parameters are included in Section 3, Description of Proposed Activity.

Disturbance, injury, or mortality of benthic and pelagic species. Construction activities disrupting softbottom habitat may injure or kill sessile or slow-moving demersal life stages of fishes and invertebrates, including eggs and larvae. Direct seafloor disturbance would crush or bury small sessile benthic organisms located directly in the footprint of pile-driving or Scour Protection placement.

Prior to Offshore Export and Inter-Array Cable and Foundation installation, pre-lay grapnel runs would be conducted throughout the Inter-Array and Offshore Export Cable Route Corridors and would have similar impacts as bottom dredges and trawls (Hiddink et al. 2017). Construction vessel anchors and spud cans may similarly cause injury or mortality to benthic organisms by direct contact upon placement or when dragged across the seafloor. Furthermore, Dominion Energy would require any necessary anchors and spud cans to be placed within previously cleared and disturbed areas to the extent possible, further reducing their impact. NOAA Fisheries (2015) analyzed benthic impacts of the Block Island Wind Farm and estimated that each vessel anchor temporarily disturbed an area of 0.12 ac (0.05 ha). Similar areas of disturbance are expected around anchors used in this Project.

Foundation types vary in footprint size and depth of penetration into the sediment. The WTG Monopile Foundations proposed for this Project cover less area but penetrate more deeply into the seafloor, compared to other technologies (ICF 2020). As shown in Section 3, Description of Proposed Activity, the maximum design scenario assumes rock or other hard material would be placed within a 230 ft (70 m) diameter surrounding each Foundation, with an area of 41,547 square feet (3,860 square meters) of seafloor around each Foundation to prevent bottom scour, for a total area of 191.9 ac (77.66 ha) within the Lease Area for all WTGs. An additional 11.4 acres (4.61 ha) of bottom around the three Offshore Substations would be covered by scour protection. Protective rock or other hard material would be placed atop 0.1 percent of the length of Offshore Export Cables for added protection where cable burial is insufficient, for a total of 1.08 ac (0.44 ha). Scour protection would be installed either in (1) a fully pre-lay solution (before monopile installation), (2) a combination of pre-lay and post-lay, or (3) a fully post-lay solution (after monopile installation). This methodology may differ among locations, depending on seabed conditions. Associated noise and physical impacts would cause mobile fishes and invertebrates to leave the area for a short while, but some fishes and mobile invertebrates would return to scavenge sessile organisms injured by the construction activity (Vallejo et al. 2017; ICF 2020).

Seafloor trenching or plowing to bury Offshore Export and Inter-Array Cables would follow pre-lay clearing and grapnel runs. Inter-array and Offshore Export Cable emplacement associated with construction of the WTGs and Offshore Substations would occur during two separate construction seasons within the Lease Area, which would provide a recovery period for benthic 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 beginning 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 Offshore Substation prior to commencement of Inter-Array cable emplacement associated with the next Offshore Substation. Invertebrates that remain within the Offshore Export Cable Route Corridor following clearing activities, such as surfclams burrowed deeper into sediments, would be displaced by the cable-laying equipment. Installation equipment is slow-moving, allowing time for most mobile fishes and macroinvertebrates to escape injury or mortality. However, sessile life stages of invertebrates and fishes in or immediately adjacent to the trenches would likely be buried, injured, or killed. Infaunal organisms, such as ocean quahogs, sea scallops, surfclams, and other bivalves would fare better than soft-bodied invertebrates. Surfclam mortality associated with clam dredging ranges from 1 to 12 percent, largely due to the impacts of dredge teeth (Sabatini 2007; Kuykendall et al. 2019). Cable-laying equipment does not have metal teeth and would therefore avoid the same level of mortality. Such equipment would continuously move through an area as cable is laid and would therefore represent a temporary impact on fishes and invertebrates at any given point along the Offshore Export Cable Route Corridor. Burrowing bivalves, such as ocean quahogs and surfclams, would reposition themselves at suitable depths in the sediment following the completion of Offshore Export and Inter-Array Cable installation. As mentioned above, the Offshore Export Cable Route Corridor 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 Fisheries (2021a) recommendations. and Dominion Energy would further micro-site within the Offshore Export Cable Route Corridor 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 ft (300 m) 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. No other hardbottom or sensitive habitat is known or expected to occur in the Offshore Project Area.

Change in water quality, including turbidity, sediment deposition, suspended sediment and chemical contamination. To predict the duration of suspended sediment and area of likely deposition associated with construction, Dominion Energy has modeled sediment transport in the Offshore Project Area (see Appendix J, Sediment Transport Analysis).

Temporary increases in turbidity within and adjacent to the Lease Area and Offshore Export Cable Route Corridor would result from resuspension of fine sediments during flattening and clearing of Foundation pads, pile-driving, Foundation placement, Offshore Export and Inter-Array Cable installation, Scour Protection, and Cable Protection placement. This increase in suspended sediment is expected to drop rapidly, by 75 percent within 2 minutes for fine sediments (Appendix J, Sediment Transport Analysis). These estimates may overshoot actual resuspension times, as cable installation activities for the Block Island Wind Farm yielded suspended sediments well below predictions of the project-specific turbidity model (Elliot et al. 2017). Fishes and invertebrates in the immediate vicinity of the seafloor disturbance and associated sediment plume would likely exhibit some short-term changes in behavior. However, suspended sediments associated with hydraulic dredges, which are considerably larger than the cable-laying equipment proposed for installation, have been shown to return rapidly to the seafloor within a short distance of the dredge and have not been shown to inhibit fish migration or transit (Johnson 2018).

Bivalves and other relatively sessile invertebrates would expel filtered sediments from their respiratory structures or reduce their filtration rates to mediate short-term turbidity plumes until the concentration of suspended sediment returns to tolerable levels (Clarke and Wilbur 2000; Bergstrom et al. 2013). Some bivalves might close their shells to protect themselves from harmful concentrations of suspended sediments by reducing contact with unsuitable water; this would temporarily impede their ability to feed and excrete waste (Roberts et al. 2016; Roberts and Elliot 2017). Alternatively, blue crabs, horseshoe crabs, and other nearshore invertebrates are well-adapted to storm-induced turbidity plumes that can last up to days. Such species would not experience undue physiological stress from the relatively brief, localized increases in turbidity associated with Offshore Export and Inter-Array Cable installation. Instead, crabs and other opportunistic scavengers may benefit from the visual cover offered by turbidity plumes while foraging. Furthermore, benthic algae and detritus may be resuspended along with sediments in turbidity plumes, similarly benefiting ocean quahogs, surfclams, and other suspension feeders. Suspended sediments near the seafloor have been shown to have nutritional values up to two orders or magnitude greater than the water column 3 ft (1 m) above the seafloor (Munroe et al. 2013).

Following Offshore Export and Inter-Array Cable installation and Cable Protection activities, suspended sediments would settle to the seafloor near the Offshore Export Cable Route Corridor trench; modeled deposition thicknesses were less than 0.27 in (0.69 cm) within 82 ft (25 m) of the trench centerline for flood tides and less than 0.09 in (0.25 cm) within 82 ft (25 m) of the trench centerline for ebb tides. The height of sediment deposits above the bottom would be influenced by bottom currents and particle size (see Appendix J, Sediment Transport Analysis).

As suspended sediments fall to the seafloor, they may bury some demersal eggs and larvae, such as those of the Atlantic sea scallop, surfclam, and longfin squid. While this may cause some mortality in younger life stages, most adult benthic organisms would move vertically to accommodate the additional sediment. For example, surfclams are fast burrowers capable of very rapid recovery following sedimentation; they have been shown to rebury themselves to desired depths within minutes of exposure to experimental trawl conditions (Sabatini 2007). Both *Crepidula fornicata* (Powell-Jennings and Callaway 2018) and *Mytilus edulis* (Hutchison et al. 2016) were shown to recover from burial beneath 2 cm of sediment, more than double the depth of sedimentation predicted by the model (see COP Appendix J). Following sediment deposition, hermit crabs, whelks (conch), and other mobile scavengers would return to forage on dead and injured organisms (Kaiser and Hiddink 2007; Vallejo et al. 2017). Any indirect impacts of sediment suspension and deposition on fishes and invertebrates would be minimal and temporary.

Natural recovery would follow Offshore Export and Inter-Array Cable installation. Estimates of recovery time vary by region, species, and nature of disturbance, but cable installations at shelf depths similar to the Offshore Project Area indicate that recovery begins immediately and may be complete within 2 years of disturbance (Brooks et al. 2006; Hiddink et al. 2017). Availability of mobile sediments and type of cable-installation equipment both influence recovery time; softbottom substrates typical of the Offshore Project Area recover quickly, but that timeframe varies with types of dredging, trenching, or burial tools used (Kraus and Carter 2018). For example, full recovery following sand mining on the U.S. Atlantic coast and in the Gulf of Mexico occurred within 3 months to 2.5 years (Brooks et al. 2006; Normandeau 2014; BOEM 2015b; Kraus and Carter 2018; Michel et al. 2013). Monitoring at the CVOW Pilot Project demonstrated that backfilling of holes left by spud cans was unnecessary, as natural sediment movement was sufficient to backfill the holes (see Section 3). Post-construction monitoring at the Block Island Wind Farm showed no substantial differences in benthic macrofaunal communities or ecological function within turbine areas 2 years after installation (HDR 2019). However, after four years, sediment beneath the turbines had become enriched with organic matter generated by filter-feeding organisms, especially mussels and barnacles, that had colonized the vertical structures (HDR 2020).

Contaminated sediment suspension, vessel fuel spills, and releases of non-toxic drilling muds associated with Trenchless Installation may result in non-routine chemical releases into the water column (see Section 4.1.2, Water Quality). Existing sediment-buried pollutants, including heavy metals and hydrocarbons, are expected to occur in measurable quantities only near densely populated and industrialized coasts (Meissner et al. 2006; Vize et al. 2008; NIRAS 2015; Taormina et al. 2018; ICF 2020). Sediment in the Offshore Project Area has not been subjected to known oil spills or industrial releases; the risk of releasing sediment-buried pollutants during construction activities is minimal.

Offshore construction vessels may release small amounts of diesel fuel into the water column. If spilled, diesel briefly floats on the water's surface before volatilizing and would not sink into the water column or impact benthic habitat and species. Releases of other chemicals from vessels are considered unlikely; were a release of other chemicals to occur, impacts would be temporary and localized. Dominion Energy would further limit the risk of accidental fuel releases by prohibiting all construction vessels from refueling at sea and requiring compliance with USGS regulations and discharge limits outlined in the Vessel Incidental Discharge Act of 2018 (see Appendix Q, Oil Spill Response Plan).

The release of non-toxic drilling muds during Trenchless Installation activities is possible but unlikely. Dominion Energy would develop and implement an Inadvertent Release Plan that would include pollution prevention measures and spill response procedures covered by the SWPPP under the Virginia Pollutant Discharge Elimination System permit.

Entrainment of plankton and ichthyoplankton. Plankton, including ichthyoplankton, may be entrained by vessel engines and jet plowing equipment. Vessels and cable installation equipment would move continuously along the Offshore Export Cable Route Corridor. The volume of water, which represents a small zone of influence relative to the remaining available pelagic habitat and would therefore only temporarily affect a given area. Actual entrainment estimates are influenced by season, cable installation tool, water depth, time of day, and other highly dynamic oceanic variables that cannot be predicted at this time. However, mortality resulting from entrainment would represent a short-term loss against the naturally high mortality of planktonic life stages of fishes. This is further minimized when compared with the background of existing anthropogenic sources of plankton entrainment, including commercial vessels, military vessels, and hydraulic scallop and clam dredges, in the Offshore Project Area. The de minimis effect of cable installation on entrainment mortality of ichthyoplankton is consistent with findings at Vineyard Wind (BOEM 2019c). Likewise, South Fork Wind Farm estimated that zooplankton and ichthyoplankton entrained by jet plows installing inter-array 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 2021a).

Increase in underwater noise and vibration. Fishes and invertebrates may be directly and indirectly affected by construction-generated noise. Behavioral changes, temporary and permanent threshold shifts, injury, and mortality have resulted from sudden onset of loud noise in the marine environment (Popper and Hastings 2009; Popper et al. 2014; Andersson et al. 2017; Jones et al. 2020). Permanent threshold shifts may arise from brief exposures to extremely loud noise and extended exposures to mid-level noise. Such shifts may result in long-term loss of hearing acuity, although exposure to less intense noise may cause only temporary reversible threshold shifts (Oestman et al. 2009).

In the case of pile-driving for monopile and piled jacket foundations, the type and size of piling and the method of driving determine the level of underwater noise and associated impacts. Impact hammer pile-driving and associated seafloor vibration would be the most injurious activity related to Project construction in the Offshore Project Area. Dominion Energy modeled monopile and pin pile installation with maximum hammer energies of 4,000 and 3,000 kilojoules, respectively (see Appendix Z, Underwater Acoustic Assessment).

At the Cable Landing Location, trenchless installation operations may involve temporary cofferdam installation using vibratory pile-driving, which would elevate underwater sound pressure and particle velocities. Trenchless Installation activities are anticipated to take approximately 4 months, with a total of 9 conduits and 4 to 5 weeks per conduit. Though this may affect nearby fishes and invertebrates, vibratory pile-driving generally produces less noise than impact pile-driving.

The biological impact of underwater noise on fishes and invertebrates is influenced by the magnitude of the sound, distance of the organism from the sound origin, and the physiology of the organism. Many fishes are sensitive to sound pressure and particle motion, or the sound-induced oscillation of water molecules; fishes with swim bladders connected to the ear are most sensitive to these pressures (Popper et al. 2014; Hawkins and Popper 2018; Popper and Hawkins 2018; ICF 2020). To better understand acoustic sensitivity in the marine environment, NOAA Fisheries initiated a Working Group on Effects of Sound on Fish and Turtles, which established interim threshold criteria finalized under the ANSI report (Popper et al. 2014). The Working Group developed general guidelines for predicting acoustic impacts according to basic morphological traits of marine organisms and established quantitative thresholds for temporary threshold shifts, recoverable injury, and mortality. The Working Group also established qualitative risks of masking effects and behavioral responses for fishes and invertebrates at three relative distances from the origin of the sound (near, intermediate, and far). Injury thresholds for young life stages, including eggs and larvae, were based on thresholds for fishes with swim bladders not connected to the ear (Popper et al. 2014).

Recent empirical studies suggest that the species thresholds established by the Working Group may be raised by as much as 20 dB for most species (Casper et al. 2016). Popper et al. (2014) employed confined test chambers that did not offer study organisms the opportunity to escape noise exposure, which may have introduced uncertainty to the injury thresholds. The SEL_{cum} 204 dB re 1 μPa^2s injury threshold established by Popper et al. (2014) was based on exposure to 960 sound pulses (SEL_{ss} 174 dB re 1 μPa^2s), which is equivalent to about 24 minutes of exposure (Andersson et al. 2017). In reality, these same species may reduce their exposure to injurious noise in the field through avoidance; for example, cod and herring may swim more than 3,280 ft (1,000 m) within the 24-minute timeframe of noise exposure (Andersson et al. 2017 and references within). Even in open water, fishes exhibit varied responses to noise exposure at the species and individual level. In Florida, sheepshead remained in the vicinity of an active pile-driving site for 10 days, while grey snapper avoided the same area after just 3 days (Iafrate et al. 2014). Pelagic species have been observed moving both horizontally and vertically within the water column to avoid air gun noise similar to that of pile-driving (Carroll et al. 2017). As more research increases our understanding of acoustic sensitivities, the interim thresholds established by the Working Group may be updated accordingly.

In a recent NOAA Fisheries Biological Opinion, pile-driving acoustic stress was determined to be unlikely to adversely affect Atlantic sturgeon or their prey (NOAA Fisheries 2015). The Atlantic sturgeon is highly mobile; an individual sturgeon would only be injured by noise if it remained in the vicinity of the pile during installation. The findings of the Biological Opinion can reasonably be extrapolated to both harvested fish species and forage fishes.

Pile-driving in the Lease Area would expose sessile and slow-moving invertebrates and life stages (e.g., squid egg mops, demersal fishes, demersal larvae, surfclams, scallops, ocean quahogs) to sound pressure, particle motion, and substrate vibrations. The interim criteria developed by the Working Group did not include consideration of particle motion and sediment vibration impacts on invertebrates, in part because conditions determining the probability of detection and response to particle motion in the field cannot be replicated in a laboratory setting (Roberts et al. 2016; Hawkins and Popper 2017). Although few studies have examined the effect of sound-generated vibrations of sediment on marine invertebrates (Popper and Hawkins 2018, Andersson et al. 2017), some evidence of behavioral effects has been reported. Adult bivalves would likely respond to the impact hammer sounds and vibrations by "flinching," or closing their valves, which prevents feeding (Day et al. 2017). Bivalves would likely resume feeding immediately after the disturbance; the short-term interruption of foraging would not affect the health of individuals or decrease abundance of the local populations of bivalves. Limited studies indicate that some crustaceans also may detect and respond to particle motion; like mollusks, crustacean populations would not be measurably affected by the temporary disturbance during construction to crustaceans is expected to be temporary (Edmonds et al 2016; Roberts et al. 2016).

In most species of squid, statocysts and lateral lines aid in the detection of particle motion (Mooney et al. 2010; Solé et al. 2018). However, squid behavioral responses to construction-related noise may vary by species, life stage, and even by individual. In a study examining the effects of air gun sounds, which are similar to the proposed pile-driving sounds, on Australian squid, certain individuals responded by squirting ink and jetting away from the source, while other individuals froze in place and remained in the vicinity of the noise (Fewtrell and McCauley 2012). Similarly, a variety of body pattern changes, inking, jetting, and startle responses were observed in the longfin inshore squid (*Doryteuthis pealeii*) in response to pile-driving sounds (Jones et al. 2020), while the European squid (*Loligo vulgaris*) and the southern shortfin squid (*Illex coindetii*) individuals responded to similar stressors by dropping to the bottom of the experimental tank and remaining in place for several days (Solé et al. 2013).

Ichthyoplankton have limited directional-swimming abilities and cannot avoid auditory stressors by fleeing the area (Pineda et al. 2007). Newly hatched squid sustained statocyst and lateral line cell damage when exposed to 50 to 400 Hz sinusoidal wave sweeps for 2 hours at a measured sound pressure level of 157±5 dB referenced to 1 micropascal (µPa) with peak levels up to 175 dB referenced to 1 micropascal (Solé et al. 2018). Recovery capabilities of damaged squid sensory cells remain unknown, although the sensory hair cells of some larval fishes can regenerate within a few weeks (Solé et al. 2018). Specific responses of squid to pile-driving noises in the Lease Area cannot be predicted in advance. Longfin squid egg mops were observed in the Lease Area during the 2020 Benthic Survey and by Guida et al. (2017), indicating that both adult and hatchling squid may be temporarily exposed to and injured by Project-related pile-driving.

Conversely, monkfish and cod egg survival and abundance were unaffected by seismic sounds similar to those that impacted squid hatchlings (Carroll et al. 2017).

Dominion Energy's underwater acoustic modeling of maximum project design elements is presented in Appendix Z, Underwater Acoustic Assessment. No population-level effect on fishes, squid, or other invertebrates is expected to occur given the limited spatial and temporal and spatial extent of project-related noise during each individual monopile or pin pile installation, relative to available habitat for these species. Although Atlantic sturgeon could be exposed to pile-driving briefly, no single individual would remain in the vicinity of the noise for more than a few hours; most mobile and invertebrates would move outside the ensonified construction areas for a short time. A small fraction of the overall range of managed species in the Lease Area would be affected by pile-driving noise, therefore impacts would be temporary and localized. These conclusions are consistent with modeling and field measurements for other Greater Atlantic offshore wind projects that reported only short-term adverse effects on fishes, invertebrates, and EFH exposed to pile-driving (BOEM 2015b; BOEM 2018). Dominion Energy would commit to using a soft-start procedure and noise mitigation systems (e.g., bubble curtain technologies) to avoid or minimize impacts to marine mammals, sea turtles, fishes, and mobile invertebrates.

Other short-term increases in noise would be generated by construction vessels and activities (e.g., grapnel runs, excavation for cofferdam, Offshore Export and Inter-Array Cable installation, and Cable Protection activities). This Project-related noise would be similar to noise produced by commercial diesel-powered vessels trawling, transiting, or idling in the area. As with pile-driving, the acoustic impact of Project-related construction vessels on fishes and invertebrates in the Offshore Project Area would be temporary and localized.

Operations and Maintenance

During O&M, the potential impact-producing factors to benthic resources may include the presence of vessels and artificial structures in the offshore habitat, presence of electric and magnetic fields (EMF), and generation of WTG noise and vibrations. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project O&M. The following impacts may occur as a consequence of the potential impact-producing factors identified above:

- Long-term conversion of softbottom to artificial hardbottom habitat and introduction of vertical infrastructure to the water column;
- Habitat creation for nonindigenous species;
- Increase in shading and artificial lights;
- Increase in underwater noise and vibration;
- Change in water quality, including fuel and chemical spills;
- Introduction of Project-related EMF; and
- Potential thermal effects from Offshore Export and Inter-Array Cables on the seabed.

Long-term conversion of softbottom to artificial hardbottom habitat and introduction of vertical infrastructure to the water column. Foundation types (with scour protection) vary in the extent to which they modify benthic substrate. The WTG Monopile Foundations and Offshore Substation Jacket

Foundations and associated Scour Protection would convert the largest area of softbottom habitat to artificial hardbottom within the Lease Area. Under this maximum design scenario, roughly 191.9 ac (77.66 ha) of softbottom in the Lease Area would be permanently converted to hardbottom by Foundations and Scour Protection. This area would provide new hardbottom habitat for a variety of benthic and demersal species, including recreationally and commercially valuable structure-associated species (e.g., black sea bass, scup) (ICF 2020).

Biogenic reefs would rapidly develop on underwater surfaces of WTG Monopile Foundations and Offshore Substation Jacket Foundations and Scour Protection as encrusting and attaching organisms emigrated from adjacent habitats or recruited from the plankton (Degraer et al. 2018) (e.g., algae, amphipods, anemones, anthozoans, barnacles, bryozoans, hydroids, mussels, sponges, tubeworms, tunicates [Steimle and Zetlin 2000; Steimle et al. 2002; Langhamer et al. 2009; Langhamer 2012; BOEM 2015b; Causon and Gill 2018; ICF 2020]). These pioneer organisms would create secondary habitat for mobile fishes and invertebrates by increasing foraging and refuge opportunities (Causon and Gill 2018; ICF 2020). However, foundation types vary in potential to create habitat impacts to benthic and demersal species. Monopile foundations provide smooth and mostly vertical walls for attachment. Monitoring at Block Island Wind Farm showed dense aggregations of mussels attached to some but not all the piled jacket foundations. Mussels and other epifauna were attached to the vertical structure from the water surface to the sea floor. The enriched organic sediment beneath the turbine was assumed to support the mussels, which in turn attracted mobile fauna such as sea stars (HDR 2020).

In contrast, the varied orientations of components of the jacket foundations provide more complex habitat, included shaded undersides of horizontal elements, narrow crevices, and other sheltering opportunities (ICF 2020). Foundation types also vary in the extent to which they modify light levels, water motion, and sedimentation rates; variability in these features can increase the abundance and diversity of marine community assemblages (Bué et al. 2020). In the North Sea, the physical complexity supported more species and greater abundances than the relatively simple monopile foundations (Causon and Gill 2018). Jacket foundation types are expected to create a stronger artificial reef effect and support more diverse assemblages of fishes and invertebrates than other foundation types. Piled jacket foundations at Block Island Wind Farm were reported to be colonized by mussels, anemones, and sponges in the water column, and the *Astrangia poculata* coral near the sea floor. The tunicate *Didemnun vexillium*, a common invasive species, also occurs on the foundations (HDR 2020).

Studies of epifaunal communities on operational WTGs provide evidence of the potential reef effect of the Project. Foundations of the Thorntonbank Wind Farm (GBSs) on flat softbottom substrates in the North Sea accumulated the same epifauna as other anthropogenic infrastructure (e.g., oil and gas platforms, coastal protection structures, shipwrecks). At least 60 species were observed on or near the foundations within the first few months, and 84 species within 4 years (Kerckhof et al. 2010; Coates et al. 2014). Species richness around the foundations was greatest during summer months (Kerckhof et al. 2010). Community succession was observed within the first year of operation as colonizing bivalves gave way to annelids, crustaceans, and mollusks (Coates et al. 2014). Reef-building amphipods and polychaetes constructed calcareous tubes on foundations, additional rugosity and adding complexity to the initially smooth surfaces (Coates et al. 2014).

Similar results have been observed on monopile foundations. Foundations in the North Sea accumulated 23 species within the first few months and 55 species within 4 years; associated scour protection accumulated 35 species within the same timeframe (Bouma and Lengkeek 2012). Monopiles of the Baltic Sea were colonized by red and green algae, hydroids, and sessile bivalves; after 7 years of succession, assemblages on the foundations were similar to those on a nearby lighthouse (Andersson and Öhman 2010). Within 4 years, epifaunal communities on jacket foundation types in the North Sea included red and green algae, anemones, barnacles, mussels, sea stars, and urchins (Causon and Gill 2018).

The timing of installation can influence the type of species that initially colonize new substrates because colonizers would be recruited from whatever suitable species are in the plankton at the time. The Labrador Current carries ichthyoplankton from the north and the Gulf Stream carries different species from the south to create a dynamic planktonic larval assemblage in the Lease Area. Furthermore, the quasi-decadal shift in the latitude of the Gulf Stream is reported to cause a corresponding northward shift of warm temperate species that follow bottom temperature isotherms (Davis et al. 2017). Because planktonic larval assemblages vary seasonally in the Offshore Project Area, initial colonization patterns of individual Foundations and Scour Protection material would reflect the season during which each Foundation was installed (Krone et al. 2013, 2017). Over time, assemblages on all Foundations would reach similar mature successional stages that reflect ambient conditions (e.g., water depth, temperature, currents).

The presence of Project infrastructure would not interfere with currents or dispersion of ichthyoplankton in the region. The monopile foundation represents a relatively narrow physical intrusion into the benthic and pelagic habitats of the Lease Area (31 ft [9.5 m] per monopile). For ichthyoplankton, presence of hard substrate is but one of several environmental indicators responsible for the initiation or delay of settlement; other signals include stage of larval development, temperature, prey availability, and chemical signature of conspecifics (Pineda et al. 2007; McManus et al. 2016). Operational WTGs in the North Sea have not exhibited the expected recruitment levels (Degraer et al. 2016). The introduction of Foundations and Scour Protection in the Lease Area would not negatively affect the regional abundances of any planktonic life forms.

At other locations, monopile foundations have been colonized more heavily at the seafloor than at the sea surface, possibly because reef-building species rely on sediments suspended just above the seafloor to construct tubes (Kerckhof et al. 2010; Bouma and Lengkeek 2012). At all foundation types studied, red and green algae and barnacles were more common near the sea surface while sessile reef-forming blue mussels dominated the base (Andersson and Öhman 2010; Causon and Gill 2018). The solid bases of monopile foundations attract mobile fishes and invertebrates near the seafloor, perhaps because these structures provide some shelter from bottom currents with easy access to surrounding soft-bottom forage areas (Bouma and Lengkeek 2012; Krone et al. 2013; Causon and Gill 2018). In contrast, the jacket foundation tends to attract mobile fishes and invertebrates, with little vertical zonation (ICF 2020). For example, steel jackets in the German Bight were dominated by adult crabs (*Cancer* spp.) at their base and larval edible crabs at upper levels (Krone et al. 2013, 2017).

Enriched organic matter (i.e., littoral fall) and empty invertebrate shells accumulate beneath and immediately adjacent to all foundation types as the associated organisms grow, feed, and ultimately die (Goddard and Love 2010; Coates et al. 2014; Causon and Gill 2018; ICF 2020). The enriched area is typically favored by small mobile organisms seeking shelter in the discarded mollusk shells (e.g., juvenile black sea bass, crabs, hake, scup, skate) and organisms that can derive nutrients from the rain of detritus (e.g., larval fishes, mussels, burrowing amphipods, polychaetes, other infauna) (ICF 2020). This enriched area around offshore structures generally supports more species per unit area than flat softbottom habitat without structures (Coen and Grizzle 2007). In some cases (e.g., areas with limited bottom currents), decomposing organic matter can cause high biological oxygen demand, resulting in anoxic areas at foundation bases (ICF 2020).

Benthic enrichment associated with littoral fall around operational oil and gas platforms in the Baltic Sea and North Sea was spatially limited, extending only 3 to 16 ft (1 to 5 m) from foundation bases (Wilhelmsson et al. 2006; Bergstrom et al. 2014). The spatial effects are especially notable at monopile foundations, where organic carbon enrichment decreased measurably with distance from the foundations, while grain size increased (Andersson and Öhman 2010; Bouma and Lengkeek 2012; Coates et al. 2014). The spatial patterns may be generated by accelerated water movement around the structures (i.e., wake effect), which causes turbulence and reduces current strength (ICF 2020). As current strength is reduced, pockets of substrate with smaller organically enriched sediment particles and greater abundance of larval recruits can form immediately down-current from the foundation bases; such enriched areas may subsequently attract mobile predators (Bouma and Lengkeek 2012; Coates et al. 2014; ICF 2020). Conversely, jacket foundations do not cause bottom currents to slow. Because water moves through rather than around the open structure, no low-flow pockets form, and spatial gradients are less apparent (Coates et al. 2014; Degraer et al. 2016).

Increased productivity around foundations may alter local distributional patterns of predatory fishes and invertebrates (Rein et al. 2013; Degraer et al. 2016). Stomach contents of benthic fishes collected near operational wind farms in softbottom habitats in the Baltic and North Seas were characterized by hardbottom prey associated with the foundations (Andersson and Öhman 2010; Degraer et al. 2016). With the exception of the Fish Haven, the Lease Area presently offers little habitat for structure-associated species; black sea bass, flounders, monkfish, ocean pout, hakes, and scup are expected to respond favorably to the introduction of structured habitat (Guida et al. 2017). Black sea bass exhibit particularly strong site fidelity to specific reefs and structures; they would likely gravitate towards the complex habitat offered by WTG Monopile Foundations and Offshore Substation Jacket Foundations. Structure-associated managed species have been observed aggregating around artificial reefs and other infrastructure in Rhode Island (Wilber et al. 2022, Hutchison et al. 2020), New York (NYSDEC 2020), New Jersey (Figley et al. 2001), Delaware (Steimle et al. 2002), Maryland (Loftus and Stone 2007; Cullen and Stevens 2017), North Carolina (Bangley and Rulifson 2014; Lemoine et al. 2019), South Carolina (Kolmos 2007), and elsewhere throughout the Mid-Atlantic Bight (Steimle and Zetlin 2000; Ross and Rhode 2016). These artificial reefs have also been frequented by Atlantic cod, bluefish, pollock, and other softbottom-dependent species (e.g., summer and winter flounder). Benefits of complex habitat provided by introduced WTGs may not extend to meso- and epipelagic species. While increased vertical mixing and subsequent transport of nutrients to the sea surface have been observed at WTGs in the North Sea, changes to primary production did not yield notable changes to the distribution of resident pelagic fishes (Floeter et al. 2017).

Lobster aggregated around operational WTG foundations in the North Sea (Roach et al. 2018). However, the unconsolidated sands of the Lease Area provide poor habitat and little recruitment opportunity for either the American or spiny lobster, which do not commonly occur in Virginia's offshore waters (ASMFC 2018).

The positive effects of European wind farms on distributions of fishes and invertebrates are well known, and limited observations of U.S. wind farms supports this finding. In a Biological Opinion for the Block Island Wind Farm, NOAA Fisheries concluded that increased prey associated with WTG structures would benefit Atlantic sturgeon transiting through the area (NOAA Fisheries 2015). In the North Sea, the secondary habitat created by colonizing species on foundations and scour protection provide additional foraging opportunities for fishes and nurseries for crabs (Stenberg et al. 2015; Krone et al. 2017). In Belgium's offshore waters, increased foraging opportunities near foundations have been linked to increases in Atlantic cod and pout abundance and productivity (Reubens et al. 2014). In the Netherlands, abundances of sand eel were higher near foundations and scour protection than on surrounding softbottom sediments (Wilhelmsson et al. 2006; Bergstrom et al. 2013, 2014). Recent observations of the Block Island Wind Farm have noted aggregations of more than 100 black sea bass individuals per WTG, with additional sightings of scup, monkfish, bluefish, and smooth dogfish (Hutchison et al. 2020). In contrast, telemetry studies in the Maryland Wind Energy Area, where no infrastructure yet exists, reported low densities of black sea bass and other structure-associated species (Secor et al. 2020).

Two species of nonindigenous Indo-Pacific lionfish (*Pterois volitans* and *P. miles*) are associated with artificial reefs and offshore platforms throughout the Gulf of Mexico (Campbell et al. 2022), leading some researchers to predict that offshore wind infrastructure may support this species in the Atlantic Ocean as well. However, lionfish first colonized the natural hardbottom of the west Florida shelf, reportedly associating preferentially with sponges on hardbottom substrates, several years before moving into the western Gulf; lionfish have since been captured in all habitats except mud, silt, and clay (Campbell et al. 2022). Moreover, lionfish have already spread up the eastern seaboard as far north as New York despite the absence of major offshore infrastructure (USGS 2022). The successful range expansion of lionfish has been attributed to their lack of predators, rapid growth rates, broad prey base, nonspecific habitat use, large home ranges, and indeterminate fecundity (i.e., females contain developing eggs of various stages and can spawn repeatedly as each batch of eggs becomes mature) (Bacheler et al. 2022, Mouchlianitis et al. 2022, Green et al. 2021, Fogg et al. 2017). These and other features (such as the venomous spines) facilitate the establishment of lionfish throughout the Caribbean, Gulf of Mexico, and Western Atlantic Ocean. It is expected that lionfish will come to be associated with infrastructure in the Offshore Project Area in much the same ways reported elsewhere.

According to a recent meta-analysis of data from offshore wind farms in Europe, fishes occur at greater abundances within operational wind farm areas than at nearby reference locations (Methratta and Dardick 2019). It remains unclear whether artificial structures increase regional biomass, redistribute existing biomass, or have some effect on both processes (Powers et al. 2003; Brickhill et al. 2005; Rein et al. 2013, Smith et al. 2015). The incidence of fishing pressure also must be accounted for, as many European wind farms are closed to fishing vessels (Coates et al. 2016). At some wind farms in the North and Baltic Seas, no measurable differences in community abundances within and outside of wind farms were observed (Degraer et al. 2016; Langhamer et al. 2018). In the U.S., neither the distribution, abundance, nor condition of individual fishes was altered by installation of WTGs at Block Island Wind Farm, despite predicted impacts to demersal fishes and American lobster communities (Wilber et al. 2018). Within the first 7-years of operation, the catch per unit effort of Atlantic cod and black sea bass increased at trawl survey locations in and around the wind farm, compared to reference locations, while that of other species like longfin squid and winter flounder varied consistently with regional trends (Wilber et al. 2022).

Offshore structures of all types (e.g., fixed, floating) attract many highly migratory fishes (e.g., bigeye tuna, yellowfin tuna, common thresher shark, dusky shark, shortfin Mako shark, whitetip shark) (Itano and Holland 2000). These highly migratory species also may use offshore structures as navigational landmarks (Taormina et al. 2018).

While Foundations would introduce some habitat variability to the relatively uniform sandy substrate in the Lease Area, only a small fraction of the areas would be subject to a reef effect. The Maximum Layout of 202 WTGs and three Offshore Substations and associated Scour Protection would extend in a 230-ft (70-m) diameter around each Foundation, converting up to 203.3 ac (82.3 ha) of softbottom to hardbottom per the maximum design scenario. Foundations offering greater structural complexity (e.g., jackets) would support more complex attached species assemblages than smooth vertical foundation types (e.g., monopiles) (Wilhelmsson and Langhamer 2014; Bué et al. 2020).

Ultimately, effects of Foundations on fishes and invertebrates in the Lease Area may be adverse, beneficial, or mixed depending on the species (NOAA Fisheries 2015; van der Stap et al. 2016). Effects on most benthic and pelagic invertebrates and fishes in the Lease Area would by neutral or beneficial (Hooper et al. 2017). The conversion of softbottom to hardbottom around each Foundation would reduce the amount of softbottom habitat in the Lease Area for ocean quahog, surfclam, flatfishes, and other softbottom dwellers; however, softbottom habitat is not a limiting resource in the Mid-Atlantic Bight or in coastal Virginia. Species that are attracted to structures (e.g., black sea bass, scup, decapod crustaceans) may benefit from the Project. Influences of the Project on local distributions of fishes and invertebrates would be limited to the Lease Area; no population-level impacts are expected.

Habitat introduction of nonindigenous species. Nonindigenous species have been reported on intertidal portions of operational wind farms in the North Sea; nearshore structures may facilitate the movement of nonindigenous species from nearshore intertidal areas to otherwise unconnected hard substrates in the offshore environment introduced by the foundations in the water column (Kerckhof et al. 2010; Adams et al. 2013; Degraer et al. 2016; ICF 2020). In contrast, offshore subtidal WTGs have not been found to facilitate the spread of nonindigenous species (Degraer et al. 2016). In the Lease Area, the nearest WTG Foundations would be 27 mi (43.5 km) from shore, limiting the opportunity for the Foundations to be used as "stepping stones" between offshore subtidal and nearshore intertidal habitats. Some potential exists for the invasive lionfish (*Pterois* spp.) to aggregate around offshore structures (Smith 2010; Morris 2012), although this species has not been reported in the Offshore Project Area. Lionfish are reported in offshore areas both with and without artificial structures (Hare et al. 2002; Grieve et al. 2016; Barker et al. 2018). Therefore, the Project is not expected to introduce or alter the settlement patterns of nonindigenous species in the Offshore Project Area.

Increase in shading and artificial lights. As required by the USCG for navigational safety, artificial lights would be installed on all Project structures as aids to navigation in accordance with USCG regulations (as discussed in Section 4.4.7, Marine Transportation and Navigation). The lights would be directed across the sea surface to increase the visibility of structures to mariners; lights would not be directed into the water. Phytoplankton in surface waters near the lighted structures would be shaded or illuminated for only moments before being transported by waves and currents out of the lighted area. Some zooplankton and ichthyoplankton exhibit diurnal vertical movements and may be attracted to illuminated surface waters and in turn attract opportunistic predators (e.g., mackerel, herring) (Hernandez 2001). Given the water depths in the Offshore Project Area, demersal fishes and invertebrates would be unlikely to detect the artificial light. Foraging fishes vary in their responses to artificial light; mackerels exhibit preference for low light, while clupeids exhibit preference for bright light (Keenan et al. 2007). Fish species that are repelled by artificial light would simply avoid the illuminated area by moving vertically or horizontally outside the reach of the light (Barker and Cowan 2018).

Artificial light may slightly disrupt daily migrations of individual fishes or invertebrates in the Lease Area. Project-related lighting is designed strictly for navigational safety and is substantially less intense than the lights typically used on fully staffed oil and gas platforms. However, just as daytime shading is not expected to substantially decrease primary productivity, night-time light pollution is not expected to substantially impact fish behavior (Gaston et al. 2013; Orr et al. 2013). This low-wattage lighting would cover a minimal fraction of the available sea surface in the Lease Area and would therefore be unlikely to affect local fishes or invertebrates.

Increase in underwater noise and vibration. Fishes and invertebrates in the Offshore Project Area may be directly and indirectly affected by operational noise and vibrations. Section 4.1.5, Underwater Acoustic Environment, discusses the potential impacts of underwater noise and vibration. Routine noise similar to that of commercial vessels trawling or idling in the area would be introduced by Project-related vessels used for O&M. The acoustic impacts of these vessels would be temporary and localized; no mitigation measures are expected to be needed during Project O&M to minimize underwater noise levels (see Appendix Z, Underwater Acoustic Assessment).

Above-water noise generated by WTG gears, generators, and blades would be detectable by some organisms as sound pressure or particle motion (vibrations). Wind speeds have been shown to influence both WTG noise and natural background noise generated by wave action and entrained bubbles, creating a steady state between artificial and natural sources. Stronger wind conditions could increase background noise and WTG noise concurrently (Nedwell et al. 2004). Operational noise would be within the range of naturally occurring background noise and would not negatively affect benthic or pelagic species in the Lease Area.

Change in water quality, including fuel and chemical spills. Turbidity and sedimentation may be temporarily increased in the Offshore Project Area during routine maintenance activities. Section 4.1.2, Water Quality, discusses the potential impacts to water quality resulting from these activities. Any increases in turbidity or incidental contaminant releases from resuspended sediments would be temporary and would not exceed natural levels.

Incidental release of fuel, oil, or other chemical during O&M could temporarily degrade surface water quality in the immediate area of the release. Dominion Energy would develop and implement an Oil Spill Response Plan (see Appendix Q, Oil Spill Response Plan) describing measures to avoid accidental spills and protocols to be implemented should a spill occur. Dominion Energy also would require all Project-related vessels to operate in accordance with laws regulating at-sea discharges of vessel-generated waste. Section 4.4.12, Public Health and Safety, contains additional information.

Introduction of Project-related EMF. Inter-Array and Offshore Export Cables would introduce EMF to the Offshore Project Area (see Appendix AA, Offshore Electric and Magnetic Field Assessment). Research has not identified any clear trends of avoidance, attraction, or adverse effects on marine species, although some species are reported to detect and respond to anthropogenic EMF. Elasmobranchs (rays, sharks, and skates), bony fishes, invertebrates, mammals, and turtles exhibit varying degrees of sensitivity to EMF (i.e., magnetosensitivity, electrosensitivity, or a combination of the two) (Taormina et al. 2018). Magnetosensitive species use earth's geomagnetic frequencies for migration, foraging, and habitat discovery, while electrosensitive species use naturally occurring electric fields to locate prey and detect and avoid predators (CSA Ocean Sciences and Exponent 2019).

Undersea cables typically used by offshore wind farms had no adverse effect on fishes or macroinvertebrates at the Block Island Wind Farm in southern New England; the energized cables emit frequencies undetectable to these species (CSA Ocean Sciences and Exponent 2019). This finding corroborates results of other studies of anthropogenic EMF, which have reported little to no interferences with movement or migration of individual fishes or invertebrates and no adverse or beneficial species-level effects (Rein et al. 2013; Copping et al. 2016; Love et al. 2017; Hutchison et al. 2018). A review of anthropogenic EMF in European offshore wind farms suggested that thermal emissions of subsea cables could impact marine species (Rein et al. 2013). However, follow-up studies of heat emitted by subsea cables concluded that effects on benthic species were negligible. Because cable footprints are narrow, the small amount of thermal output is easily absorbed by the sediment surrounding and overlying buried cables; thermal gradients do not form above the sediment because the overlying water is in constant motion (Emeana et al. 2016; Taormina et al. 2018). EMF associated with the Block Island Wind Farm had no effect on Atlantic sturgeon or any prey consumed by protected whales and sea turtles, including most regional fish and invertebrate species (NOAA Fisheries 2015).

For project-specific EMF modeling, transitory exposures to peak loading magnetic-field levels at the seabed above the buried Offshore Export and Inter-Array Cables were found to be below reported thresholds for effects on the behavior of magnetosensitive marine organisms including sharks, skates, rays, and dogfish. The weak electric fields induced in seawater and in local electrosensitive marine organisms also were found to be below reported detection thresholds. Full results of EMF modeling and potential impacts to marine species are provided in Appendix AA, Offshore Electric and Magnetic Field Assessment.

Dominion Energy would commit to burying Project-related cables to minimize detectable EMF. EMF was conservatively modeled at burial depths of 3 to 7 ft (1 to 2 m), while the target burial depths would range between 3 to 16 ft (1 to 5 m) along most of the length of Offshore Export and Inter-Array Cables, which would likely result in an even lower EMF above the buried Offshore Export and Inter-Array Cables. Given the targeted cable burial depths and the data from operational wind farms and field experiments, EMF is not expected to have any measurable effect on benthic resources and habitat (Gill et al. 2014; Dunlop et al. 2016; Love et al. 2017; Kilfoyle et al. 2018; Taormina et al. 2018; Wyman et al. 2018; CSA Ocean Science and Exponent 2019; BOEM 2020). Offshore Export Cable specifications for the Project are similar to those that BOEM determined would have negligible impacts on coastal habitats, species, or individuals (BOEM 2020). See Appendix AA, Offshore Electric and Magnetic Field Assessment, for additional information.

Potential thermal effects from Offshore Export and Inter-Array Cables on the seabed. The potential effect of increased sediment temperature on benthic resources above energized export cables is driven by four principal factors:

1. The spatial extent of detectable and biologically relevant increases in sediment/pore water temperatures above energized cables;
2. The likelihood that burrowing invertebrates will encounter sediment that has been warmed by buried export cables;
3. The likelihood that an encounter with warmed sediment would adversely affect the organisms; and
4. Whether project-specific heat dissipation above the buried cables would be biologically relevant in the context of regional climate change.

Spatial Extent of Detectable and Biologically Relevant Increases in Sediment/Pore Water Temperatures Above Energized Cables

The cable vendor modeled the heat transfer above the Offshore Export Cable buried at the target burial depth of 2.5 m. The expected increase in sediment temperature at depths potentially encountered by deep burrowing organisms (0.2 m to 0.3 m) is dependent on overlying seawater temperature, as shown below for 10 °C and 25 °C ambient seawater conditions; pore water temperature generally varies with sediment temperature. This analysis assumes that the ambient sediment temperature at 0.2 m and 0.3 m is equal to the ambient seawater temperature (Table 4.2-18).

Table 4.2-18. Ambient Seabed and Sediment Temperature

Ambient Seawater Temperature (°C)	Sediment Temperature at 0.2 m (°C)	Sediment Temperature at 0.3 m (°C)
10.00 °C	12.28 °C	13.44 °C
25.00 °C	26.88 °C	27.79 °C

The predicted minor increases in sediment temperatures above the buried cables are consistent with BOEM’s Environmental Impact Statements for South Fork (BOEM 2021b) and Vineyard Wind (BOEM 2021c). Both Environmental Impact Statements indicated that such increases in temperature would not degrade benthic habitat and are, therefore, biologically insignificant.

Portions of the Offshore Export Cables will not be buried as deep to accommodate undersea cable crossings, which will bring the area of thermal influence closer to the sediment surface. In these instances, however, protective material (e.g., concrete mattresses) will be installed where the Offshore Export Cable approaches the seafloor, which will make burrowing impossible in these areas. The heat of cables near the sediment surface will be quickly dissipated as ocean water flows through and around the mattresses.

Likelihood of Burrowing Invertebrates Encountering Sediment Warmed by Buried Offshore Export Cables

In the CVOW benthic surveys, drop down and towed cameras recorded burrows, mounds, and siphon holes indicating benthic burrowing activity throughout the Offshore Project Area. Most burrowing invertebrates and vertebrates remain within the top 10 cm of the seafloor and would not encounter thermal effects of energized cables. Tetra Tech searched peer-reviewed papers through Web of Science™, publicly available papers online, and government websites and reports to identify benthic organisms that are reported to burrow deeper than 10 cm into the sediment. Tetra Tech cross-referenced those data with organisms that were either observed in CVOW benthic images or expected to occur in the CVOW Offshore Project Area based on general distribution data. Of the deeper-burrowing organisms considered, the Atlantic Surfclam and Atlantic Razor Clam are present in the CVOW Offshore Project Area. The mud/ghost shrimp and softshell clam were not directly observed in CVOW surveys but could occur in the area. Brief profiles of these organisms are below:

Atlantic Surfclam, Spisula solidissima

- **Presence:** Range extends from Gulf of St. Lawrence south to Cape Hatteras Present in benthic grab samples in Lease Area and Offshore Export Cable Route Corridor (Appendix D, Benthic Characterization Report).
- **Depth:** The larger clams burrowed to a depth of 5-6 in (12-14 cm) with their siphons projecting up between the closely packed smaller clams, which were burrowed 2-4 cm below the sediment-water interface. Individual clams burrowed to a depth approximately equal to their shell lengths (Meyer et al. 1987). This species is managed by the Mid-Atlantic Fishery Management Council, which has designated EFH throughout the Lease Area and a portion of the Offshore Export Cable Corridor to a depth of 3 ft (91 cm) below the sediment water interface. The highest density of clams is at 0-38 m water depth, but EFH extends to 60 m water depth (MAFMC 2017, Table 19). The surfclam is vulnerable to dredges that penetrate sandy bottom sediments to a depth of 20-25 cm (NEFMC 2017). In Virginia, the minimum length at maturity is 4.5 cm; therefore, adult burrows would be at least 4.5 cm deep, and older clams would be deeper. Adult surfclams more than 22.6 cm have been reported (Cargnelli et al. 1999b); by extrapolation, burrows could be up to 22.6 cm deep.
- **Temperature:** Growth rate is positively correlated with temperature and is most rapid in spring/early summer (Cargnelli et al. 1999b). Adult surfclams perform best in water that is 22 °C, and prolonged exposure to water ≥30 °C may be lethal (Munroe et al. 2016); exposure to 37 °C is lethal in the lab (Cargnelli et al. 1999b). Surfclams can survive temperatures as low as 2 °C in the field but become active at >15 °C. Experiments conducted for aquaculture determined that juvenile surfclams thrive at 20 °C year-round (Acquafredda et al. 2019). No data on sediment temperatures were included in these studies, but it is reasonable to assume that sediment and water are in equilibrium in the absence of any feature that alters the ambient thermal profile of the seafloor.

Razor Clam, various species

- **Presence:** Range from South Carolina to Canada (MADMF 2022). Present in benthic grab samples in the Lease Area and Offshore Export Cable Corridor (Appendix D, Benthic Characterization Report). At the CVOW Pilot Project, the razor clam (Ensis sp.) dominated the reference sample, accounting for approximately 25.2 percent of all individuals (Appendix D, Attachment D-2, Table D-2-6).
- **Depth:** Burrows up to 70 cm in sandy muddy sediment, ~45 cm in muddy sediment (Holland and Dean 1977). Atlantic razor clam, also called the jackknife clam (*Ensis directus*) can dig to 70 cm below the sediment surface (Lee 2012; Winter et al. 2014).
- **Temperature:** Unknown but reported to become sluggish in water temperatures of 30 °C (Leavitt 2010).

Coastal Mud Shrimp, Upogebia affinis

- **Presence:** Distributed from Cape Cod to Texas; not observed in CVOW surveys, but potentially present in nearshore areas of the Offshore Export Cable Corridor (Fofonoff et al. 2018a).
- **Depth:** Burrows up to 2 meters in Gulf of Mexico (Texas Parks and Wildlife Department 2012). Burrows in Japan were coinhabited by amphipods down to 0.5 cm (Seike and Goto 2020).
- **Temperature:** Broad temperature range characterized as cold temperate/tropical (Fofonoff et al. 2018a).

Softshell Clam, Mya arenaria

- **Presence:** Native range extends from Cape Hatteras to Maine out to 200 m water depth; once common in Chesapeake Bay but not commercially harvested for some decades (Baker and Mann 1990); southern extent on Atlantic Coast now thought to be Chesapeake Bay (Fofonoff et al. 2018b). Not observed in CVOW benthic surveys.
- **Depth:** In large animals (about 10 cm), siphons can reach up to 20 cm to the sediment surface (Fofonoff et al. 2018b). The depth of the burrow increases with age, so that the top of the shell can be 2 cm below the surface when shell length is only 1 cm, 4 cm deep at a size of 2 cm, and 12 cm deep at a size of 4 cm (Zwarts and Wanick, 1989, as cited in Baker and Mann [1990]).
- **Temperature:** Broad temperature range characterized as Polar/Warm temperate (Fofonoff et al. 2018b).

Likelihood That Warmed Sediment Would Adversely Affect Organisms

Thermal effects above the Offshore Export and Inter-Array Cables are not expected to cause any significant adverse impact on burrowing invertebrates in the Offshore Project Area.

- The surfclam could burrow deep enough to encounter some thermal effect from the cables. In winter, the additional heat would have minimal but potentially positive effect on growth. In summer, ambient bottom temperatures in the Offshore Project Area already exceed the optimum for surfclams; therefore, the additional heat would not have a measurable effect.
- Razor clams can burrow deeper than the 0.3 m depth evaluation, and thus could encounter temperatures greater than ambient. However, razor clams are not known to be limited by the expected temperatures. These clams are distributed widely throughout the Mid-Atlantic Bight where temperatures exceed those expected in the Offshore Project Area. No population-level effects would result from heat transfer above the cables.
- The coastal mud shrimp and softshell clam are not known to occur in the Offshore Export Cable Route Corridor. The mud shrimp occurs in the Gulf of Mexico as far as Texas, where summer water temperatures are considerably higher than those projected above the buried cables in the Offshore Project Area. The mud shrimp also can burrow to depths greater that the 0.3 m evaluation. Given their more southern affinity and thermal tolerance, no effects on the mud shrimp are expected.
- The softshell clam population off Virginia has been in decline for some decades and has become rare or absent south of Chesapeake Bay. This species is highly unlikely to be affected by the thermal output of the buried cables based on the temperature distribution information presented above.

Background Temperature Conditions and Trends in the Region

Along the U.S. Atlantic Coast, ocean temperatures have increased since the mid-20th century (Amaya et al. 2023). In models of some coastal regions, bottom temperatures are predicted to increase even more than surface temperatures (Saba et al. 2016). In predictive models, the greatest increase in bottom temperatures (>4 °C) occurs across a broad region north of Cape Hatteras (Alexander et al. 2020). Many species are expected to shift their distributions in response to the waters warming in the Mid-Atlantic Bight, and as the Gulf Stream shifts northwest.

The spatial distribution of numerous populations of fishes and invertebrates have shifted apparently in response to temperature change, although decreased pH and other factors confound the attribution of changes to temperature alone (Hale et al. 2017; Kavanaugh et al. 2017; Hare et al. 2016). The vulnerability of a particular marine organism to changes in ocean temperatures is a function of its mobility, tolerance ranges, life cycle, and other factors as well as the rate of climate change. Sessile and slow-moving species may experience range retractions if they cannot relocate to avoid rapid onset of adverse conditions. Conversely, if change is gradual relative to the organism's life span, even relatively sessile species can adjust. Hale et al. (2017) found that centers of abundance for 60 percent of surveyed benthic macroinvertebrates, including the Atlantic surfclam and ocean quahog, shifted north along the U.S. Atlantic Coast from 1990-2010. For example, increases in ambient bottom temperatures in the Mid-Atlantic Bight area in the past several decades have driven the surfclam harvest farther north and into deeper waters (Timbs et al. 2019; Munroe et al. 2016). Within the context of regional tends in increasing bottom temperatures and changes in species distributions, the thermal impacts of energized subsea cables is negligible and insignificant.

Against this background of shifts in both surface and bottom water temperatures across the region, the thermal impacts of subsea export cables would be extremely localized, negligible, and not ecologically significant. Population-level effects to benthic organisms are not expected.

Decommissioning

Impacts resulting from decommissioning of the Project are expected to be similar to or less than those experienced during construction. Decommissioning techniques are further expected to advance during the lifetime of the Project. A full decommissioning plan will be provided to the appropriate regulatory agencies for approval prior to decommissioning activities, and potential impacts will be re-evaluated at that time.

4.2.4.4 Summary of Avoidance, Minimization, and Mitigation Measures

Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate the potential impact-producing factors described (Table 4.2-19). Dominion Energy will also implement measures identified by the final Essential Fish Habitat consultation and applicable measures included in the Fisheries Mitigation and Monitoring Plan (Appendix V-2). In addition, Dominion Energy will implement all avoidance, minimization, and mitigation measures included in the Construction Mitigation and Monitoring Plan (CMMP) for the Project. Dominion Energy submitted the draft Protected Species Mitigation and Monitoring Plan (now referred to as the CMMP) for the Project to NOAA Fisheries on December 8, 2022. Dominion Energy will continue discussions and engagement with the appropriate regulatory agencies and environmental non-governmental organizations throughout the life of the Project to develop an adaptive mitigation approach that provides the most flexible and protective mitigation measures.

Table 4.2-19. Summary of Avoidance, Minimization, and Mitigation Measures

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
Construction; Decommissioning	Offshore Project Area	Disturbance of softbottom habitat Disturbance, injury, or mortality of benthic and pelagic species, including ESA-listed fish Change in water quality, including turbidity, sediment deposition, and chemical contamination Entrainment of plankton and ichthyoplankton Increase in underwater noise and vibration	• Dominion Energy would establish a horizontal buffer of at least 164 ft (50 m) around identified artificial reefs, shipwrecks, and other mapped hardbottom habitat in the Fish Haven area. No other hardbottom or sensitive habitat is known or expected to occur in the Offshore Project Area. Dominion Energy would further micro-site within the Offshore Export Cable Route Corridor to avoid such habitats where feasible to minimize the probability of adverse interactions with sensitive benthic resources; • The release of non-toxic drilling muds during Trenchless Installation activities is possible but unlikely. Dominion Energy would develop and implement an Inadvertent Release Plan that would include pollution prevention measures and spill response procedures covered by the Stormwater Pollution Prevention Plan; and • Dominion Energy would commit to using a soft-start procedure and noise mitigation systems such as bubble curtain technologies to avoid or minimize impacts to marine mammals, sea turtles, fishes, and mobile invertebrates. During pile-driving activities, Dominion Energy will implement near-field and/or far-field noise mitigation systems to minimize underwater sound propagation. Examples of near-field noise mitigation systems include the Hydro Sound Damper, the Noise Mitigation Sleeve or the AdBm Noise Mitigation System. Dominion Energy is committed to the use of a double big bubble curtain for far field noise mitigation; • The Greater Atlantic Regional Fisheries Office would be notified soon as possible of any observed takes of ESA-fish occurring as a result of any fisheries survey; and • Dominion Energy would ensure that all Project personnel 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, and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements.
Operations and Maintenance	Offshore Project Area	Long-term conversion of softbottom to artificial hardbottom habitat and introduction of vertical infrastructure to the water column Habitat creation for nonindigenous species such as *Didemnun vexillium* (invasive tunicate)	• Dominion Energy does not expect the installation of hard structure to introduce nonindigenous species to the Project Area; however, existing species in the area may colonize or become associated with the structures once they are installed (e.g., lionfish); • As required by the U.S. Coast Guard for navigational safety, artificial lights would be installed on all Project structures; • Dominion Energy would develop and implement an Oil Spill Response Plan describing measures to

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
		Increase in shading and artificial lights Increase in underwater noise and vibration Change in water quality, including fuel and chemical spills Introduction of Project-related electric and magnetic fields (EMF). Potential thermal effects from Offshore Export and Inter-Array Cables on the seabed.	avoid accidental spills and protocols to be implemented should a spill occur. Dominion Energy also would require all Project-related vessels to operate in accordance with laws regulating at-sea discharges of vessel-generated waste; • Dominion Energy would commit to burying Project-related cables wherever feasible to minimize detectable EMF and thermal effects; and • Dominion Energy would ensure that all Project personnel 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, and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements.

4.2.5 Marine Mammals

This section describes the marine mammal species (e.g., whales, dolphin, porpoise, and seals) known to be present, traverse, or incidentally occur in the waters within and surrounding the Offshore Project Area (see Figure 4.2-20). Potential impacts to marine mammals resulting from construction, O&M, and decommissioning of the Project are discussed. Proposed measures and BMPs are described in this section with intent to avoid, minimize, and/or mitigate potential impacts to marine mammals as necessary. Other assessments and reports detailed within this COP which are related to marine mammals include:

- Underwater Acoustic Environment (Section 4.1.5);
- Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat (Section 4.2.4);
- Sea Turtles (Section 4.2.6);
- Benthic Resource Characterization Reports (Appendix D);
- Essential Fish Habitat Assessment (Appendix E);
- Underwater Acoustic Assessment (Appendix Z);
- Offshore Electric and Magnetic Field Assessment (Appendix AA);
- Construction Mitigation and Monitoring Plan (Appendix FF); and
- Underwater Acoustic Impact Assessment of Pile Driving During Construction (Appendix GG).

For the purposes of this section, the Marine Mammals Study Area (Study Area) includes the nearshore waters, offshore waters, and coastlines within the vicinity of the Offshore Project Area (see Figure 4.2-20). The Study Area was designed to capture the full range of animals that may be within the vicinity of or traverse through the Offshore Project Area and the portions of the Onshore Project Area that intersect the Nearshore Trenchless Installation Area based on their highly mobile nature. It also considers the known northern and southern boundaries of some of the typical species present in the area. This section draws information from several sources of data, reports, and studies in the assessment of marine mammals. These sources include regionally specific data gathered by Dominion Energy, specifically Protected Species Observer (PSO) sighting data (and some Passive Acoustic Monitoring [PAM] data) specific to the Study Area, which were also collected during Project-related vessel-based survey activities conducted in 2018–2019. RPS Ocean Sciences' (RPS) PSO sighting reports (Milne 2018) include sightings from the Offshore Project Area and surrounding waters. The most recent 2020-2021 PSO sighting data are summarized in Table 4.2-20.

This section was prepared in accordance with BOEM's site characterization requirements in 30 CFR § 585.626(3) and BOEM's Guidelines for *Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019).

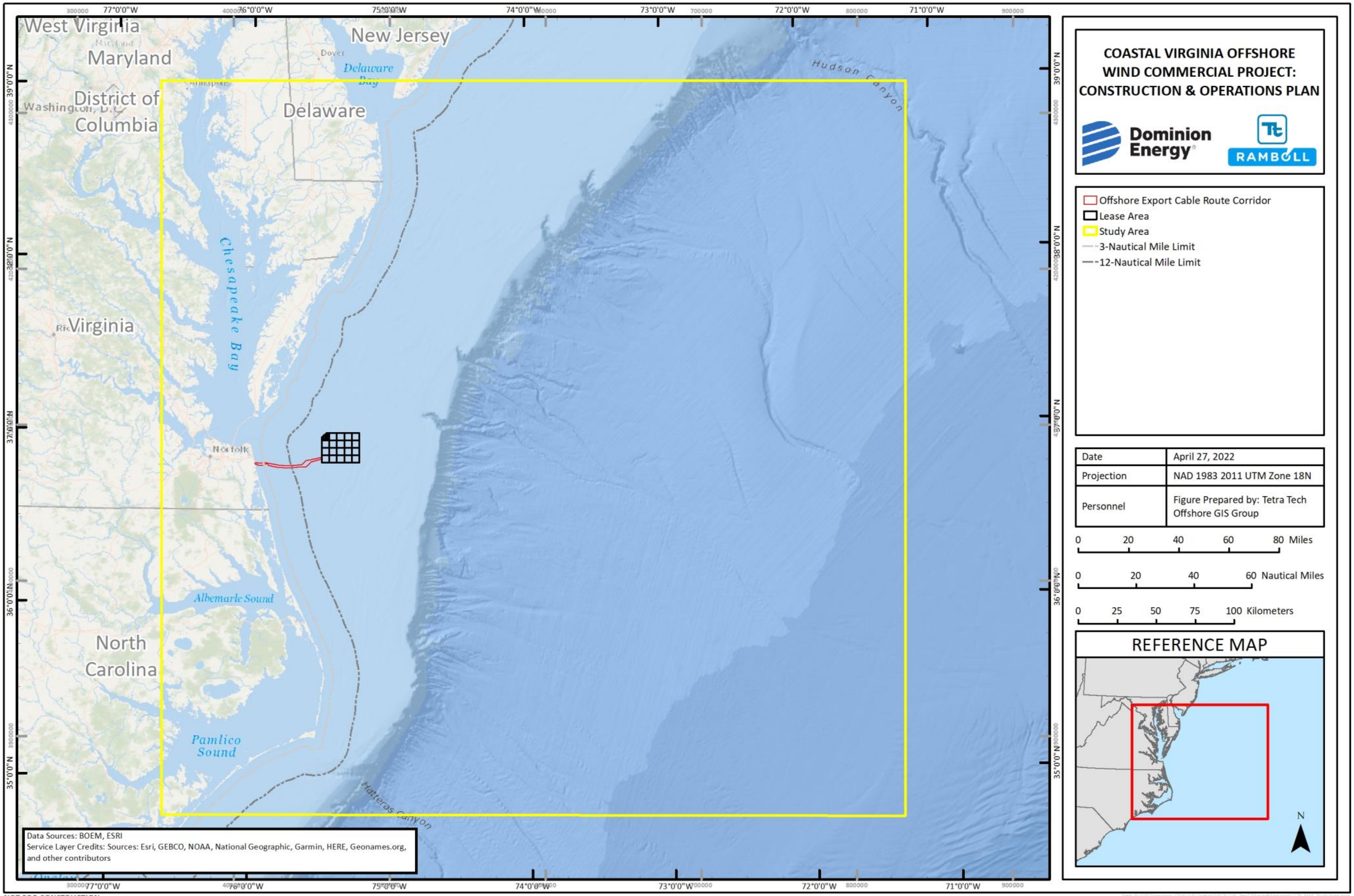

Figure 4.2-20. Marine Mammal Study Area

Table 4.2-20. PSO Sighting Data Summary

Species	2020									2021								
PSO Sightings in 2020–2021 by Month	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Atlantic spotted dolphin	5	34	77	260	112	44	53	0	0	0	0	0	20	36	68	0	0	N/A
Common bottlenose dolphin	10	59	102	107	303	377	150	124	27	3	20	6	11	126	46	362	130	N/A
Common dolphin	0	0	27	46	16	0	0	0	224	840	366	620	945	0	0	0	0	N/A
False killer whale	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	N/A
Fin whale	0	0	0	1	0	0	0	0	0	0	13	0	0	0	0	0	0	N/A
Humpback whale	0	1	0	0	0	0	7	1	23	10	25	0	0	0	0	0	0	N/A
Minke whale	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	N/A
North Atlantic Right Whale	0	0	0	0	0	0	0	0	3	0	3	1	0	0	0	0	0	N/A
Pantropical spotted dolphin	0	0	72	0	7	0	0	0	0	0	0	0	0	10	10	0	0	N/A
Pilot whale spp.	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	3	0	N/A
Pygmy Sperm Whale	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	N/A
Sperm whale	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Spinner dolphin	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A

N/A: PSO sighting data not available

Additionally, this section relies on publicly available, regionally specific information (including existing literature, assessments, and reports [e.g., historical sighting accounts]), NOAA Fisheries Stock Assessment Reports (SARs) (Hayes et al. 2019, 2020, 2021, 2022), scientific publications, technical reports, predictive density modeling data (Roberts and Halpin 2022), and geospatial sighting information retrieved from the Ocean Biogeographic Information System (OBIS) datasets (OBIS 2020). Multi-year stranding data are available through annual reports from the Virginia Aquarium & Marine Science Center Stranding Response Program (Costidis et al. 2019; Swingle et al. 2016, 2017, and 2018).

Additional data required to complete this analysis include the Passive Acoustic Monitoring (PAM) data gathered by the joint Cornell, Oceana, and International Fund for Animal Welfare acoustic buoy data deployed in the Offshore Project Area and adjacent waters up to nearshore Virginia (Salisbury et al. 2016, 2018). These studies collected 2 years of acoustic data between 2015 and 2017 to determine the acoustic presence of North Atlantic right, minke, fin, and humpback whales and integrated findings with data collected during a previous study covering a 3-year period from 2012 to 2015. Odontocete (toothed marine mammals) signatures were also recorded. The hydrophone array used during the 2012–2015 study consisted of five hydrophones along an approximately linear transect. The newer study utilized two arrays: (1) a star-pattern array consisting of five hydrophones and (2) an array of five additional hydrophones along the historical 2012–2015 transect. The methodology used allowed for localization of vocalizing marine mammals along with the species-level identification, when possible, of baleen whales and odontocetes.

Other sources include the joint BOEM, NOAA Fisheries, USFWS, and Navy multi-year, aerial- and vessel-based Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys, and its associated PAM studies for marine mammals and/or sea turtles along the East Coast of the U.S. (NOAA Fisheries 2010a, 2011, 2012, 2013, 2014, 2016, 2017, 2018a). These datasets were used to develop the AMAPPS Marine Mammal Models for select species, which are available through on Online Model Viewer (NOAA Fisheries 2020a). Aerial surveys were conducted in the nearshore and offshore waters for Virginia between 2010 and 2018 (except for 2015) using a 20 km separation between transects, but included additional finer-scale transect lines within the Virginia WEA starting in 2012. Additional regionally specific multi-year studies include Williams et al. (2014). Older published reports, such as the Cetacean and Turtles Assessment Program (CETAP 1982) are also included.

Numerous technical papers, reports, and anecdotal sighting data are available from the Navy Species Monitoring Program. For this program, Mallette et al. (2016, 2017, 2018a, 2018b, 2019) also conducted aerial surveys in the nearshore and offshore waters of Virginia over several years. Other Navy-funded ship-based vessel surveys were conducted beginning in 2012; the most recent available report covers the 2018 season (Engelhaupt et al. 2014, 2015, 2016, 2017, 2018). The Navy has conducted both aerial and vessel-based surveys specifically targeting humpback whales in the nearshore and offshore waters of Virginia (Aschettino et al. 2016, 2018, 2019).

4.2.5.1 Affected Environment

The affected environment includes areas where marine mammals are known to be present, traverse, or incidentally occur in the waters within and surrounding the Study Area and have the potential to be directly or indirectly affected by the construction, operation, and decommissioning of the Project. All marine mammal species are protected under the Marine Mammal Protection Act (MMPA) of 1972 (50 CFR § 216) as amended in 1994. Within the framework of the MMPA, marine mammal populations are further defined as belonging to a specific "stock," which is defined as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature" (16 U.S.C. § 1362). The MMPA prohibits the "take" of marine mammals, which is defined under the MMPA as the harassment, hunting, or capturing of marine mammals, or the attempt thereof. "Harassment" is further defined as any act of pursuit, annoyance, or torment, and is classified as Level A Harassment (potentially injurious to a marine mammal or marine mammal stock in the wild) and Level B Harassment (potentially disturbing a marine mammal or marine mammal stock in the wild by causing disruption to behavioral patterns). In addition, some marine mammal species found in U.S. waters are listed and protected under the Endangered Species Act (ESA) (16 U.S.C. § 1531). The ESA protects endangered and threatened species and their designated critical habitats by prohibiting the unauthorized take of listed animals. Under the ESA, to "take" a listed endangered or threatened species is to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The regulations also define "harm" as an act that kills or injures wildlife.

Occurrence in the Offshore Project Area

There are 38 marine mammal species (seven large whales, 20 dolphins [including larger oceanic dolphin species], five beaked whales, one porpoise, one manatee, and four seals) that are known to be present (some year-round, and some seasonally or incidentally) in the Mid-Atlantic OCS region, which encompasses the Study Area (see Table 4.2-21). NOAA Fisheries uses Marine Species Density Data Gap Assessments as developed by Roberts and Halpin 2022, which built upon older abundance models (originally developed by the Navy [Navy 2007]) to establish current estimates of marine mammal abundance. The current species abundance estimates can be found in NOAA Fisheries SARs (Hayes et al. 2019, 2020, 2021, 2022). The data contained in these SARs suggest that marine mammal density in the Mid-Atlantic OCS region is patchy and seasonally variable.

Table 4.2-21. Marine Mammals Known to Occur in the Marine Waters of Coastal and Offshore Virginia

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence/Seasonality a/	Federal Status	Virginia Status
Odontocetes (Toothed Whales)							
Phocoenidae (Porpoises)							
Harbor Porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	95,543	Shallow, inshore and nearshore, estuarine and coastal waters	Common/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/Fall/ Winter/Spring	MMPA—non-strategic	—
Common Bottlenose Dolphin	*Tursiops truncatus*	Western North Atlantic	62,851	Deeper, offshore waters	Common/Year-round	MMPA—non-strategic	—
		Southern Migratory Coastal	3,752	Shallow, inshore and nearshore, estuarine and coastal waters	Common/Year-round	MMPA—strategic	—
Clymene Dolphin	*Stenella clymene*	Western North Atlantic	4,237	Deeper, offshore waters	Extralimital/Summer	MMPA—non-strategic	—
Dwarf Sperm Whale	*Kogia sima*	Western North Atlantic	7,750	Continental shelf and deeper, offshore waters	Uncommon/Variable	MMPA—non-strategic	—
False Killer Whale	*Pseudorca crassidens*	Western North Atlantic	1,791	Continental shelf and deeper, offshore waters	Uncommon/Variable	MMPA—non-strategic	—
Fraser's Dolphin	*Lagenorhynchus hosei*	Western North Atlantic	unknown	Deeper, offshore waters	Uncommon/Variable	MMPA—non-strategic	—
Killer Whale	*Orcinus orca*	Western North Atlantic	unknown	Continental shelf and deeper, offshore waters	Uncommon/Year-round	MMPA—non-strategic	—
Long-finned Pilot Whale	*Globicephala melas*	Western North Atlantic	39,215	Continental shelf	Common/Year-round	MMPA—non-strategic	—
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	28,924	Continental shelf	Uncommon/Year-round	MMPA—non-strategic	—

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence/Seasonality a/	Federal Status	Virginia Status
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 and deeper, offshore waters	Uncommon/Variable	MMPA—non-strategic	—
Pygmy Killer Whale	*Feresa attenuata*	Western North Atlantic	unknown	Deeper, offshore waters	Uncommon/Variable	MMPA—non-strategic	—
Pygmy Sperm Whale	*Kogia breviceps*	Western North Atlantic	7,750	Continental shelf and deeper, offshore waters	Uncommon/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 and deeper, offshore waters	Uncommon/Year-round	MMPA—non-strategic	—
Common Dolphin	*Delphinus delphis*	Western North Atlantic	172,974	Continental shelf and slope	Common/Year-round	MMPA—non-strategic	—
Sperm Whale	*Physeter macrocephalus*	North Atlantic	4,349	Deeper, offshore waters and slope	Uncommon/Year-round	MMPA-strategic; Endangered ESA	Endangered
Spinner Dolphin	*Stenella longirostris orientalis*	Western North Atlantic	4,102	Deeper, offshore waters and slope	Uncommon/Year-round	MMPA—non-strategic	—
Striped Dolphin	*Stenella coeruleoalba*	Western North Atlantic	67,036	Deeper, offshore waters and slope	Uncommon/Year-round	MMPA—non-strategic	—
White Beaked Dolphin	*Lagenorhyncus albirostris*	Western North Atlantic	536,016	Continental shelf	Uncommon/Variable	MMPA—non-strategic	—
Ziphiidae (Beaked whales)							
Blainville's Beaked Whale	*Mesoplodon densirostris*	Western North Atlantic	10,107 c/	Deeper, offshore waters	Uncommon/Spring/Summer	MMPA—non-strategic	—
Cuvier's Beaked Whale	*Ziphius cavirostris*	Western North Atlantic	5,744	Deeper, offshore waters	Uncommon/Variable	MMPA—non-strategic	—
Gervais' Beaked Whale	*Mesoplodon europaeus*	Western North Atlantic	10,107 c/	Deeper, offshore waters	Uncommon/Spring/Summer	MMPA—non-strategic	—
Sowerby's Beaked Whale	*Mesoplodon bidens*	Western North Atlantic	10,107 c/	Deeper, offshore waters	Uncommon/Variable	MMPA—non-strategic	—

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence/Seasonality a/	Federal Status	Virginia Status
True's Beaked Whale	*Mesoplodon mirus*	Western North Atlantic	10,107 c/	Deeper, offshore waters	Uncommon/Spring/Summer	MMPA—non-strategic	—
Mysticetes (Baleen Whales)							
Balaenopteridae (Rorquals)							
Blue Whale	*Balaenoptera musculus*	Western North Atlantic	unknown	Continental shelf and deeper, offshore waters	Uncommon/Year-round	MMPA—strategic; Endangered ESA	Endangered
Fin Whale	*Balaenoptera physalus*	Western North Atlantic	6,802	Continental shelf and deeper, offshore waters	Common/Year-round	MMPA—strategic; Endangered ESA	Endangered
Humpback Whale (West Indies DPS)	*Megaptera novaeangliae*	Gulf of Maine	1,396	Continental shelf and coastal waters	Common/Fall/Winter/Spring	MMPA—non-strategic b/	Endangered
Common Minke Whale	*Balaenoptera acutorostrata*	Canadian East Coast	21,968	Continental shelf	Common/Year-round	MMPA—non-strategic	—
Sei Whale	*Balaenoptera borealis*	Nova Scotia	6,292	Continental Shelf	Uncommon/ Winter/Spring/Summer	MMPA—strategic; Endangered ESA	Endangered
Balaenidae (Right and Bowhead whales)							
North Atlantic Right Whale	*Eubalaena glacialis*	Western Atlantic	368	Continental shelf and coastal waters	Common/Year-round	MMPA—strategic; Endangered ESA	Endangered
Sirenia (Sea Cows)							
Trichechidae (Manatees)							
West Indian Manatee	*Trichechus manatus*	Florida	4,834	Coastal, bays, estuaries, and inlets	Extralimital/Variable	MMPA—strategic; Threatened ESA	Endangered
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	7.6M	Coastal, bays, estuaries, and inlets	Uncommon/Winter/Spring	MMPA—non-strategic	—
Hooded Seal	*Cystophora cristata*	Western North Atlantic	593,500	Coastal, bays, estuaries, and inlets	Extralimital/Summer/Fall	MMPA—non-strategic	—

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence/Seasonality a/	Federal Status	Virginia Status

Notes:

Marine Mammal Protection Act (MMPA)

a/ Occurrence defined as:

Common: occurrences are regularly documented, and the Study Area is generally considered within the typical range of the species.

Uncommon: occurrences are occasionally documented, and the Study Area is generally considered within the typical range of the species.

Extralimital: few occurrences have been documented and the Study Area is generally considered outside the typical range of the species; any occurrences would likely be of incidental individuals.

b/ Note that the humpback whale (*Megaptera novaeangliae*) was previously federally listed as endangered; however, based on the revised listing completed by NOAA Fisheries in 2016, the Distinct Population Segment (DPS) of humpback whales that occurs along the East Coast of the U.S., 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.

Status denoted as (---) indicates no regulatory status for that species under Federal or Virginia authority.

c/ *Mesoplodon* spp. are extremely difficult to differentiate at sea and the best available datasets only provide abundance estimates at the genus level (Hayes et al. 2019).

Sources: Hayes et al. 2019, 2020, 2021, 2022; Roberts and Halpin 2022; VDWR 2020; USFWS 2014.

Various environmental factors, including water temperature, movements or availability of prey, and human presence or disturbance contribute to marine mammal abundance and occurrence. Distribution patterns, both temporal and spatial, can also change over time in response to these parameters. Some of these changes are due to environmental changes stemming from climate change factors that may affect marine mammals' typical foraging or migrating habitat. Marine mammals typically use the waters of the Study Area for foraging and migration, and some individuals remain year-round. Occurrence is also affected since some cetacean (whale, dolphin, and porpoise) species are pelagic, occurring further offshore, and some are coastal, while some can occur in either area. 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 occur in shallower depths closer to shore. Marine mammal sighting data across multiple years are summarized for each season in Figure 4.2-21 and Figure 4.2-22, illustrating these different preferences and shifts in occurrence both spatially and temporally. In the following species discussions, distribution trends including seasonal and inter-annual patterns are based on both recent survey data and historical behavioral trends.

The six ESA-listed marine mammal species known to be present year-round or seasonally in the waters of the mid-Atlantic are the sperm whale, right whale, fin whale, blue whale, sei whale, and the West Indian manatee (transient). The status of the humpback whale stock that inhabits the Mid-Atlantic OSC region, and which is considered to occur year-round, was revised and members of this stock are no longer considered endangered. 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 (including right whales) are known to remain year-round (Salisbury et al. 2016, 2018). Dolphins, especially some bottlenose stocks, are known to reside in Virginia coastal regions (Gubbins 2002).

The potential for the West Indian manatee and blue whale to occur within the Offshore Project Area is low. The sperm whale and sei whale are also unlikely to occur, but given their ESA status and occasional occurrence, they have been included. Surveys conducted in waters off Norfolk Canyon in Virginia observed sperm, blue, and sei whales in April 2018 as well as right, fin, and humpback whales (Cotter 2019). The blue whale sighting from that survey was the first photographic record of this species in the nearshore area (Navy Marine Species Monitoring 2018a). It may be that prey availability, changing habitat from climate change, or other factors are adjusting known distributions, or are refining previous findings. The West Indian manatee has been sighted in Virginia waters; however, such events are infrequent. As these species are uncommon in the Study Area, they will not be described further in this analysis.

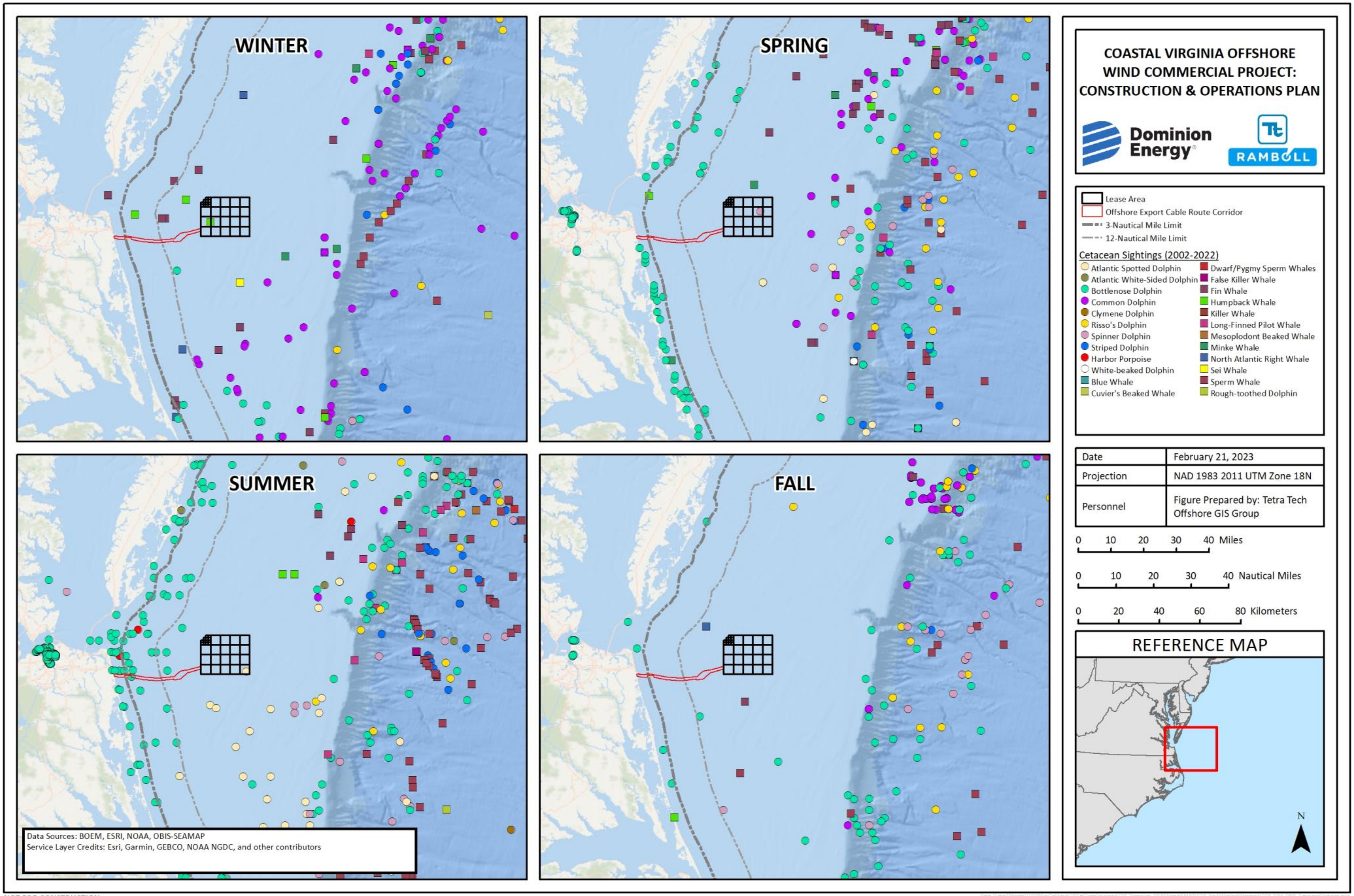

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Figure 4.2-21. OBIS Seasonal Cetacean Sightings in the Marine Mammal Study Area

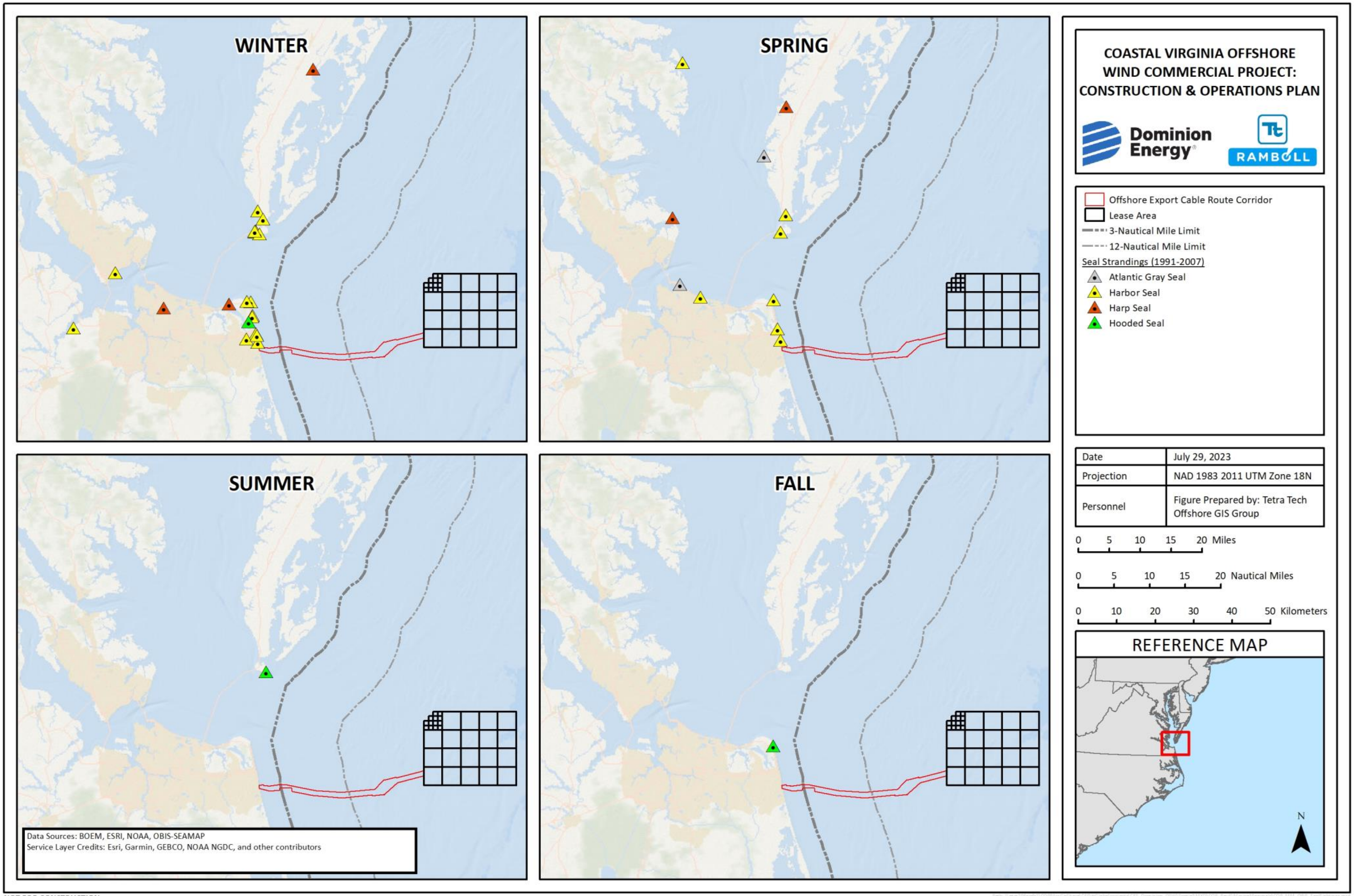


Figure 4.2-22. OBIS Seasonal Seal Strandings in the Marine Mammal Study Area

While stranding data exist for harbor and gray seals along the mid-Atlantic coast south of New Jersey, their preference for colder northern waters makes their occurrence in the Study Area less likely during the summer and fall (Hayes et al. 2022). Winter haul-out sites for harbor seals have been identified within the Chesapeake Bay region. Historical data indicate that seals were generally not present during spring, summer, and fall months (Waring et al. 2016). However, more recent tagging and acoustic surveys in Virginia nearshore waters spanning two years of study are providing updated baseline data that indicate that seals utilize the area more than previously thought. There is now regular seasonal occurrence of seals, including harbor and gray, between fall and spring (Navy Marine Species Monitoring 2018b). Harbor seals are the predominantly observed species. Coastal Virginia was thought to represent the southern extent of the habitat range for gray seals, with few stranding records reported for Virginia and sightings occurring only during winter months as far south as New Jersey until recently (Waring et al. 2016). Similar to shifts in cetacean occurrence, prey availability or changing habitat from climate change or other factors could be driving changes in distribution of seals. Because harp and hooded seals are not anticipated to occur in the Study Area, these species will not be described further in this analysis. Gray seal distribution and status will not be further described, but consideration of take for this species will be included with harbor seals because the current best available data on predicted densities of seals (Roberts and Halpin 2022) do not distinguish between harbor and gray seals, but rather provides a single density value for both species.

In general, the range of the remaining non-ESA dolphin, beaked-whale, and other cetacean species listed in Table 4.2-21 is outside the Study Area. They are usually found in more pelagic shelf-break waters or have a preference for northern latitudes, and their presence in the Study Area is unlikely. Because the potential presence of these species in the Study Area is considered extremely low, they are not further addressed in this analysis.

The following subsections provide additional information on the biology, habitat use, abundance, distribution, and the existing threats (including human-derived threats) to the non-ESA listed or the federally listed (ESA) endangered marine mammals that are common in Virginia waters and have the likelihood of occurring at least seasonally in the Study Area. These species include the harbor porpoise, Atlantic spotted dolphin, pantropical spotted dolphin, Atlantic white-sided dolphin, bottlenose dolphin, long-and short-finned pilot whale, Risso’s dolphin, common dolphin, sperm whale, fin whale, humpback whale, minke whale, sei whale, right whale, and harbor seal.

These subsections also provide information regarding marine mammal hearing based on the NOAA Fisheries National Marine Fisheries Service (NOAA Fisheries 2018b) categories for low-, mid-, and high-frequency cetacean hearing groups. As part of an effort to assess impacts from anthropogenic sound sources, marine mammal species have been arranged into functional hearing groups based on their generalized hearing sensitivities: (1) high-frequency cetaceans (harbor porpoise), (2) mid-frequency cetaceans (dolphins, toothed whales, beaked whales), (3) low-frequency cetaceans (*Mysticetes*; i.e., baleen whales), (4) otariid pinnipeds (sea lions and fur seals), and (5) phocid pinnipeds (true seals) (NOAA Fisheries 2018a). These groupings are based on technical guidelines from NOAA Fisheries and are listed in Table 4.2-22 and described in further detail in Section 4.1.5, Underwater Acoustic Environment. Note that otariid pinnipeds do not occur in the Offshore Study Area or Nearshore Trenchless Installation Area.

Table 4.2-22. Functional Hearing Range for Marine Mammals

Functional Hearing Group	Functional Hearing Range
LF cetaceans (baleen whales)	7 Hz to 35 kHz
MF cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
HF cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (underwater) (true seals)	50 Hz to 86 kHz

Notes:
Hz – hertz; kHz – kilohertz; HF – high frequency; LF – low frequency; MF – mid-frequency
Source: NOAA Fisheries 2018b

Human-induced impacts include underwater noise, vessel collisions, entanglements, habitat loss, pollution, and commercial fishing (Kenney 2002). Underwater noise generated from a variety of human activities is a known stressor for marine wildlife (Nowacek et al. 2007). Noise sources include noise from vessels associated with wind farm development or construction; from survey and construction equipment such as multi-beam echosounders or other bottom survey equipment (typically utilized during pre-construction surveys); and pile-driving activities (see Section 3, Description of Proposed Activity, for additional information). Noise in the marine environment may cause injury and displacement and is known to affect marine mammal behavior. Stress from noise may reduce reproductive fitness by increasing energy expenditures, reducing foraging success, or by masking vocalizations which can also have other indirect effects. Increases in ship numbers and changes in vessel traffic associated with pre-construction surveys, wind farm construction, and post-construction operation and maintenance activities also increase the risk of vessel collisions with marine wildlife. These and other potential impacts to marine mammal species will be discussed further in Section 4.2.5.3, Summary of Avoidance, Minimization, and Mitigation Measures.

Species Overview

ESA-Listed Endangered Species with Common Occurrence in the Offshore Project Area

North Atlantic Right Whale

The North Atlantic right whale (*Eubalaena glacialis*) (right whale) is considered one of the most critically endangered populations of large whales in the world and is listed as federally endangered under the ESA. The Western Atlantic stock is considered depleted under the MMPA (Hayes et al. 2021). There is a recovery plan (NOAA Fisheries 2005) for the right whale, and the most recent 5-year review of the species was published by NOAA Fisheries in November 2022 (NOAA Fisheries 2022). The review reported that the status of North Atlantic right whale recovery has continued to decline since the last 5-year review performed in 2017 and recommended that the species status remain as Endangered (NOAA Fisheries 2022). The North Atlantic right whale had a 2.8 percent recovery rate between 1990 and 2011, but the overall abundance declined 23.5 percent between 2011 and 2019 (Hayes et al. 2022). Distinguishing features for right whales include a stocky body, generally black coloration (although some have white patches on their undersides), lack of a dorsal fin, a large head (about one quarter of the body length), strongly bowed margin of the lower lip, and callosities on the head region. The tail is broad, deeply notched, and all black with smooth trailing edge (Jefferson et al. 2015). Right whales are considered grazers as they swim slowly with their mouths open. They are the slowest swimming whales, only reaching speeds up to 10 miles/hour (16 kilometers/hour). They can dive at least 1,000 ft (300 m) and stay submerged for typically 10 to 15 minutes, feeding on their prey below the surface (Jefferson et al. 2015). The species' prey is primarily copepods (*Calanus finmarchicus* believed to be the primary prey) along with other zooplankton, including *Centropages*, *Pseudocalanus*, and cyprids (Mayo and Marx 1990). Right whale hearing is in the LF range (Southall et al. 2007; NOAA Fisheries 2018b).

The species is migratory, moving annually between high-latitude feeding grounds and low-latitude calving and breeding grounds. The current range of the western North Atlantic right whale population extends from the southeastern U.S., which is utilized for wintering and calving, to summer feeding and nursery grounds between New England and the Bay of Fundy and the Gulf of St. Lawrence (Kenney 2009; Hayes et al. 2022). A few events of right whale calving have been documented from shallow coastal areas and bays (Kenney 2009). North Atlantic right whales may be found in feeding grounds within New England waters between February and May, with peak abundance in late March (Hayes et al. 2022). The offshore waters of Virginia, including waters within the Study Area, are used as a migration corridor for right whales and are considered a Biologically Important Area for migration. Biologically Important Areas are designated by NOAA Fisheries with the input of specialists in order to identify areas where cetacean species or populations are known to concentrate for specific behaviors, even though insufficient data are available to reflect this importance with spatial mapping. Right whales occur during seasonal movements north or south between important feeding and breeding grounds (Knowlton et al. 2002; Firestone et al. 2008). Right whales are known to have extensive movements both within and between their winter and summer habitats, and their calving grounds are thought to extend as far north as Cape Fear, North Carolina (Hayes et al. 2022). Right whales have been observed in coastal Atlantic waters year-round. They have been acoustically detected off Georgia and North Carolina in 7 of 11 months monitored (Hodge et al. 2015) and other recent passive acoustic studies of right whales off the Virginia coast demonstrate their year-round presence in Virginia (Salisbury et al. 2016, 2018), where increased detections in fall and late winter/ early spring have been documented. They are typically most common in the spring (late March and April) when they are migrating north, and in the fall (i.e., October and November) when they are migrating south (Kenney and Vigness-Raposa 2010; NOAA Fisheries 2017). There were sightings of up to eight right whales on two separate days in coastal Virginia in April 2018 (April 9 and 11, 2018; Cotter 2019). Currently, there are no marine mammal sanctuaries in the waters off Virginia pertaining to critical habitat for North Atlantic right whales, but the area is designated as a Biologically Important Area for migration (NOAA Fisheries 2005; Hayes et al. 2022). In 2016, the Southeastern U.S. Calving Area Critical Habitat was expanded northward to Cape Fear, North Carolina (Hayes et al. 2022). The relative abundance and density of North Atlantic right whales peaks in winter along the nearshore portions of the continental shelf, declines in spring, and is lowest during summer and fall, according to predictive density mapping based on long-term survey data (Roberts and Halpin 2022 see Figure 4.2-23). Note the Roberts and Halpin (2022) data examine nearshore distribution, whereas the distribution patterns noted above are more general for Virginia waters. Annual peaks in sightings occur in April and annual lows occur from July to October according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for North Atlantic right whales was not publicly available at the time of writing; therefore, this information is not included here. Three sightings of right whales were reported by PSOs during 2021, between February and March.

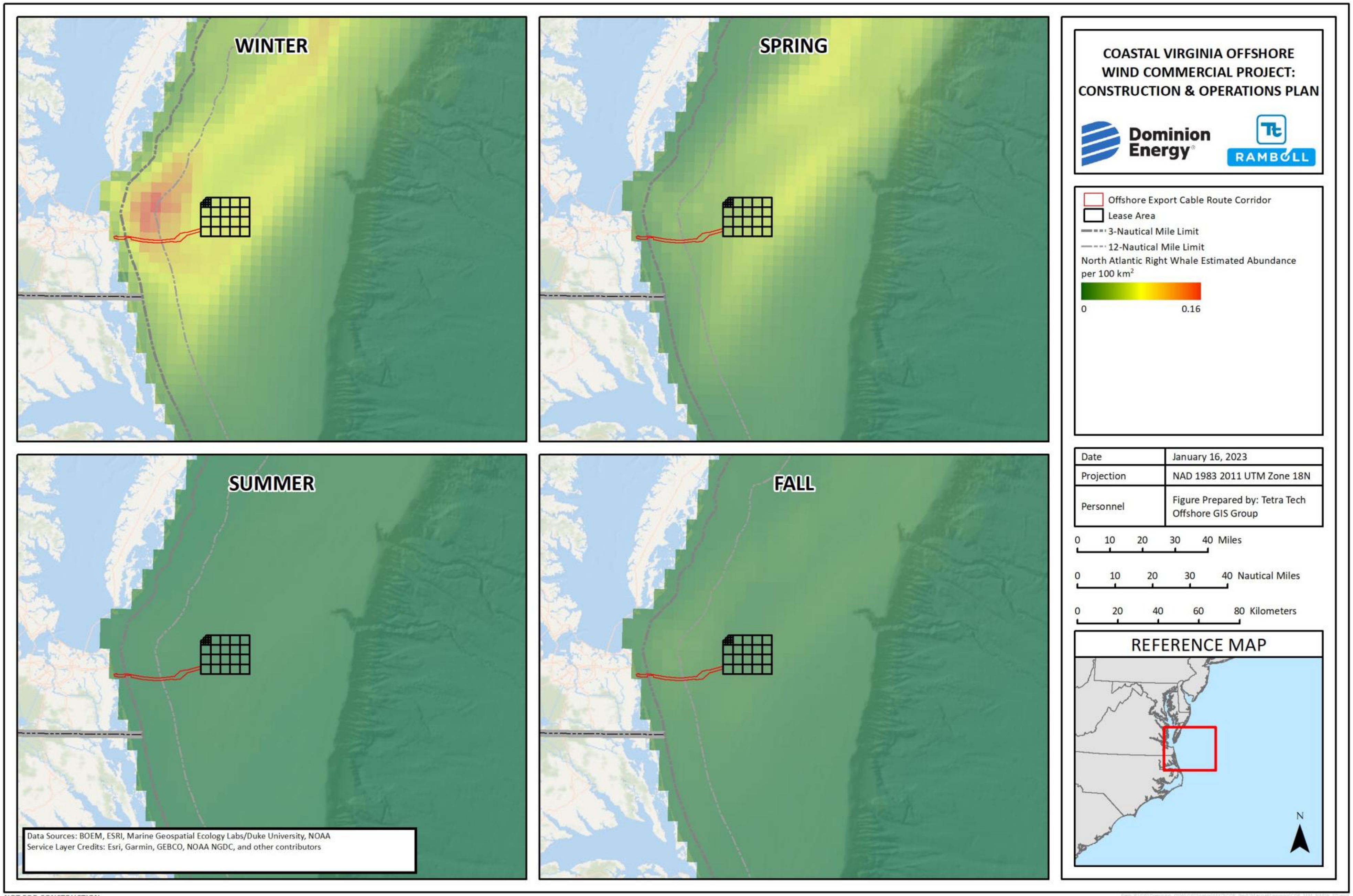


Figure 4.2-23. Seasonal Distribution of the North Atlantic Right Whale in the Marine Mammal Study Area

Abundance estimates for the North Atlantic right whale population vary. The North Atlantic right whale was the first species targeted during historical commercial whaling operations and was the first species to be greatly depleted as a result (Kenney 2009). North Atlantic right whales were hunted in southern New England until the early twentieth century. Shore-based whaling in Long Island involved catches of right whales year-round, with peak catches in spring during the northbound migration from calving grounds off the southeastern U.S. to feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa 2010). As of the 2003 SAR, there were estimated to be only 291 North Atlantic right whales in existence, which is less than what was reported in the Northern Right Whale Recovery Plan (NOAA Fisheries 2005; Waring et al. 2004). This is a tremendous difference from pre-exploitation numbers, which are thought to be around 1,000 individuals in the 1600s (Hayes et al. 2022). When protections for the right whale were implemented in the 1930s, it is believed that the North Atlantic right whale population was roughly 100 individuals (Waring et al. 2004). In 2015, the western North Atlantic population size was estimated to be at least 476 individuals (Waring et al. 2016). That minimum population size estimate decreased to 412 individuals in 2020 (Hayes et al. 2022). Additional information provided by Pace et al. (2017) confirms that the probability that the North Atlantic right whale population has declined since 2010 is 99.9 percent. Data indicate that the number of adult females dropped from 200 in 2010 down to 186 in 2015, while males dropped from 283 to 272 in the same timeframe.

Another cause for concern is the confirmed mortality of 17 individuals in 2017 alone (Pace et al. 2017). An unusual mortality event (UME) was established for North Atlantic right whale in June 2017 due to elevated strandings along the Atlantic coast, especially in the Gulf of St. Lawrence region of Canada. Under the MMPA, a UME is defined as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response." The UME for right whale strandings was declared in 2017 based on a high number of dead whales discovered in Canadian and U.S. waters and is still considered active with the current total at 50 whales (NOAA Fisheries 2022). The mortalities of 17 whales in 2017 equaled roughly 4 percent of the population, which is significant given the current population estimate.

Contemporary anthropogenic threats to right whale populations include fishery entanglements and vessel strikes, although habitat loss, pollution, anthropogenic noise, and intense commercial fishing may also negatively impact their populations (Kenney 2009; Hayes et al. 2022). Ship strikes can impact North Atlantic right whales on a population level due to their critically endangered status and their intrinsically small remnant population that persists in the North Atlantic (Laist et al. 2001). From 2015 through 2019, the minimum rate of annual human-caused mortality and serious injury to right whales averaged 7.78 per year (Hayes et al. 2022). Records from 2014 through 2018 indicate there have been 43 confirmed injury events, including 18 mortalities (Hayes et al. 2022). From 2014 through 2018, the minimum rate of annual human-caused mortality and serious injury to this species from fishing entanglements averaged 5.76 per year, while ship strikes averaged 2.01 whales per year (Hayes et al. 2022). Environmental fluctuations and anthropogenic disturbance may be contributing to a decline in overall health of individual North Atlantic right whales that has been occurring for the last three decades (Rolland et al. 2016). The most recent NOAA right whale SAR states that the low annual reproductive rate of right whales, coupled with small population size, suggests anthropogenic mortality may have a greater impact on population growth rates for the species than for other whales and that any single mortality or serious injury can be considered significant (Hayes et al. 2022).

Most ship strikes are fatal to the North Atlantic right whales (Jensen and Silber 2004). Right whales have difficulty maneuvering around boats and spend most of their time at the surface, feeding, resting, mating, and nursing, which increases their vulnerability to collisions. Mariners should assume that North Atlantic right whales will not move out of their way, nor will they be easy to detect from the bow of a ship given their dark color and low profile while swimming (World Wildlife Fund 2005). To address the potential for ship strike, NOAA Fisheries designated the nearshore waters of the Mid-Atlantic Bight as the Mid-Atlantic U.S. Seasonal Management Area (SMA) for right whales in December 2008 (see Figure 4.2-24). NOAA Fisheries requires that all vessels 65 ft (19.8 m) or longer must travel at 10 knots (18.5 km/h) or less within the right whale SMA from November 1 through April 30 when right whales are most likely to pass through these waters (NOAA Fisheries 2018c). Findings from the Right Whale Speed Rule Assessment (NOAA Fisheries 2020b) and studies by Van der Hoop et al. (2012) have concluded that 85 percent of vessels comply with the speed rule within most of the SMAs, while in others, only about 25 percent comply. The Dynamic Management Area program (DMA) found that mariner cooperation was limited in mandatory SMAs with less than 50 percent cooperation in the Mid-Atlantic, and around 83 percent off of New England. Portions of the Study Area are located within the right whale Mid-Atlantic SMA at the mouth of the Chesapeake Bay. NOAA Fisheries also implements Slow Zones (based on presence of both visually and acoustically detected whales.

Based on the current knowledge of right whale occurrences and the establishment of an SMA around approaches to Chesapeake Bay, right whales have the potential to occur in the Study Area, and overall likelihood of occurrence of North Atlantic right whales in the Study Area is highest during the migration periods of fall and spring.

Fin Whale

The fin whale (*Balaenoptera physalus*) is listed as endangered under the ESA, and the western North Atlantic stock is designated as depleted under the MMPA (Hayes et al. 2022). A final recovery plan for the fin whale was published in 2010 (NOAA Fisheries 2010b), and a recent five-year review of the current recovery plan recommended reclassifying from endangered to threatened due to an overall increasing world population (NOAA Fisheries 2019b). A fin whale has a sleek, streamlined body with a V-shaped head. Fin whales have distinctive coloration: black or dark brownish-gray on the back and sides, and white on the underside (NOAA Fisheries 2010b). Head coloring is asymmetrical: dark on the left side of the lower jaw, white on the right-side of the lower jaw. Many fin whales have several light-gray V-shaped chevrons behind their heads, and the underside of the tail flukes is often white with a gray border; these markings are unique and can be used to identify individuals (NOAA Fisheries 2010b). They feed on krill and small schooling fish during the summer and fast during the winter. Fin whales are the second-largest living whale species on the planet and are found world-wide in all temperate and polar oceans (NOAA Fisheries 2019b). Fin whale hearing is in the LF range (Southall et al. 2007; NOAA Fisheries 2018a).

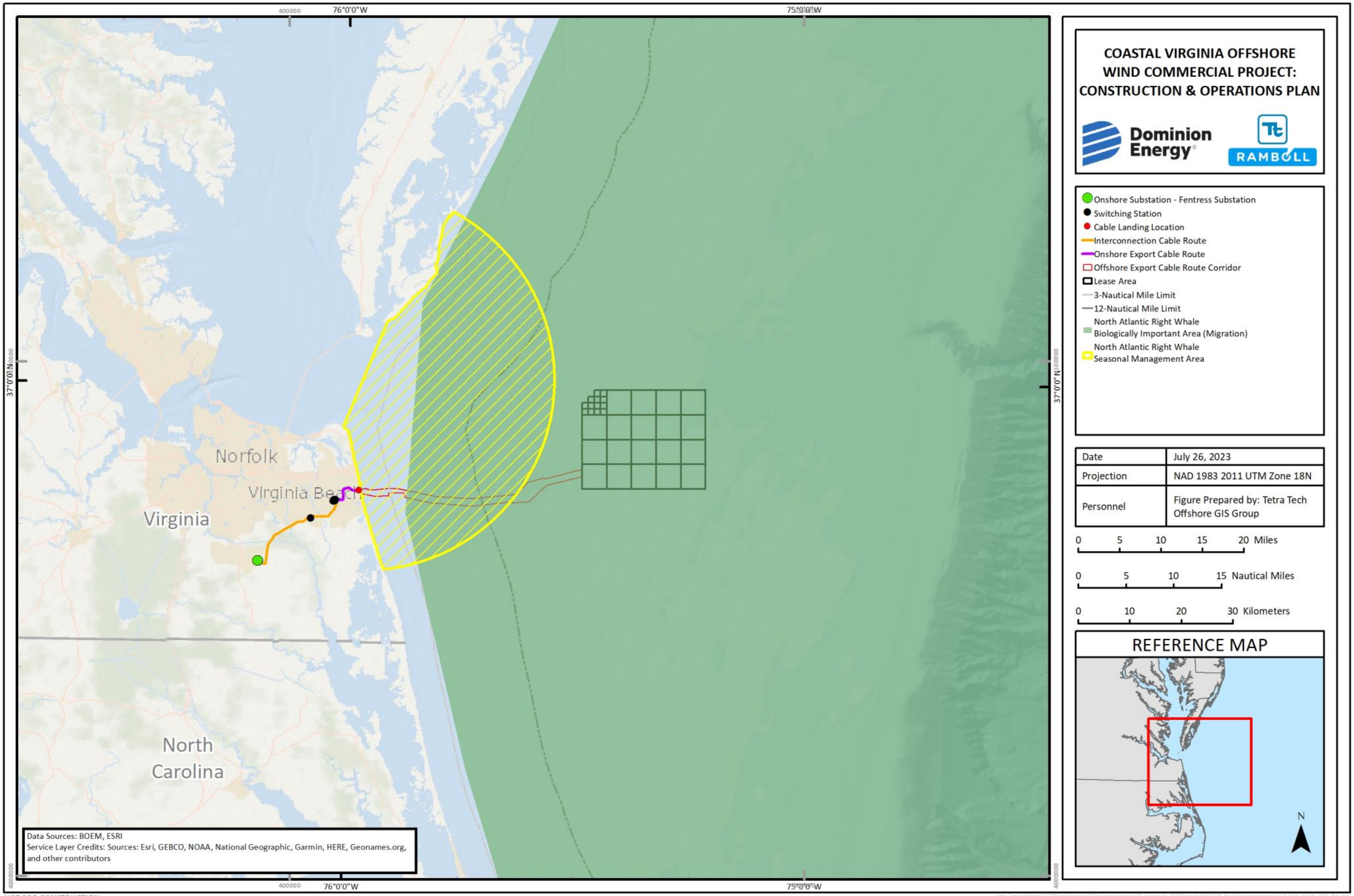


Figure 4.2-24. North Atlantic Right Whale Seasonal Management Area and Biologically Important Area in the Marine Mammal Study Area

The range of fin whales in the North Atlantic extends from the Gulf of Mexico, Caribbean Sea, and Mediterranean Sea in the south to Greenland, Iceland, and Norway in the north (Jonsgård 1966; Archer et al. 2019). They are the most commonly sighted large whales in continental shelf waters from the mid-Atlantic coast of the U.S. to Nova Scotia, principally from Cape Hatteras and northward (Sergeant 1977; Sutcliffe and Brodie 1977; CETAP 1982, Hain et al. 1992; NOAA Fisheries 2019). Fin whales are present in the Mid-Atlantic OCS region during all four seasons, although sighting data indicate that they are more prevalent during winter, spring, and summer (Hayes et al. 2022). While fall is the season of lowest overall abundance off Virginia, fin whales do not depart the area entirely. Fin whales, much like humpback whales, seem to exhibit habitat fidelity to feeding areas (Hayes et al. 2022; NOAA Fisheries 2019). While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, mating and calving (and general wintering) areas are largely unknown (Hayes et al. 2022). Strandings data indicate that calving may take place in the Mid-Atlantic OCS region during October to January for this species (Hain et al. 1992).

The relative abundance and density of fin whales begins to increase in winter along the continental slope, peaks in spring and summer, and is lowest during fall, according to predictive density mapping based on long-term survey data (Roberts et al. 2020; see Figure 4.2-25). Annual peaks in occurrence are in March and annual lows occur in August according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for fin whales indicates moderate presence throughout the Lease Area with low presence in the nearshore waters of Virginia in all seasons modeled (spring, summer, fall) (NOAA Fisheries 2020a). One sighting of fin whale was reported in July of 2020, and thirteen sightings of fin whales were reported by PSOs during 2021, during February.

The best abundance estimate for fin whales in the western North Atlantic is 6,802 individuals, based on the most recent SAR. Insufficient data are available to determine the population trend for fin whales; however, a decline in fin whale abundance has been noted within the northern Gulf of St. Lawrence (Hayes et al. 2021). Present threats to fin whales are similar to those that threaten other large whale species, namely fishery entanglements and vessel strikes. There are no confirmed fishery-related mortalities or serious injuries of fin whales reported in the NOAA Fisheries Sea Sampling bycatch database (Hayes et al. 2022). Past records on entanglement reported by Glass et al. (2008) show that between 2002 and 2006 fin whales belonging to the Gulf of Maine population were involved in eight confirmed entanglements with fishery equipment. Past records on mortality reported by NOAA Fisheries data indicate that fin whales are susceptible to ship strikes; four fin whales were confirmed killed by collision from 2014 through 2018 (Hayes et al. 2022). A review of recent NOAA Fisheries records for 2014 through 2018 found four incidents that had sufficient information to confirm the cause of death as collisions with vessels, and an additional nine observations of fin whales entangled with fishing gear were reported in the U.S. North Atlantic waters (Hayes et al. 2022). For the period 2014 through 2018, the minimum annual rate of human-caused mortality and serious injury to fin whales was 2.35 per year, including incidental fishery interaction records totaling 1.55 individuals, and records of vessel collisions totaling 0.8 whales (Hayes et al. 2022). Fin whales are present year-round throughout Virginia's offshore waters, especially along the continental slope (NOAA Fisheries 2020c). Likelihood of occurrence begins to increase in winter, peaks in spring and summer, and declines in fall (Roberts and Halpin 2022; OBIS 2020). The overall likelihood of fin whale occurrence in the Study Area is moderately high based on available data, particularly along the eastern portion of the Lease Area.

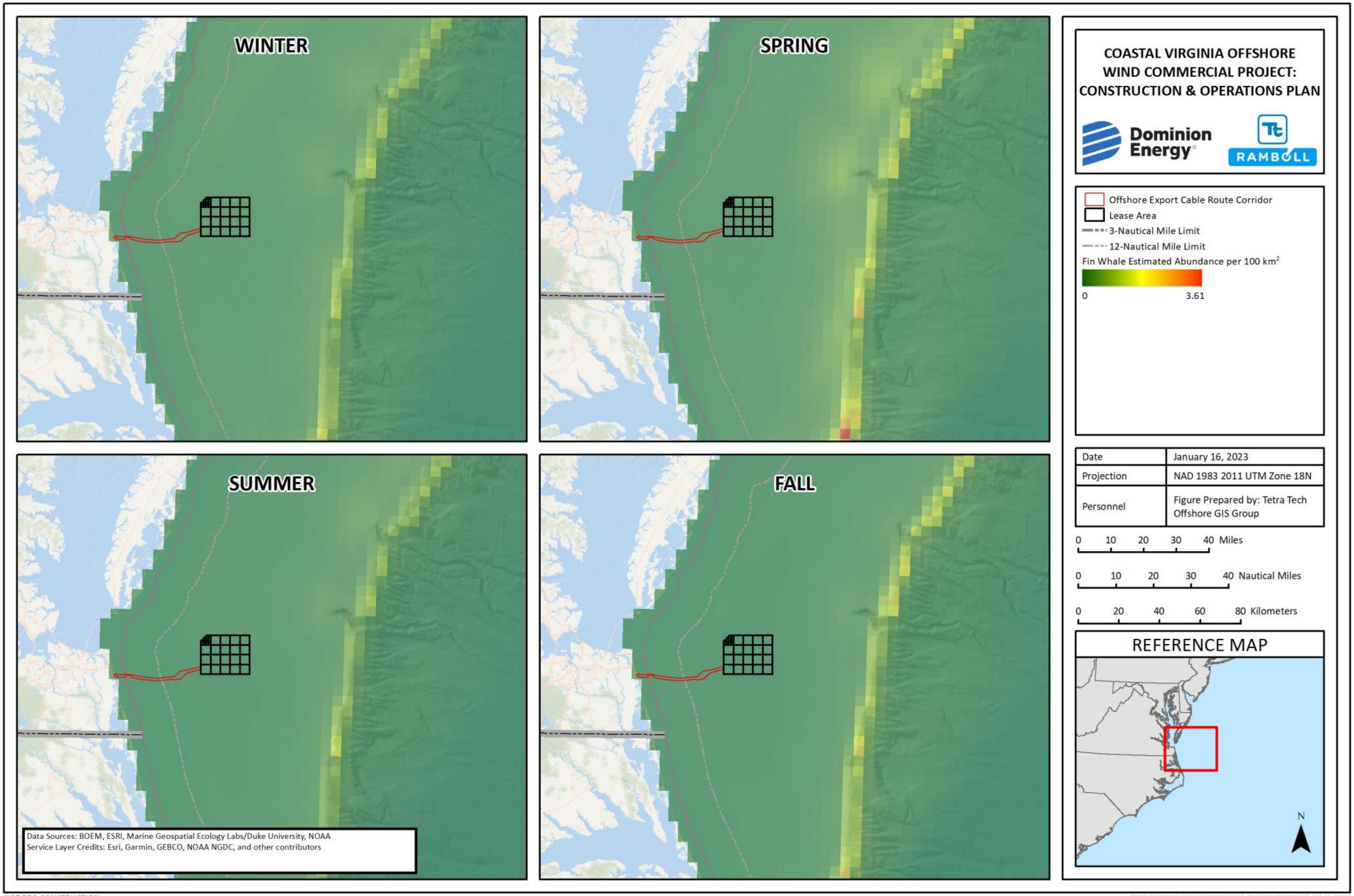


Figure 4.2-25. Seasonal Distribution of the Fin Whale in the Marine Mammal Study Area

Sei Whale

The sei whale (*Balaenoptera borealis borealis*) is listed as endangered under the ESA and is designated as depleted under the MMPA (Hayes et al. 2022). A final recovery plan for the sei whale was published in 2011 (NOAA Fisheries 2011). A five-year review of the species was completed in 2012 (NOAA Fisheries 2012) with no change in status and another five-year review was initiated in 2018 (pending). Sei whales are a blue-black-gray color with skin often marked by pits or wounds, which after healing become ovoid white scars probably caused mainly by ectoparasitic copepods. The sei whale can be distinguished from other baleen species by its dorsal fin, which is falcate and curves backward, set about two-thirds of the way back from the tip of the snout. Unlike fin whales, they tend not to roll high out of the water as they dive. In sei whales, the blowholes and dorsal fin are often exposed above the water surface simultaneously. Although sei whales may prey upon small schooling fish and squid, available information suggests that calanoid copepods and euphausiids are the primary prey of this species (Flinn et al. 2002). However, insufficient data pertaining to the diet and foraging of sei whales in the waters off Virginia are available (Costidis et al. 2017). Sei whale hearing is in the LF range (Southall et al. 2007; NOAA Fisheries 2018a).

The sei whale is a widespread species in the world's temperate, subpolar, subtropical, and tropical marine waters. NOAA Fisheries considers sei whales occurring from the U.S. East Coast to Cape Breton, Nova Scotia, and east to 42°W, as belonging to the "Nova Scotia stock" of sei whales (Hayes et al. 2022). Sei whales occur in deep water characteristic of the continental shelf edge throughout their range (Hain et al. 1992; Hayes et al. 2022). In the waters off Virginia, sei whales are rarely sighted; however, this may be an artifact of being keyed (i.e., identified using standard identification parameters) as fin whales during surveys since it is difficult to distinguish between the two. However, a 2018 aerial survey conducted by the Navy recorded sei whales in the area surrounding Norfolk Canyon (Navy, n.d.).

The relative abundance and density of sei whales peaks in summer along the continental slope and farther offshore, declines in fall, slightly increases in winter, and is lowest in spring, according to predictive density mapping based on long-term survey data (Roberts and Halpin 2022; see Figure 4.2-26). Specifically, annual peaks in occurrence are in May and annual lows occur from January to March according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for sei whales indicates low presence throughout the Study Area in all seasons modeling (spring, summer, fall) (NOAA Fisheries 2020a).

There is limited information on the stock identity of sei whales in the North Atlantic (Hayes et al. 2022). The best abundance estimate based on the most recent SAR for the Nova Scotia stock of sei whales is 6,292 (Hayes et al. 2022). Insufficient data are available to determine trends of the Nova Scotian sei whale population. From 2014 through 2018, the minimum annual rate of human-caused mortality and serious injury was 1.20 (Hayes et al. 2022). No confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NOAA Fisheries Sea Sampling bycatch database (Hayes et al. 2022). Sei whales are present seasonally in Virginia's offshore waters, especially along the continental slope (NOAA Fisheries 2020a). Their likelihood of occurrence peaks in summer, declines in fall and winter, and is lowest in spring (Roberts and Halpin 2022; OBIS 2020). The overall likelihood of sei whale occurrence in the Study Area is low to moderate based on available data.

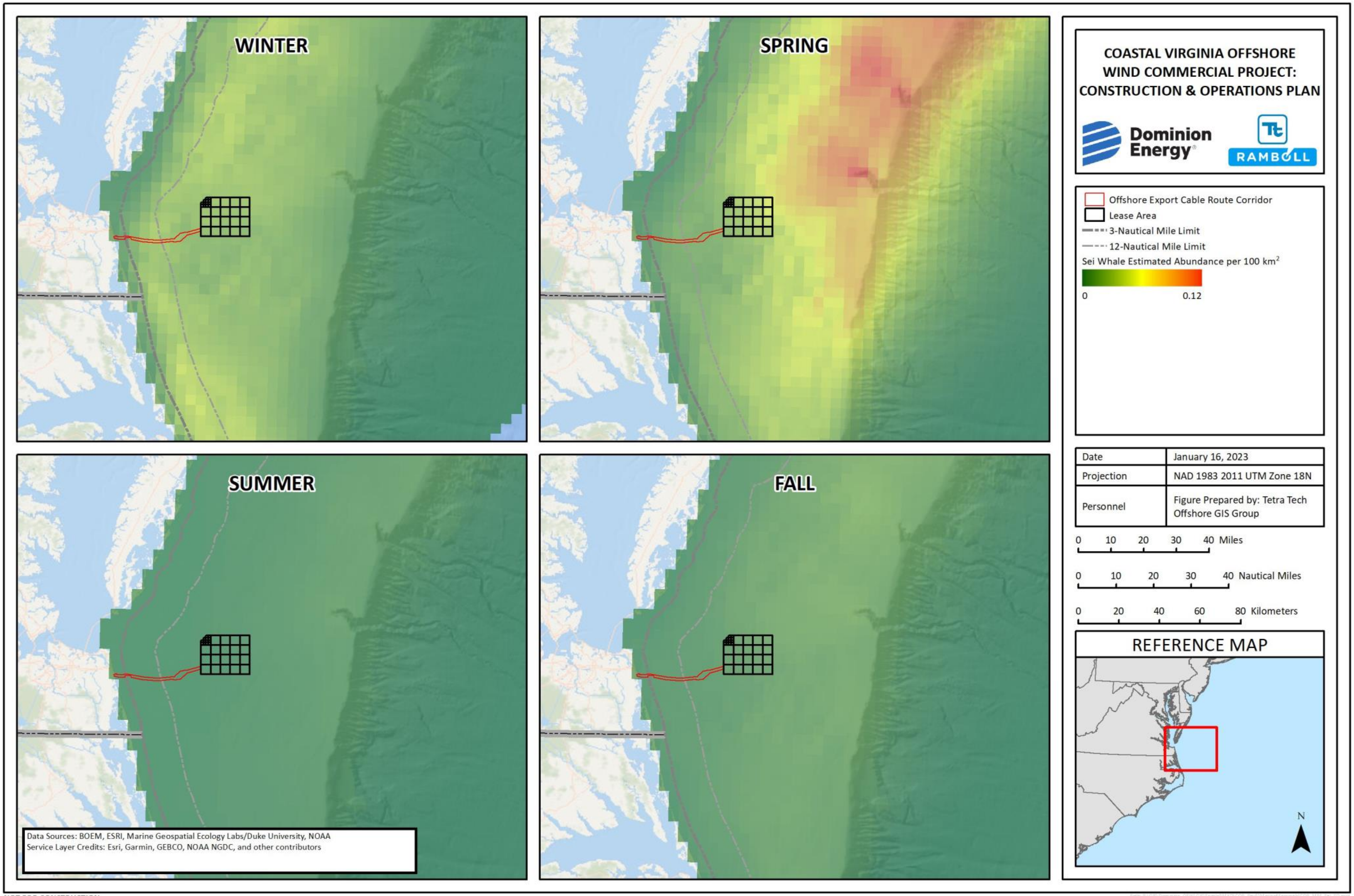


Figure 4.2-26. Seasonal Distribution of the Sei Whale in the Marine Mammal Study Area

Sperm Whale

The sperm whale (*Physeter macrocephalus*) is listed as endangered under the ESA and the North Atlantic stock is designated as a strategic stock under the MMPA (Waring et al. 2015). A recovery plan for sperm whales was finalized in 2010 (NOAA Fisheries 2010c). Sperm whales have a disproportionately large head, one quarter to one third of their total body length, with a rod-shaped lower jaw that is narrow and underslung with 20–26 pairs of well-developed teeth (Jefferson et al. 2015). Sperm whales are generally dark gray in color with white lips and often white areas on the belly and flanks (Jefferson et al. 2015). Their dorsal fin is low in profile, thick, and not pointed or curved followed by “knuckles” markings along its spine. Photographs of markings on the dorsal fins and flukes of sperm whales are distinctive and used in studies of life history and behavior (Jefferson et al. 2015). Sperm whales feed primarily on large- and medium-sized squid and other cephalopods such as octopus, medium- and large-sized demersal elasmobranchs (such as rays and sharks) and many teleost (bony) fish species (Christensen et al. 1992). While foraging, the whales typically gather in small clusters. Between diving bouts, sperm whales are known to raft (resting in a loose grouping) together at the surface. Adult males often forage alone. Groups of females may spread out over distances greater than 0.5 nm when foraging (Jefferson et al. 2015). Sperm whales are highly social, with a basic social unit consisting of 20 to 40 adult females, calves, and some juveniles (Whitehead 2009). During their prime breeding period and old age, male sperm whales are essentially solitary. Males rejoin or find nursery groups during prime breeding season. When socializing, they generally gather into larger surface-active groups (Jefferson et al. 2015; Whitehead 2003). In the Northern Hemisphere, the peak breeding season for sperm whales occurs between March and June, and in the Southern Hemisphere, the peak breeding season occurs between October and December (NOAA Fisheries 2018a). No breeding grounds are known off the coast of Virginia, though calving grounds are believed to exist around Cape Hatteras (Costidis et al. 2017). Sperm whale hearing is in the MF range (Southall et al. 2007; NOAA Fisheries 2018b).

The sperm whale is thought to have a more extensive distribution than any other marine mammal, except possibly the killer whale (Hayes et al. 2020). This species is found in polar to tropical waters in all oceans, from approximately 70° N to 70° S (Whitehead 2003). It ranges widely throughout the world’s oceans but shows a strong preference throughout all deep oceans of the world, essentially from equatorial zones to the edges of the polar pack ice (Whitehead 2003). In the Atlantic, sperm whales are found throughout the Gulf Stream and North Central Atlantic Gyre (Hayes et al. 2020). Its distribution is typically associated with waters over the continental shelf break, the continental slope, and into deeper waters with higher concentrations near drop-offs and areas with strong currents and steep topography regardless of season (Whitehead et al. 1992; Jefferson et al. 2015; Hayes et al. 2020). Off the coast of Virginia, sperm whales have recently been observed spending a significant amount of time near Norfolk Canyon and in waters over 6,000 ft (1,800 m) deep (Navy, n.d.). The sperm whale, an odontocete whale, is migratory. However, their migrations are not as well known, nor stereotypic as exhibited by most of the baleen whale species. Sperm whales have been known to concentrate off Cape Hatteras during winter months, with a northward migration to Delaware and Virginia (Costidis et al. 2017). In the North Atlantic, there appears to be a general shift northward during the summer, but there is no clear migration direction in some temperate areas (Whitehead 2003).

The relative abundance and density of sperm whales peaks in summer along the continental slope and farther offshore, declines in fall, and is lowest in winter and spring, according to predictive density mapping based on long-term survey data (Roberts et al. 2020; see Figure 4.2-27). Annual peaks in occurrence are in August and annual lows occur in March according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for sperm whales indicates moderate presence throughout the Lease Area, with low presence in the nearshore waters of Virginia in the modeling for all seasons (spring, summer, fall) (NOAA Fisheries 2020a). One sighting of a sperm whale was reported by PSOs in August of 2020.

The current abundance estimate for this species in the North Atlantic stock based on the most recent SAR is 4,349 individuals (Hayes et al. 2021). From 2008 to 2012, annual average human-caused mortality was 0.8 due to reports of one sperm whale mortality in 2009 and one in 2010 in the Canadian Labrador halibut longline fishery, one entanglement mortality in Canadian pot/trap gear, and one vessel strike mortality (Waring et al. 2015). There are no documented reports of fishery-related mortality or serious injury to this stock in the U.S. Exclusive Economic Zone during from 2013 to 2017 (Hayes et al. 2020). Sperm whales have not been documented as bycatch in the observed U.S. Atlantic commercial fisheries. Historically, 424 sperm whales were harvested in the Newfoundland-Labrador area between 1904 and 1972, and 109 male sperm whales were taken near Nova Scotia in 1964 to 1972 in a Canadian whaling fishery before whaling moratoriums were implemented (Waring et al. 2015). From 2013 to 2017, 12 sperm whale strandings were documented along the U.S. Atlantic coast (Hayes et al. 2020). Ship strikes are another source of human-caused mortality, and four reported ship strikes occurred along the east coast of the U.S. and Canada from 1994 to 2006 (Hayes et al. 2020). No recent collisions have been reported from 2006 to 2019 (Hayes et al. 2020). For the North Atlantic, the minimum population size has been estimated at 3,451 individuals (Hayes et al. 2020).

Sperm whales are present year-round in Virginia's waters, especially along the continental slope and farther offshore (NOAA Fisheries 2020a). Their likelihood of occurrence peaks in summer, declines in fall, and is lowest in winter and spring (Roberts et al. 2020; OBIS 2020). Based on available data, the overall likelihood of sperm whale occurrence in the Study Area is low most of the year, with a moderate likelihood in the spring and summer in the deeper offshore waters.

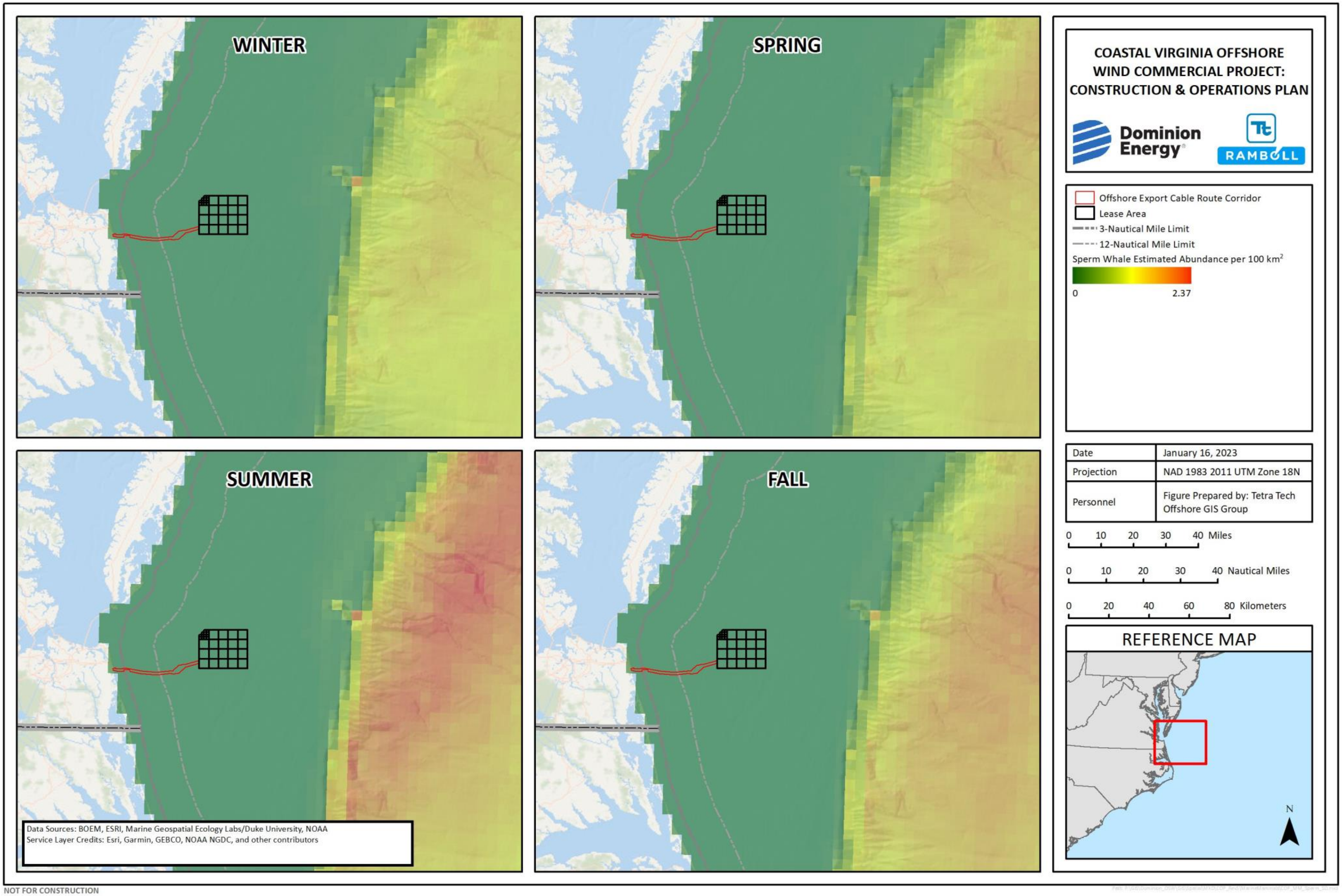


Figure 4.2-27. Seasonal Distribution of the Sperm Whale in the Marine Mammal Study Area

MMPA-Protected Species (Non-ESA-Listed) with Common Occurrence in the Study Area

Humpback Whale

The humpback whale (*Megaptera novaeangliae*) was listed as endangered in 1970 due to a population decrease resulting from overharvesting by whaling. A final recovery plan for the humpback whale was published in 1991 (NOAA Fisheries 1991). In September of 2016, NOAA Fisheries revised the listing and identification of 14 DPSs for humpback whales (81 FR 62259). The Gulf of Maine stock is part of the West Indies DPS, which is not ESA-listed and is considered non-strategic under the MMPA (Bettridge et al. 2015; Hayes et al. 2020); this stock is the one most likely to be found within the Study Area. North Atlantic humpback whale body coloration is primarily dark grey or black, but can have a variable amount of white on their pectoral fins, flukes, and belly. Their tail variation is so distinctive that the pigmentation pattern on the undersides of their flukes is used to identify individual whales (Katona et al. 1981). Humpback whales feed on small prey that is often found in large concentrations, including krill and fish such as herring and sand lance (Kenney and Vigness-Raposa 2010; Bettridge et al. 2015). Humpback whale hearing is in the LF range (Southall et al. 2007; NOAA Fisheries 2018a).

Humpback whales exhibit consistent fidelity to feeding areas within the northern hemisphere. The West Indies DPS feeds in six different areas during spring, summer, and fall; the Gulf of Maine, the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and Norway (Bettridge et al. 2015; Hayes et al. 2020). This DPS of humpback whales migrates from these feeding areas to the West Indies (including the Antilles, the Dominican Republic, the Virgin Islands, and Puerto Rico), where they mate and in the year following mating give birth to calves between January and March (NOAA Fisheries 1991; Blaylock et al. 1995, Bettridge et al. 2015; Hayes et al. 2020). While migrating, humpback whales utilize the mid-Atlantic as a pathway between calving/mating grounds in the south to their feeding grounds in the north (Hayes et al. 2019). Not all humpback whales migrate to the Caribbean during winter, and some individuals of this species are sighted in mid- to high-latitude areas during winter (Swingle et al. 1993). The Mid-Atlantic OCS area may also serve as important habitat for juvenile humpback whales, as evidenced by increased levels of juvenile strandings along the Virginia and North Carolina coasts (Wiley et al. 1995).

The relative abundance and density of humpback whales peak 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 (Roberts et al. 2020; Figure 4.2-28). Annual peaks in occurrence are in April and annual lows occur in September according to biogeographic information data (OBIS 2020; Figure 4.2-21). The AMAPPS Marine Mammal Model for humpback whales indicates moderate presence throughout the Study Area in the fall and spring, with low presence in summer (no modeling is provided for winter) (NOAA Fisheries 2020a). Several sightings of humpback whales were reported by PSOs during 2020: one during May, seven in October, one in November, and twenty-three in December. Additionally, in 2021 ten were reported in January and 25 in February.

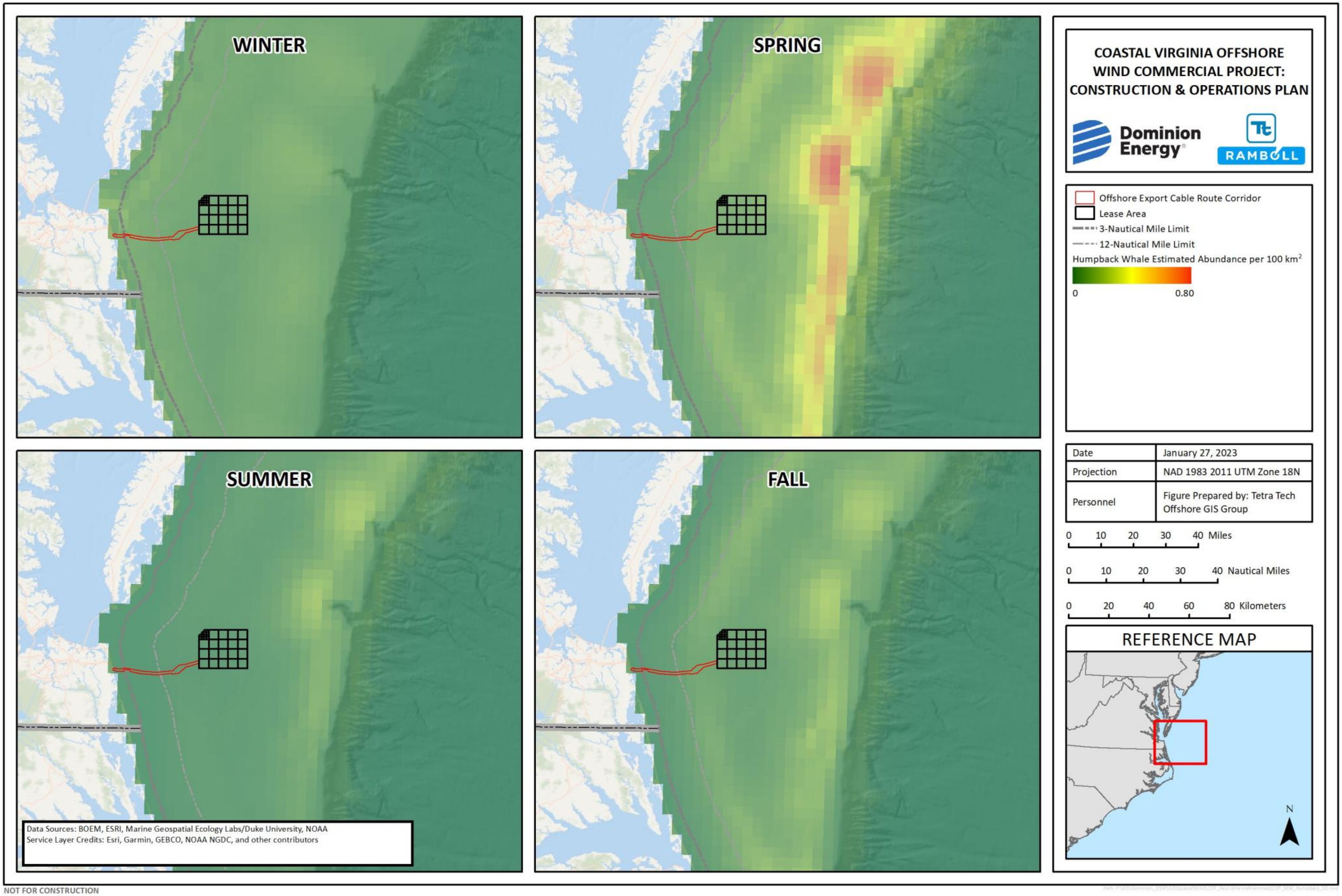


Figure 4.2-28. Seasonal Distribution of the Humpback Whale in the Marine Mammal Study Area

The humpback whale population within the North Atlantic has been estimated to include approximately 11,570 individuals (Waring et al. 2016). According to the latest SAR, the best estimate of abundance for the Gulf of Maine stock of humpback whales is 1,396 individuals (Hayes et al. 2021). In the North Atlantic Ocean, the threats of harmful algal (red tide) blooms, vessel collisions (ship strikes), and fishing gear entanglements are a threat to humpback whales and are likely stressors that can moderately reduce the population size or the growth rate of the West Indies DPS (Bettridge et al. 2015). Humpback whales that were entangled exhibited the highest number of serious injury events of the six species of large whale studied by Glass et al. (2008). Historically, between 2002 and 2006, humpback whales belonging to the Gulf of Maine stock were involved in 77 confirmed entanglements with fishery equipment and 9 confirmed ship strikes (Glass et al. 2008), and recent trends indicate higher numbers of both impacts. Nelson et al. (2007) reported that the minimum annual rate of anthropogenic mortality and serious injury to humpback whales occupying the Gulf of Maine was 4.2 individuals per year. The average annual rate of humpback whale serious injury and mortality increased 16 percent from 2011 to 2015 (9.8 percent from 8.25 percent; Henry et al. 2020). From 2012 to 2016, there were 119 confirmed injury events and 84 mortality events (Hayes et al. 2020, Henry et al. 2020. Thirty-three of the injury events and eight of the mortalities were caused by entanglement and an additional three injury events and 11 mortality events were attributed to vessel strikes (Henry et al. 2020). For the period 2013 through 2017, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 12.15 animals per year, including incidental fishery interaction records totaling 7.75 animals per year; and records of vessel collisions totaling 4.4 (Hayes et al. 2020). Between July and September 2003, a UME that included 16 humpback whales was documented in offshore waters of coastal New England and the Gulf of Maine. Biotoxin analyses of samples taken from some of these whales found saxitoxin (a shellfish toxin associated with toxic algal blooms) at very low/questionable levels and domoic acid at low levels, but neither were adequately documented and therefore no definitive conclusions could be drawn (Hayes et al. 2020). A UME in 2005 with seven humpback whales was reported in New England waters, and another with 21 dead humpback whales found between July 10 and December 31 (Hayes et al. 2020) was reported in 2006. The causes of these UMEs are unknown. Additionally, in January 2016, a humpback whale UME was declared for the U.S. Atlantic coast due to elevated numbers of mortalities (a total of 133 strandings between 2016 and 2020; Hayes et al. 2020). Partial and full necropsy examinations indicate that about 50 percent had evidence of human interaction, either ship strike or entanglement (Hayes et al. 2020; NOAA Fisheries 2020b). This UME and the investigation are still ongoing.

Humpback whales are present seasonally in Virginia’s offshore waters, especially along the continental slope (NOAA Fisheries 2020a). Their likelihood of occurrence peaks in early spring, declines in summer, and is lowest in fall and early winter (Roberts and Halpin 2022; OBIS 2020). Based on available data, the overall likelihood of humpback whale occurrence in the Study Area is relatively high, particularly along the eastern portion of the Lease Area.

Minke Whale

The minke whale (*Balaenoptera acutorostrata acutorostrata*) is not ESA-listed, and the Canadian East Coast stock is listed by NOAA Fisheries as “non-strategic” under the MMPA (Hayes et al. 2022). For the common minke whale, three putative subspecies have been proposed: *Balaenoptera acutorostrata* in the North Atlantic, *Balaenoptera acutorostrata scammoni* in the North Pacific, and the dwarf minke whale, an unnamed subspecies, in the Southern hemisphere (Risch et al. 2019). Minke whales are the smallest and are among the most widely distributed of all the baleen whales. Minke whales have a fairly tall sickle-shaped dorsal fin located about two-thirds down their back, and their body is black to dark grayish/brownish with a pale chevron on the back behind the head and above the flippers and a white underside. As is typical of baleen whales, minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al. 2002; Risch et al. 2019). Minke populations are often segregated by sex, age, or reproductive condition. They feed on schooling fish (e.g., herring, sand eel, capelin, cod, pollock, and mackerel), invertebrates (squid and copepods), and euphausiids (Risch et al. 2019). Minke whales feed below the surface of the water, and calves are usually not seen in adult feeding areas. Minke whale hearing is in the LF range (Southall et al. 2007; NOAA Fisheries 2018a).

Minke whales occur in the North Atlantic and North Pacific, from tropical to polar waters (Risch et al. 2019). Generally, they inhabit warmer waters during winter and travel north to colder regions in summer, while some animals migrate as far as the ice edge. They are frequently observed in coastal or shelf waters. Minke whales off the eastern coast of the U.S. are considered to be part of the Canadian East Coast stock.

The relative abundance and density of minke whales peaks in spring on the continental shelf extending toward the slope, declines in summer, and is lowest in fall and winter, according to predictive density mapping based on long-term survey data (Roberts and Halpin 2022; see Figure 4.2-29). Annual peaks in occurrence are in April and annual lows occur in September according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for minke whales indicates moderate presence throughout the Study Area in all seasons modeled (spring, summer, fall) (NOAA Fisheries 2020a). One minke whale sighting was reported by PSOs in December of 2020 and one in May of 2021.

The population estimate for minke whales in the Canadian East Coast stock according to the latest SAR is 21,968 (Hayes et al. 2022). Minke whales have been observed south of New England during all four seasons; however, widespread abundance is highest in spring through fall (Hayes et al. 2022). Minke whales inhabit coastal waters during much of the year and are thus susceptible to collision with vessels and bycatch from gillnet and purse seine fisheries (Hayes et al. 2022). From 2008 to 2012, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 9.9 per year (Waring et al. 2015), while from 2010 to 2014 this decreased to 8.25 per year (Hayes et al. 2022). From 2013 through 2017, the average annual minimum detected human-caused mortality and serious injury was 8.20 minke whales per year (Hayes et al. 2022). In addition, hunting for minke whales continues today by Norway in the northeastern North Atlantic and by Japan in the North Pacific and Antarctic (Reeves et al. 2002; Hayes et al. 2022). International trade in the species is currently banned. Average annual fishery-related mortality and serious injury does not exceed the Potential Biological Removal (PBR) for this species. In 2012, a confirmed vessel strike resulted in a mortality off Newark, New Jersey. In 2014, a confirmed vessel strike resulted in a mortality off Dam Neck, Virginia. In 2015, a fresh carcass of a minke whale was reported off Coney Island, New York, with wounds consistent with vessel strike. Thus, from 2013 to 2017, as determined from stranding and entanglement records, the minimum detected annual average was 0.8 common minke whales per year struck by vessels in U.S. waters or first seen in U.S. waters (Hayes et al. 2022). A UME of minke whales was declared in January 2017 due to elevated stranding along the Atlantic coast: a total of 97 whales were stranded between 2017 and 2020 (Hayes et al. 2022, NOAA Fisheries 2020b). This UME is ongoing.

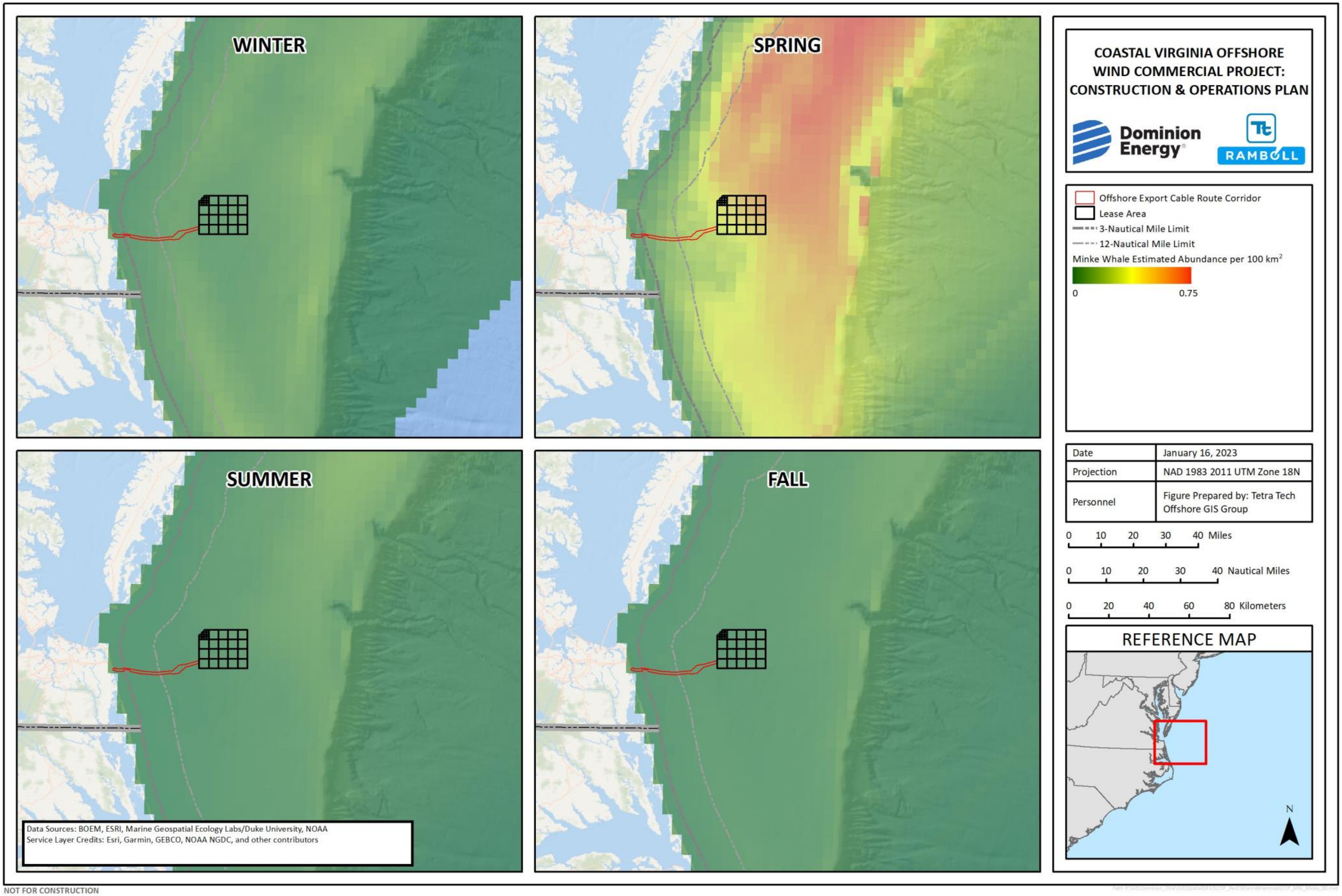


Figure 4.2-29. Seasonal Distribution of the Minke Whale in the Marine Mammal Study Area

Minke whales are present year-round in Virginia's offshore waters (NOAA Fisheries 2020a). Their likelihood of occurrence peaks in spring, declines in summer, and is lowest in fall and winter (Roberts et and Halpin 2022; OBIS 2020). Based on available data, the overall likelihood of minke whale occurrence in the Study Area is moderately high, particularly in the Lease Area.

Harbor Porpoise

Harbor porpoises (*Phocoena phocoena*) in the Gulf of Maine/Bay of Fundy stock are not ESA-listed and this stock is not considered strategic under the MMPA (Hayes et al. 2022). This species has been listed as "non-strategic" because average annual human-related mortality and injury, while poorly understood, does not exceed the PBR (Hayes et al. 2022). Harbor porpoise are the smallest North Atlantic cetacean, measuring at only 4.6 ft to 6.2 ft (1.4 m to 1.9 m), and feed primarily on pelagic schooling fish, bottom fish, squid, and crustaceans (Bjørge and Tolley 2009; Reeves and Reed 2003). Harbor porpoise hearing is in the high frequency range (Southall et al. 2007; NOAA Fisheries 2018a).

The harbor porpoise is likely to occur in the waters of the mid-Atlantic during winter months, as this species prefers cold temperate and subarctic waters (Hayes et al. 2022). Harbor porpoise generally move out of the mid-Atlantic during spring, migrating north to the Gulf of Maine.

The relative abundance and density of harbor porpoises peaks in winter throughout the continental shelf, shifts northeast in spring, and is lowest in summer and fall, according to predictive density mapping based on long-term survey data (Roberts and Halpin 2022; see Figure 4.2-30). Annual peaks in occurrence are in February and annual lows occur from May to November according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for harbor porpoises indicates low presence in the offshore portions of the Study Area, with slightly elevated presence along the coastline in the fall, and with low presence throughout the Study Area in the spring and summer (NOAA Fisheries 2020a).

The current population estimate for harbor porpoise for the Gulf of Maine/Bay of Fundy stock is 95,543 (Hayes et al. 2022). The total annual estimated average human-caused mortality and serious injury is 150 harbor porpoises per year (Hayes et al. 2022). The most common threat to the harbor porpoise is incidental mortality from fishing activities, especially from bottom-set gillnets. A UME event in 2005 involved the stranding of 38 animals along the North Carolina coast from January 1 to March 28 (Waring et al. 2012). Most strandings of harbor porpoise from 2012 to 2017 occurred in Massachusetts. During this time, a total of 315 harbor porpoises were stranded along the U.S. and Canadian Atlantic Coast, 14 of which were reported in Virginia (Hayes et al. 2022). Two of the 14 Virginia strandings were due to fisheries interactions (Hayes et al. 2022). It has been demonstrated that the porpoise echolocation system is capable of detecting net fibers in certain circumstances but not consistently enough to prevent fishery interactions. In 1999, a Take Reduction Plan to reduce harbor porpoise bycatch in U.S. Atlantic gillnets was implemented. The ruling implements time and area closures; some areas are closed completely while others are closed to gillnet fishing unless the gear meets certain restrictions.

Harbor porpoises are present seasonally in Virginia's offshore waters, especially in nearshore portions of the continental shelf (NOAA Fisheries 2020a). Their likelihood of occurrence peaks in winter, shifts northeast in spring, and is lowest in summer and fall (Roberts and Halpin 2022; OBIS 2020). The overall likelihood of harbor porpoise occurrence in the Study Area is high, based on available data.

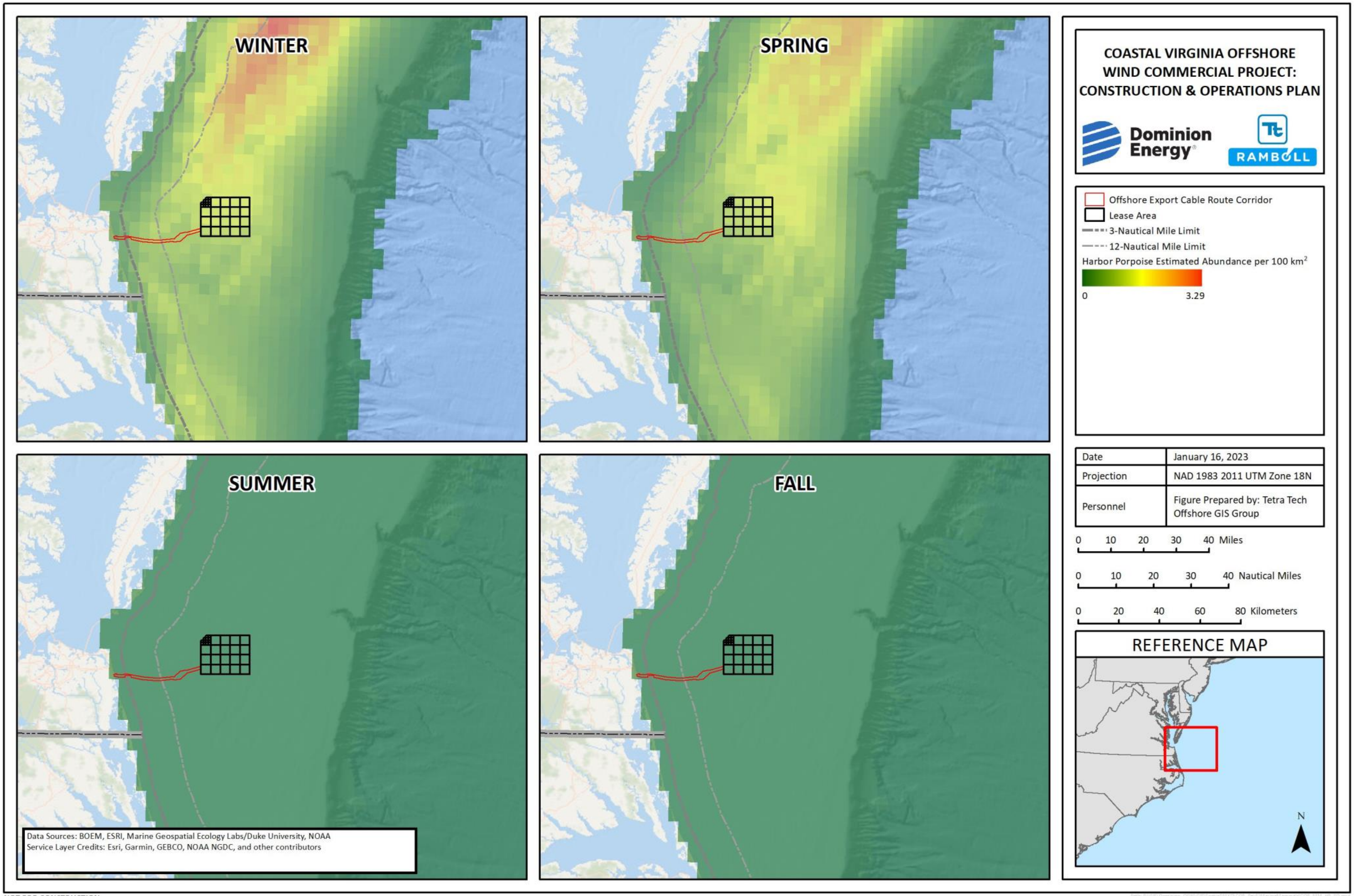


Figure 4.2-30. Seasonal Distribution of the Harbor Porpoise in the Marine Mammal Study Area

Atlantic Spotted Dolphin

There are two species of spotted dolphin in the western North Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*) (Perrin et al. 1987). Only the Atlantic spotted dolphin is anticipated in the vicinity of the Study Area; however, potential impacts to pantropical spotted dolphins were considered as the species' range extends to the 40°N latitude (Jefferson et al. 2015). The Atlantic spotted dolphin is not ESA-listed, and the stock is not considered strategic under the MMPA (Hayes et al. 2021). Atlantic spotted dolphins have a robust body with a tall, curved dorsal fin located midway down their back (Jefferson et al. 2015). and reach 5 to 7.5 ft (1.5 to 2.3 m) in length (Herzing 1997). They have moderately long, slender beaks and their color patterns vary with age and location. In addition, two forms of the Atlantic spotted dolphin exist, one that is large and heavily spotted and another that is smaller in size with fewer spots (Hayes et al. 2021). The hearing range for the species is in the MF range (Southall et al. 2007; NOAA Fisheries 2018a). Atlantic spotted dolphins prefer tropical to warm temperate waters along the continental shelf 33 to 650 ft (10 to 200 m) deep to slope waters greater than 1,640 ft (500 m) deep (Hayes et al. 2021).

The relative abundance and density of Atlantic spotted dolphins remains moderately high east of the continental slope year-round; on the continental shelf, Atlantic spotted dolphin presence peaks in summer and fall and declines during winter and spring according to predictive density mapping based on long-term survey data (Roberts and Halpin 2022; OBIS 2020; see Figure 4.2-31). The AMAPPS Marine Mammal Model for Atlantic spotted dolphins indicates moderate presence throughout the Study Area in spring and fall with high presence throughout the offshore portions in the summer (no modeling provided for winter) (NOAA Fisheries 2020a). Several sightings of Atlantic spotted dolphins were reported by PSOs during 2020, throughout the spring, summer and fall months from April through October. Spotted dolphins were again detected in 2021 in April through June.

The best population estimate for the Atlantic spotted dolphin according to the latest SAR is approximately 39,921 individuals (Hayes et al. 2022). Prior to 1998, the two species of spotted dolphins were not differentiated during surveys so prior abundance estimates are for both species combined (Hayes et al. 2021). Current threats to both species in the Atlantic are poorly understood as insufficient data are available to determine the population trends for either species. From 2013–2017, 21 Atlantic spotted dolphins were reported stranded between North Carolina and Florida (NOAA Fisheries unpublished data reported in Hayes et al. 2020). It could not be determined whether there was evidence of human interaction for nine of these strandings, and for 12 dolphins, no evidence of human interaction was detected (Hayes et al. 2020). However, stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured wash ashore, or stranded animals may not show clear signs of entanglement or other fishery-interaction.

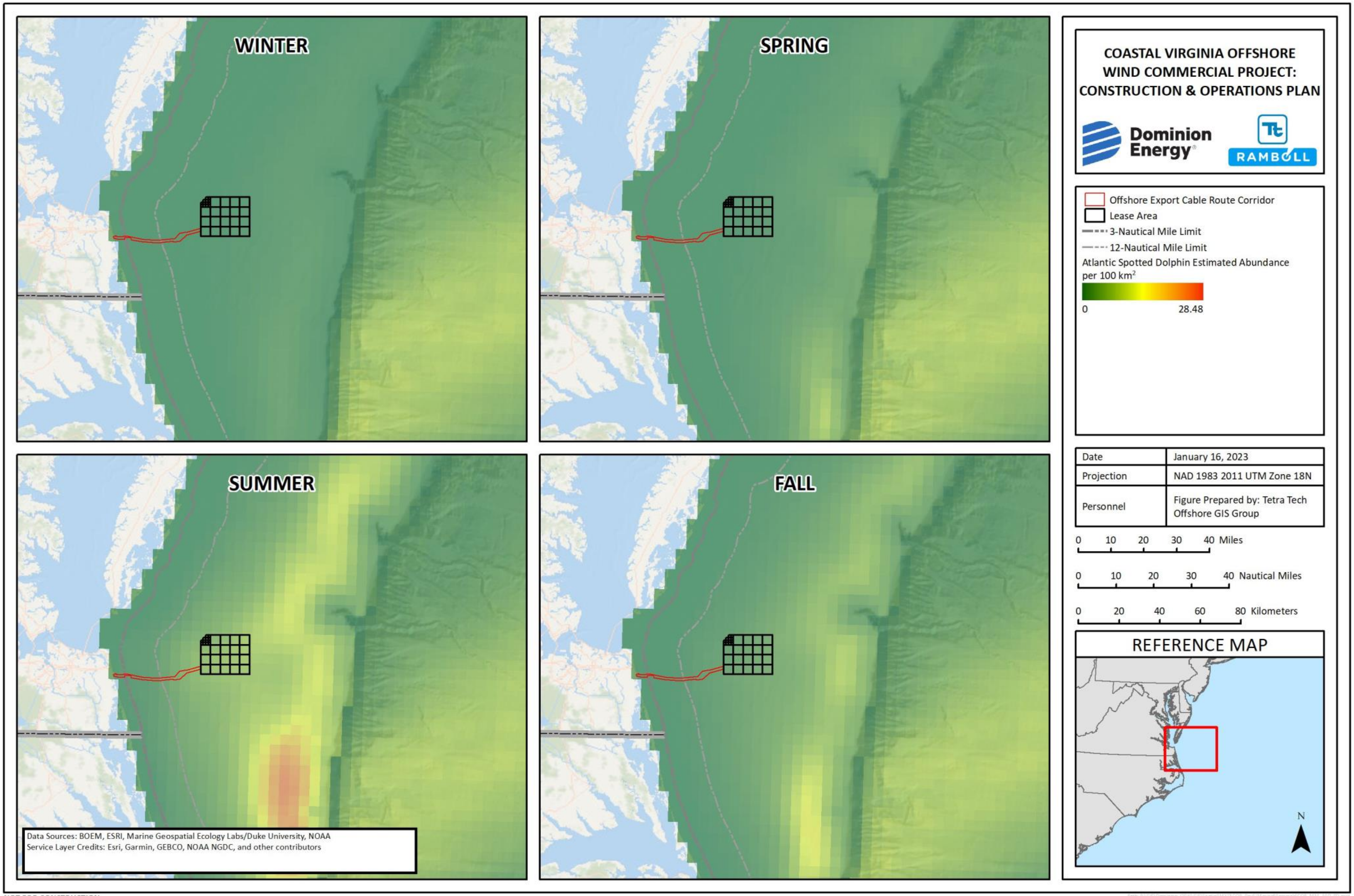


Figure 4.2-31. **Seasonal Distribution of the Atlantic Spotted Dolphin in the Marine Mammal Study Area**

Atlantic spotted dolphins are present year-round in Virginia’s offshore waters, especially east of the continental slope (NOAA Fisheries 2020a). Their likelihood of occurrence peaks in summer and fall and declines in winter and spring (Roberts and Halpin 2022; OBIS 2020). Based on available data, the overall likelihood of Atlantic spotted dolphin occurrence in the Study Area is moderately high, particularly in eastern portions of the Lease Area. Sightings occurred between April through October during 2020, then again in April 2021 (the final month for which PSO data are currently available).

Pantropical Spotted Dolphin

The pantropical spotted dolphin is not ESA listed, and the stock is not considered strategic under the MMPA (Hayes et al. 2021). Pantropical spotted dolphins are typically 6 to 7 ft (1.8 to 2.2 m) in length at adulthood (Jefferson et al. 2015). Pantropical dolphins have long, slender beaks like the Atlantic spotted dolphin, but are also distinguished by a dark cape or coloration on their backs, which stretches from their head to almost midway between the dorsal fin and the tail flukes, and by a white-tipped beak (Herzing 1997; Jefferson et al. 2015). Their diet consists of a wide variety of fish and squid as well as benthic invertebrates (Herzing 1997). The hearing range for the species is in the MF range (Southall et al. 2007; NOAA Fisheries 2018a). The species prefers tropical to warm temperate waters along the continental shelf 33 to 650 ft (10 to 200 m) deep to slope waters greater than 1,640 ft (500 m) deep (Hayes et al. 2021).

In general, pantropical spotted dolphins are found in very low numbers north of North Carolina and this species is not anticipated in the vicinity of the Study Area; however, impacts to the species have been considered as their documented range extends to the 40°N latitude (Jefferson et al. 2015). Along the U.S. East Coast, the relative abundance and density of pantropical spotted dolphins remains moderately low east of the continental slope, with higher presence on the continental shelf and during summer and fall according to predictive density mapping based on long-term survey data (Roberts and Halpin 2022; OBIS 2020; see Figure 4.2-32). Several sightings of pantropical spotted dolphins were reported by PSOs during 2020, during summer months (June and August).

The best population estimate for the pantropical spotted dolphin according to the latest SAR is approximately 6,593 individuals (Hayes et al. 2022). Prior to 1998, the species of spotted dolphins were not differentiated during surveys, so prior abundance estimates for both species are combined (Hayes et al. 2021). Current threats to both species in the Atlantic are poorly understood since insufficient data are available to determine the population trends for either species. From 2013–2017, five pantropical spotted dolphins were reported stranded on the U.S. East Coast, all in Florida (NOAA Fisheries unpublished data reported in Hayes et al. 2020). It could not be determined whether there was evidence of human interaction for one of these strandings, and for the other four, no evidence of human interaction was detected (Hayes et al. 2020). However, stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured wash ashore, or stranded animals may not show clear signs of entanglement or other fishery interaction. Based on available data, the overall likelihood of pantropical spotted dolphin occurrence in the Study Area is low.

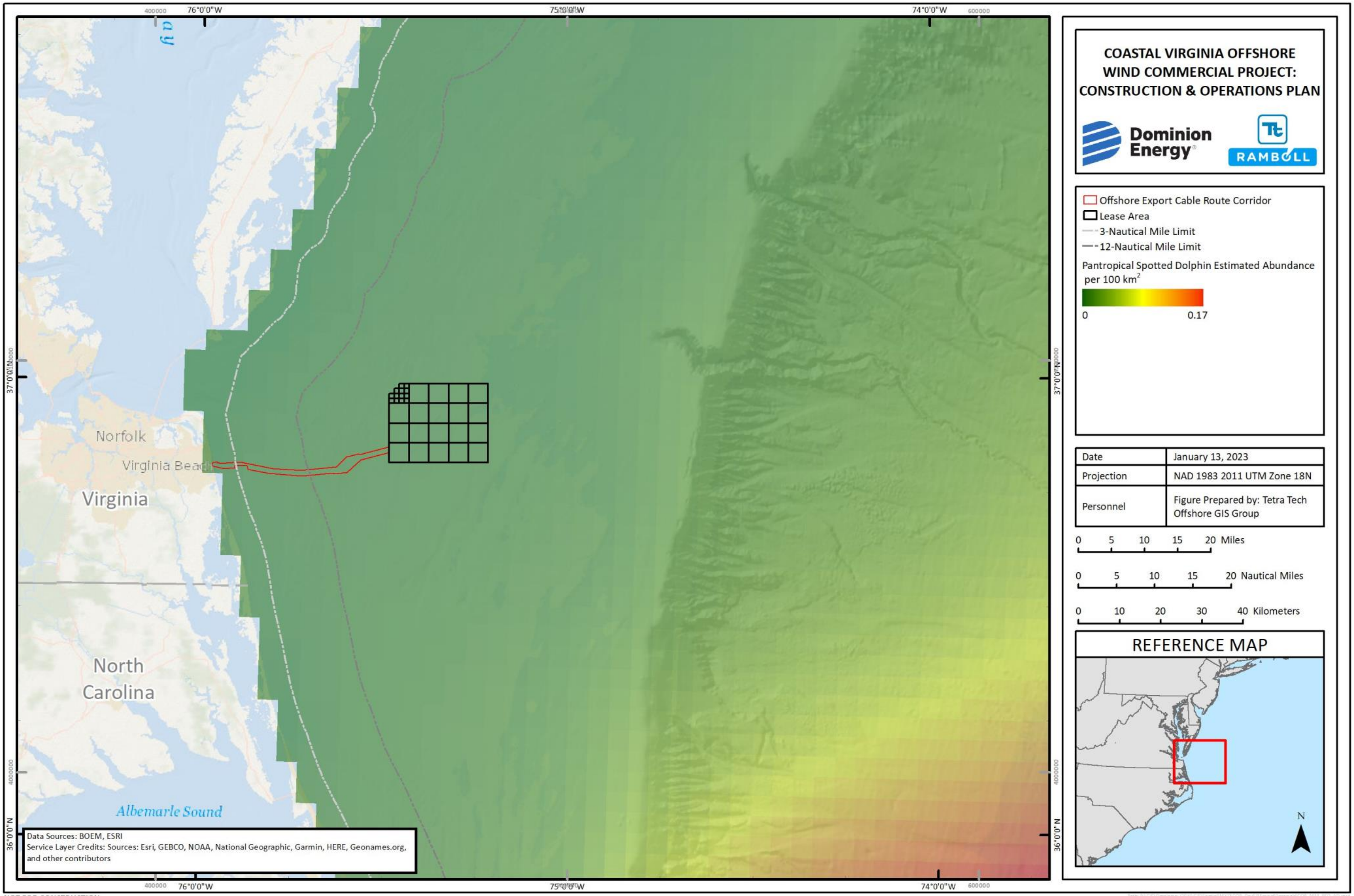


Figure 4.2-32. Estimated Annual Abundance of the Pantropical Spotted Dolphin in the Marine Mammal Study Area

Bottlenose Dolphin

The population of bottlenose dolphins (*Tursiops truncatus)* in the North Atlantic consists of a complex mosaic of dolphin stocks (Waring et al. 2010). Two stocks may be found in the vicinity of the Study Area, the Western North Atlantic Offshore Stock (WNAOS) and the Southern Migratory Coastal Stock (SMCS). Neither stock is ESA-listed. The WNAOS is considered non-strategic under the MMPA (Hayes et al. 2018, 2022); however, the SMCS is considered a depleted strategic stock under the MMPA (Hayes et al. 2022). Bottlenose dolphins are roughly 8 to 12 ft (2.4 to 3.7 m) long with a short, stubby beak and show sexual dimorphism, with males being larger and heavier than females. Bottlenose dolphins feed on a large variety of organisms, depending on their oceanic habitat. The coastal, shallow population tends to feed on benthic fish and invertebrates, while deep-water populations consume pelagic or mesopelagic fish such as croakers, sea trout, mackerel, mullet, and squid (Reeves et al. 2002). Bottlenose dolphins appear to be active both during the day and night. Their activities are influenced by the seasons, time of day, tidal state, and physiological factors, such as reproductive seasonality (Wells and Scott 2002). The species' hearing is in the MF range (Southall et al. 2007; NOAA Fisheries 2018a).

Because this species occupies a wide variety of habitats, it is regarded as possibly the most adaptable cetacean (Reeves et al. 2002). The species occurs worldwide in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 10 to 32 degrees Celsius (°C; 50 to 90 degrees Fahrenheit [°F]). There are two distinct bottlenose dolphin morphotypes: migratory coastal and offshore. The migratory coastal morphotype resides in waters typically less than 65.6 ft (20 m) deep, along the inner continental shelf (within 4.6 mi [7.5 km]) of shore; Hayes et al. 2018). This migratory coastal population was further subdivided into seven stocks based largely upon spatial distribution (Waring et al. 2016). The SMCS is the coastal stock found south of Assateague, Virginia, to northern Florida and is the stock most likely to be encountered in the vicinity of the Offshore Export Cable portion of the Study Area. Seasonally, SMCS movements indicate they are mostly found in southern North Carolina (Cape Lookout) from October to December; they continue to move farther south from January to March, to as far south as northern Florida before moving back north to coastal North Carolina from April to June. SMCS bottlenose dolphins occupy waters north of Cape Lookout, North Carolina, to as far north as Chesapeake Bay from July to August (Hayes et al. 2021). An observed shift in spatial distribution during a summer 2004 survey indicated that the northern boundary for the SMCS may vary from year to year (Hayes et al. 2021). The offshore population consists of one stock (WNAOS) in the western North Atlantic Ocean distributed primarily along the Outer Continental Shelf and continental slope, and distributed widely during the spring and summer from Georges Bank to the Florida Keys with late summer and fall incursions as far north the Gulf of Maine depending on water temperatures (Kenney 2009; Hayes et al. 2020). The WNAOS is found seaward of 34 km (21 mi) and in waters deeper than 111.5 ft (34 m). The Study Area is within the range of the WNAOS.

The relative abundance and density of bottlenose dolphins is moderate along the continental slope year-round; on nearshore portions of the continental shelf, bottlenose dolphin presence peaks in spring and summer, declines in fall, and is lowest in winter according to predictive density mapping based on long-term survey data (Roberts et al. 2020; see Figure 4.2-33). Annual peaks in occurrence are in August and annual lows occur in January according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for bottlenose dolphins indicates moderate presence in the Lease

Area with high presence along the coastline and ECR also along the eastern edge of the Study Area, farther offshore, in all seasons (NOAA Fisheries 2020a). Several sightings of bottlenose dolphins were reported in every month by PSOs during 2020 (starting in April) and 2021 (through August), with sightings peaking in late summer and fall.

The most recent population estimates from the latest SARs are approximately 62,851 individuals for the WNAOS and approximately 3,751 individuals for the SMCS (Hayes et al. 2022). Common bottlenose dolphins are among the most frequently stranded small cetaceans along the Atlantic coast. Many of the animals show signs of human interaction (i.e., net marks, mutilation, etc.); however, it is unclear what proportion of these stranded animals are from which stock because most strandings are not identified to morphotype (Hayes et al. 2021). The biggest threat to the species is bycatch, because they are often caught in fishing gear, gillnets, purse seines, and shrimp trawls (Waring et al. 2016). They have also been adversely impacted by pollution, habitat alteration, boat collisions, and human disturbance, and are subject to bioaccumulation of toxins. Scientists have found a strong correlation between dolphins with elevated levels of polychlorinated biphenyls and illness, indicating certain pollutants may weaken their immune system (Ross 2002). Total U.S. fishery-related mortality and serious injury for the WNAOS is less than ten percent of the calculated PBR and, therefore, can be considered to be insignificant and approaching the zero mortality and serious injury rate (Hayes et al. 2020).

Three UMEs have previously impacted western Atlantic bottlenose dolphins: 1987 to 1988; 2011; and 2013 to 2015. Two of these UMEs, 1987 to 1988 and 2013 to 2015, were attributed to morbillivirus (Lipscomb et al. 1994; Morris et al. 2015). Both of these UMEs included deaths of dolphins in locations that apply to the SMCS (Hayes et al. 2018). When the impacts of the 1987–1988 UME were being assessed, only a single coastal stock of common bottlenose dolphin was thought to exist along the western Atlantic from New York to Florida so impacts to the SMCS alone are not known (Scott et al. 1988). However, it was estimated that between 10 and 50 percent of the coast-wide stock died as a result of this UME (Scott et al. 1988; Eguchi 2002). The total number of stranded common bottlenose dolphins from New York through North Florida (Brevard County) during the 2013–2015 UME was 1,827 individuals (Hayes et al. 2021). The third UME was in South Carolina during February–May 2011 with a total of six strandings from the SMCS (Hayes et al. 2021). The cause of this UME was undetermined. The SMCS mean annual human-caused mortality for 2011–2015 ranged between a minimum of 0 and a maximum of 14.3 (Hayes et al. 2018). Although there was no statistically significant difference in abundance for the SMCS between the 2010 and 2011 and 2016 surveys, a statistically significant decline in population size of all common bottlenose dolphins in coastal waters from New Jersey to Florida between 2010 and 2011 and 2016 was detected (Hayes et al. 2018). From 1995 to 2001, NOAA Fisheries recognized only the western North Atlantic Coastal Stock of common bottlenose dolphins in the western North Atlantic, and this stock was listed as depleted as a result of a UME in 1988–1989 (64 Federal Register [FR] 17789, April 6, 1993). The SMCS retains the depleted designation as a result of its origin from the western North Atlantic Coastal Stock (Hayes et al. 2021).

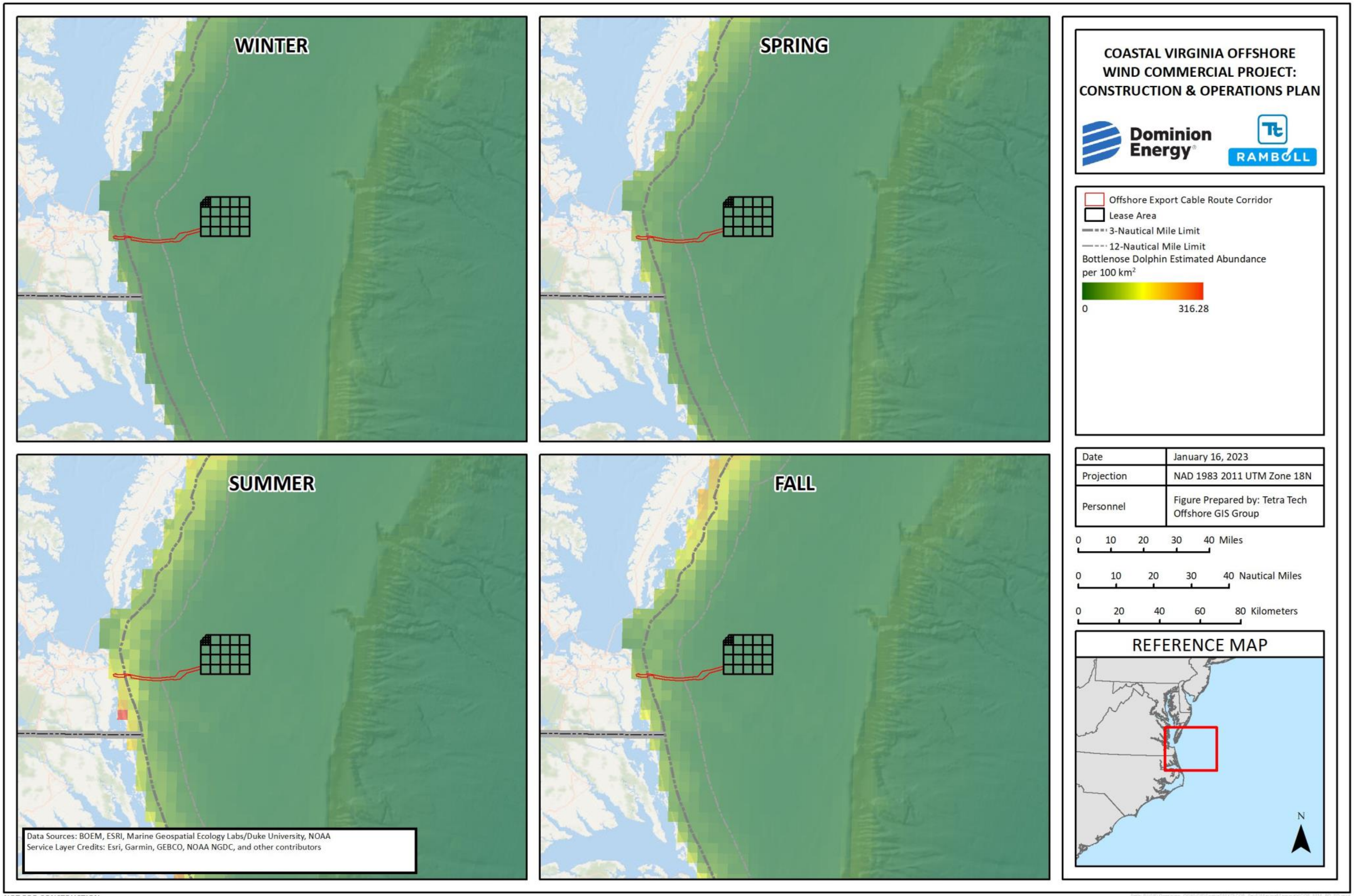


Figure 4.2-33. Seasonal Distribution of the Bottlenose Dolphin in the Marine Mammal Study Area

Bottlenose dolphins are present year-round in Virginia's offshore waters, both in nearshore portions of the continental shelf and along the continental slope (NOAA Fisheries 2020a). Their likelihood of occurrence peaks in spring and summer, declines in fall, and is lowest in winter (Roberts and Halpin 2022; OBIS 2020). Based on available data, the overall likelihood of bottlenose dolphin occurrence in the Study Area is high, particularly along the Offshore Export Cable Route Corridor.

Common Dolphin

The common dolphin (*Delphinus delphis*) is not ESA-listed and the western North Atlantic stock is not considered strategic under the MMPA (Hayes et al. 2022). All common dolphins are slender and have a long beak sharply demarcated from the melon and are distinguished from other dolphins by a unique crisscross color pattern formed by interaction of the dorsal overlay and cape (Perrin 2009) resulting in distinctive color bands on their sides. There is significant sexual dimorphism present, with males being on average about 9 percent larger in body length (Hayes et al. 2022). Common dolphins feed on nutrient-rich squids and small fish, including species that school in proximity to surface waters, and on mesopelagic species found near the surface at night (Hayes et al. 2022; IUCN 2019). The species' hearing is in the MF range (Southall et al. 2007; NOAA Fisheries 2018a).

The species is one of the most widely distributed cetaceans and occurs in temperate, tropical, and subtropical regions (Jefferson et al. 2015). Common dolphins can be found either along the 650 to 6,500 ft (200 to 2,000 m) isobaths over the continental shelf edges and in areas with sharp bottom relief such as seamounts and escarpments and in pelagic waters of the Atlantic and Pacific Oceans (Reeves et al. 2002; Hayes et al. 2022). They are present in the Western Atlantic from Newfoundland to Florida. Common dolphins show a strong affinity for areas with warm, saline surface waters. The species is seasonally found in abundance between Cape Hatteras and Georges Bank from mid-January to May. Between mid-summer and fall they migrate onto Georges Bank and the Scotian Shelf, and large aggregations occur on Georges Bank in fall (Reeves et al. 2002; Hayes et al. 2022). The species is less common south of Cape Hatteras, although pods have been reported as far south as the Georgia/South Carolina border and points south (Jefferson et al. 2015; Hayes et al. 2022). Common dolphins occur in greatest abundance within a broad band off the northeast edge of Georges Bank in the fall (Jefferson et al. 2015).

The relative abundance and density of short-beaked common dolphins increases in fall along the continental slope, peaks in winter, and declines in spring and summer, according to predictive density mapping based on long-term survey data (Roberts and Halpin 2022; see Figure 4.2-34). Annual peaks in occurrence are in December and annual lows occur in September according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for common dolphins indicates moderate presence in the nearshore portions of the Study Area increasing to high presence in the Lease Area and eastern portion of ECR in all seasons modeling (spring, summer, fall) (NOAA Fisheries 2020a). Several sightings of common dolphins were reported by PSOs during summer 2020. Sightings greatly increased in the winter (January and February) months of 2021 and remained high through April.

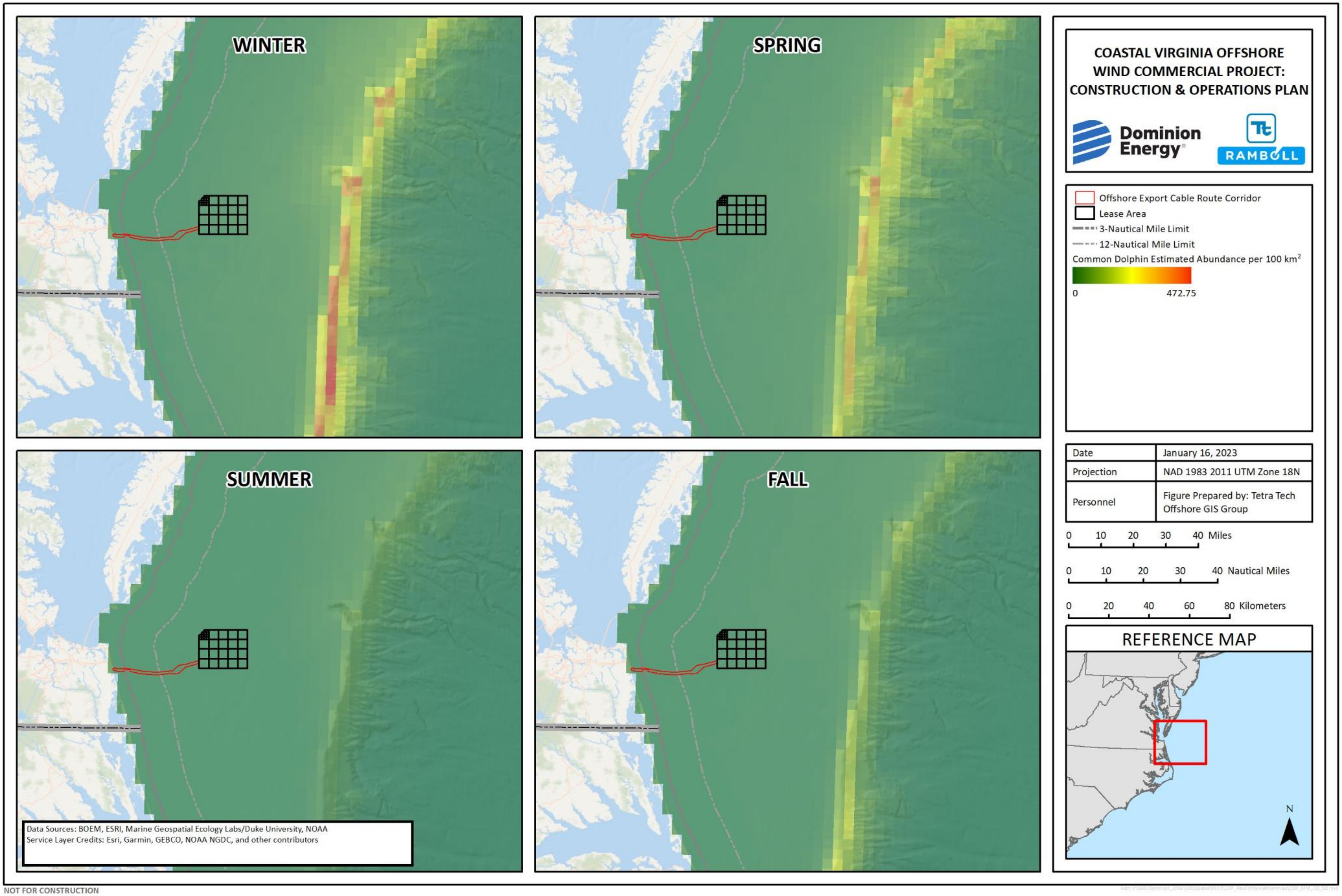


Figure 4.2-34. Seasonal Distribution of the Common Dolphin in the Marine Mammal Study Area

The best population estimate for the common dolphin off the U.S. Atlantic Coast based on the species SAR is approximately 172,974 individuals (Hayes et al. 2022). The common dolphin is also subject to bycatch. It has been caught in gillnets, pelagic trawls, and longline fishery activities. Average annual estimated fishery-related mortality or serious injury to this stock during 2014 to 2018 was 399 individuals (Hayes et al. 2022). From 2014 to 2018, 499 common dolphins strandings were reported between Maine and Florida (Hayes et al. 2022). Average annual fishery-related mortality and serious injury does not exceed the PBR for this species (Hayes et al. 2022). Common dolphins are present year-round in Virginia's offshore waters (NOAA Fisheries 2020a). Their likelihood of occurrence increases in fall, peaks in winter, and declines in spring and summer (Roberts and Halpin 2022; OBIS 2020). The overall likelihood of common dolphin occurrence in the Offshore Project Area is high.

Long-finned and Short-finned Pilot Whale

The two species of pilot whales in the Western Atlantic, the long-finned (*Globicephala melas melas*) and short-finned pilot whale (*Globicephala macrorhynchus*), are difficult to differentiate from field observations. Neither species is ESA-listed. The western North Atlantic stocks for each species are non-strategic under the MMPA (Hayes et al. 2022). Long-finned pilot whales are medium-sized animals with a stocky body, large bulbous or squarish forehead, thick dorsal fin located about a third of the body length behind the head. The short-finned pilot whale also has a bulbous forehead but with no obvious beak (Jefferson et al. 2015). Long-finned pilot whales are dark black, dark gray, or brownish in color. They have pale grayish or whitish marks, such as a diagonal eye-stripe, or a blaze, that extend from behind the eye and up towards the dorsal fin. Long-finned pilot whales also have a large saddle behind the dorsal fin and a whitish anchor-shaped patch that starts at the throat and extends down their underside (Jefferson et al. 2015). The short-finned pilot whale's dorsal fin is far forward on its body and has a relatively long base (Jefferson et al. 2015). The body color on the short-finned pilot whale tends to be black or dark brown with a large gray saddle behind the dorsal fin. Pilot whales feed preferentially on squid but will eat fish (e.g., herring) and invertebrates (e.g., octopus, cuttlefish) if squid are not available. They also occasionally ingest shrimp (particularly younger whales) and various other fish species. The species hunt most of their prey at depths of 600 to 1,650 ft (200 to 500 m), although they can forage deeper if necessary (Reeves et al. 2002). Both species' hearing is in the MF range (Southall et al. 2007; NOAA Fisheries 2018a).

Both species of pilot whale are more generally found along the edge of the continental shelf at depths of 330 to 3,300 ft (100 to 1,000 m), choosing areas of high relief or submerged banks. Long-finned pilot whales, in the western North Atlantic, are more pelagic occurring in especially high densities in winter and early spring over the continental slope, then moving inshore and onto the shelf in summer and autumn following squid and mackerel populations (Reeves et al. 2002, see Figure 4.2-35). They frequently travel into the central and northern Georges Bank, Great South Channel, and northward into the Gulf of Maine areas during the late spring through late fall (Hayes et al. 2022). Short-finned pilot whales prefer tropical, subtropical, and warm temperate waters (Jefferson et al. 2015). The short-finned pilot whale mostly ranges from New Jersey south through Florida, the northern Gulf of Mexico, and the Caribbean without any seasonal movements or concentrations (Hayes et al. 2022). Populations for both of these species overlap spatially along the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Hayes et al. 2022). While the exact latitudinal ranges of the two species remains uncertain, most pilot whale sightings south of Cape Hatteras are expected to be short-finned pilot whales, while north of approximately 42°N most pilot whale sightings are expected to be long-finned pilot whales (Hayes et al. 2020).

The relative abundance and density of pilot whales is most highly concentrated along the continental slope to the east of the Lease Area, according to predictive density mapping based on long-term survey data and long-term occurrence data (Roberts and Halpin 2022; OBIS 2020). The AMAPPS Marine Mammal Model for long- and short-finned pilot whales indicates moderate presence throughout the offshore portions of the Study Area offshore portions of the with low presence along the coastline of Virginia in all seasons modeled (no modeling provided for winter) (NOAA Fisheries 2020a). Pilot whales were reported by PSOs in August of 2020 and Jul of 2021.

The best population estimate for long-finned pilot whales based on the recent SARs is 39,215 individuals, and for short-finned pilot whales it is 28,924 (Hayes et al. 2022). Pilot whales are subject to bycatch in gillnet fishing, pelagic trawling, longline fishing, and purse seine fishing. The total annual human-caused mortality and serious injury for long-finned pilot whales during 2013–2017 was 21 long-finned pilot whales (Hayes et al. 2022). The estimated mean annual fishery-related mortality and serious injury during 2013–2017, due to the pelagic longline fishery, was 160 for short-finned pilot whales (Hayes et al. 2022). Mass strandings involving hundreds of individuals are not unusual and demonstrate that these large pods have a high degree of social cohesion (Reeves et al. 2002).

Long- and short-finned pilot whales are present year-round in Virginia's offshore waters, especially along the continental slope; although pilot whale presence is likely predominantly comprised of short-finned pilot whales given the more southernly latitude and range preferences known for the pilot whale species (Roberts and Halpin 2022; OBIS 2020; NOAA Fisheries 2020a). Based on available data, the overall likelihood of pilot whale occurrence in the Study Area is high, particularly along the eastern portion of the Lease Area.

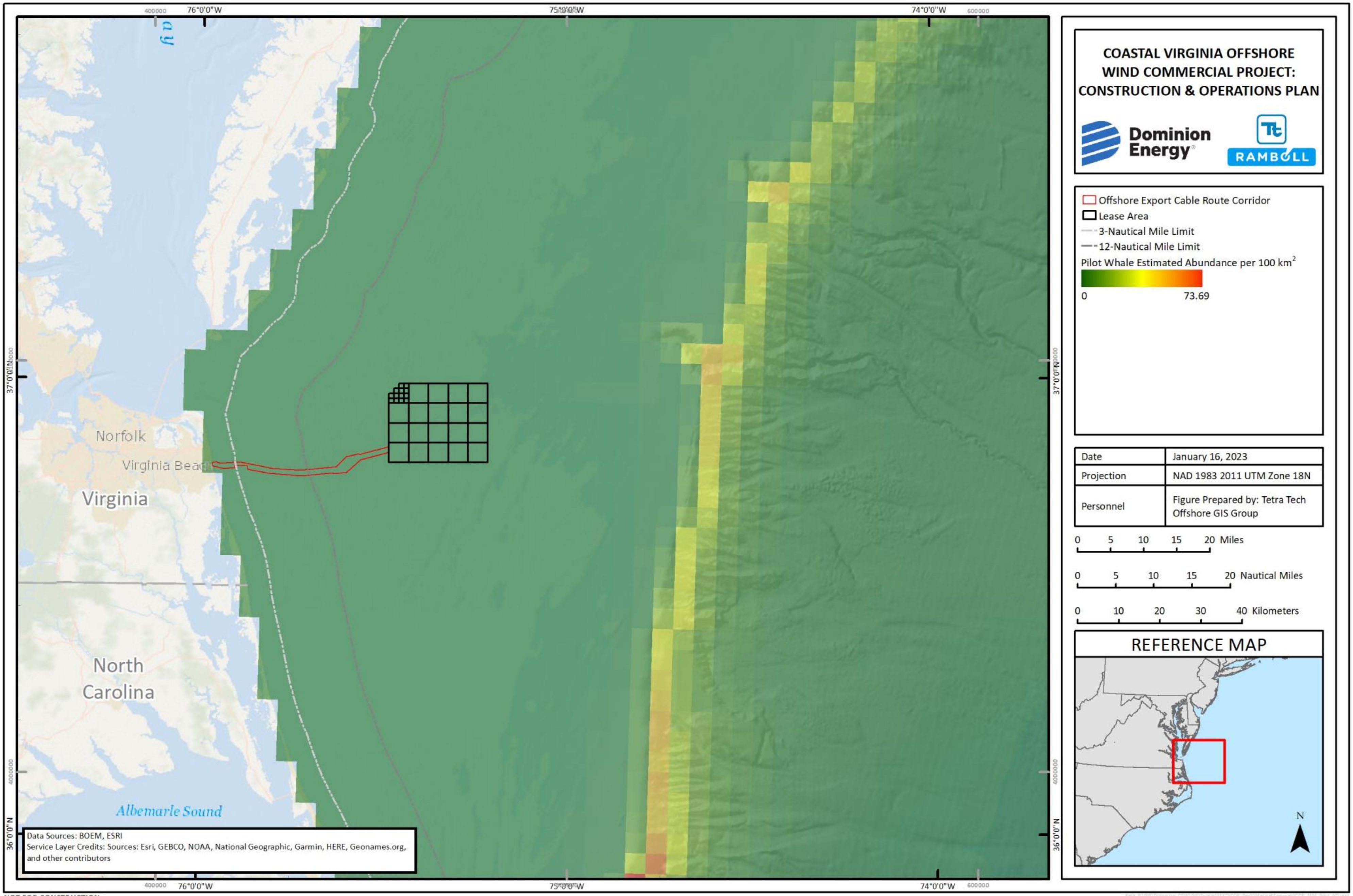


Figure 4.2-35. Annual Distribution of the Long-finned and Short-finned Pilot Whale in the Marine Mammal Study Area

Risso's Dolphin

Risso's dolphin (*Grampus griseus*) is not ESA-listed and the western North Atlantic stock is not considered strategic under the MMPA (Hayes et al. 2022). The species' anterior body is extremely robust, tapering to a relatively narrow tail stock, and has one of the tallest dorsal fins in proportion to body length of any cetacean (Baird 2009). Color patterns change dramatically with age. Infants are gray to brown dorsally and creamy-white ventrally, with a white anchor-shaped patch between the pectoral flippers and white around the mouth (Jefferson et al. 2015). Calves then darken to nearly black, while retaining the ventral white patch. Older animals can appear almost completely white on the dorsal surface or when swimming just beneath the surface (Jefferson et al. 2015). The diet for this species consists mostly of squid (Jefferson et al. 2015). Risso's dolphin hearing is in the MF range (NOAA Fisheries 2018a).

The species is distributed worldwide in temperate and tropical oceans, with an apparent preference for steep, shelf-edge habitats between about 1,312 to 3,280 ft (400 to 1,000 m) deep (Baird 2009). Risso's dolphin of the western North Atlantic stock prefers temperate to tropical waters typically from 59 to 68°F (15 to 20°C) and are rarely found in waters below 50°F (10°C). They occur along the continental shelf edge ranging from Cape Hatteras to Georges Bank during spring through fall, and throughout the Mid-Atlantic Bight out to oceanic waters during winter (Baird 2009). Risso's dolphins are usually seen in groups of 12 to 40 individuals. Loose aggregations of hundreds or even several thousand individuals are occasionally seen (Jefferson et al. 2015). Sightings of this species from surveys are mostly in the continental shelf edge and continental slope areas (Hayes et al. 2019, 2022).

The relative abundance and density of Risso's dolphins increases in winter along the continental slope and farther offshore, peaks in spring, declines in summer, and is lowest in fall, according to predictive density mapping based on long-term survey data (Roberts and Halpin 2022; OBIS 2020; see Figure 4.2-36). Annual peaks in occurrence are in June and annual lows occur in December according to biogeographic information data (OBIS 2020; see Figure 4.2-21). The AMAPPS Marine Mammal Model for Risso's dolphins indicates low presence throughout the majority of the Offshore Project Area with moderate presence along the eastern, offshore edge of the Lease Area in all seasons modeling (spring, summer, fall; NOAA Fisheries 2020a).

The best population estimate for the western North Atlantic stock based on the most recent SAR for Risso's dolphin is approximately 35,215 individuals (Hayes et al. 2022). Mass strandings of this species are very rare (Baird 2009). Total annual estimated average fishery-related mortality or serious injury to this stock during 2012–2017 was 53.9 Risso's dolphins (Hayes et al. 2022). The total U.S. fishery mortality and serious injury rate for this stock is not less than 10 percent of the calculated PBR and therefore cannot be considered to be insignificant and approaching zero. The status of Risso's dolphins is not known but is not considered strategic (Hayes et al. 2022). Population trends for this species have not been investigated.

Risso's dolphins are present year-round in Virginia's offshore waters, especially east of the continental slope (NOAA Fisheries 2020a). Their likelihood of occurrence increases in winter, peaks in spring, declines in summer, and is lowest in fall (Roberts and Halpin 2022; OBIS 2020). Based on available data, the overall likelihood of Risso's dolphin occurrence is moderately high in the offshore Study Area, particularly along the eastern portion of the Lease Area.

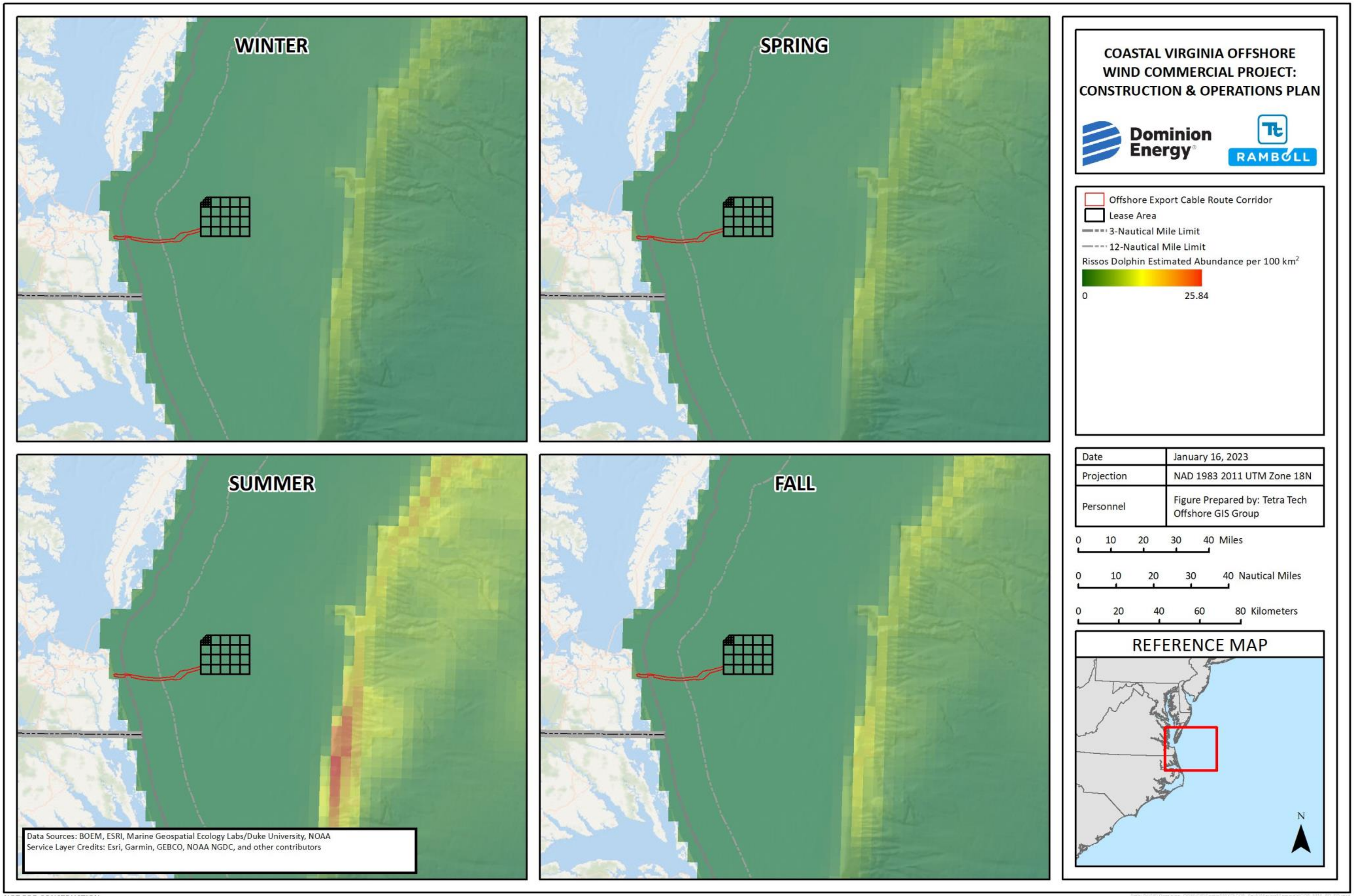


Figure 4.2-36. Seasonal Distribution of the Risso's Dolphin in the Marine Mammal Study Area

Atlantic White-sided Dolphin

The Atlantic white-sided dolphin can be found in cold temperate to subpolar waters in the North Atlantic within deep OCS and slope waters (Jefferson et al. 2015). In the western North Atlantic, this species occurs from Labrador and southern Greenland to the coast of Virginia (Jefferson et al. 2015). During winter and spring, concentrations of Atlantic white-sided dolphins can be found in the Mid-Atlantic region, particularly in deeper waters along the continental slope (Waring et al. 2012). Atlantic white-sided dolphins range between 8.2 to 9.2 ft (2.5 to 2.8 m) in length, with females being approximately 20 cm shorter than males (Jefferson et al. 2015). This species is highly social and is commonly seen feeding with fin whales. White-sided dolphins feed on a variety of small species such as herring, hake, smelt, capelin, cod, and squid, with regional and seasonal changes in the species consumed (Jefferson et al. 2015). Other prey species include mackerel, silver hake, and several other varieties of gadoids (Waring et al. 2012). Recent population estimates for Atlantic white-sided dolphins in the Western North Atlantic Ocean places this species at 93,233 individuals (Hayes et al. 2021).

This species can be found off the coast of southern New England during all seasons of the year but is usually most numerous in areas farther offshore at a depth of 330 ft (100 m) (Kenney and Vigness-Raposa 2010; Bulloch 1993; Reeves et al. 2002; see Figure 4.2-37. The AMAPPS Marine Mammal Model for Atlantic white-sided dolphins indicates very low presence throughout the majority of the Offshore Project Area during spring and summer with slightly higher presence during fall and winter (NOAA Fisheries 2020a). Similar trends are also seen according to predictive density mapping based on long-term survey data (Roberts et al. 2020), and these data indicate almost no presence (less than 1.0 animals per 100 km^2) during July, August, and September.

The greatest human-induced threat to the Atlantic white-sided dolphin is bycatch, because they are occasionally caught in fishing gillnets and trawling equipment. An estimated average of 328 dolphins each year were killed by fishery-related activities during 2003 to 2007 (Waring et al. 2010). From 2008 through 2012, an estimated annual average of 116 dolphins per year were killed (Waring et al. 2015), and from 2010 through 2014, the estimate decreased to 74 individuals annually (Hayes et al. 2019). During the period of 2012 to 2016, this number decreased to an estimated 30 individuals annually (Hayes et al. 2019). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as “non-strategic” (Waring et al. 2011, 2015). The overall likelihood of occurrence in the Study Area is low. It is included as a precautionary measure, as geographic distributions may shift over the construction time period as a result of climate change.

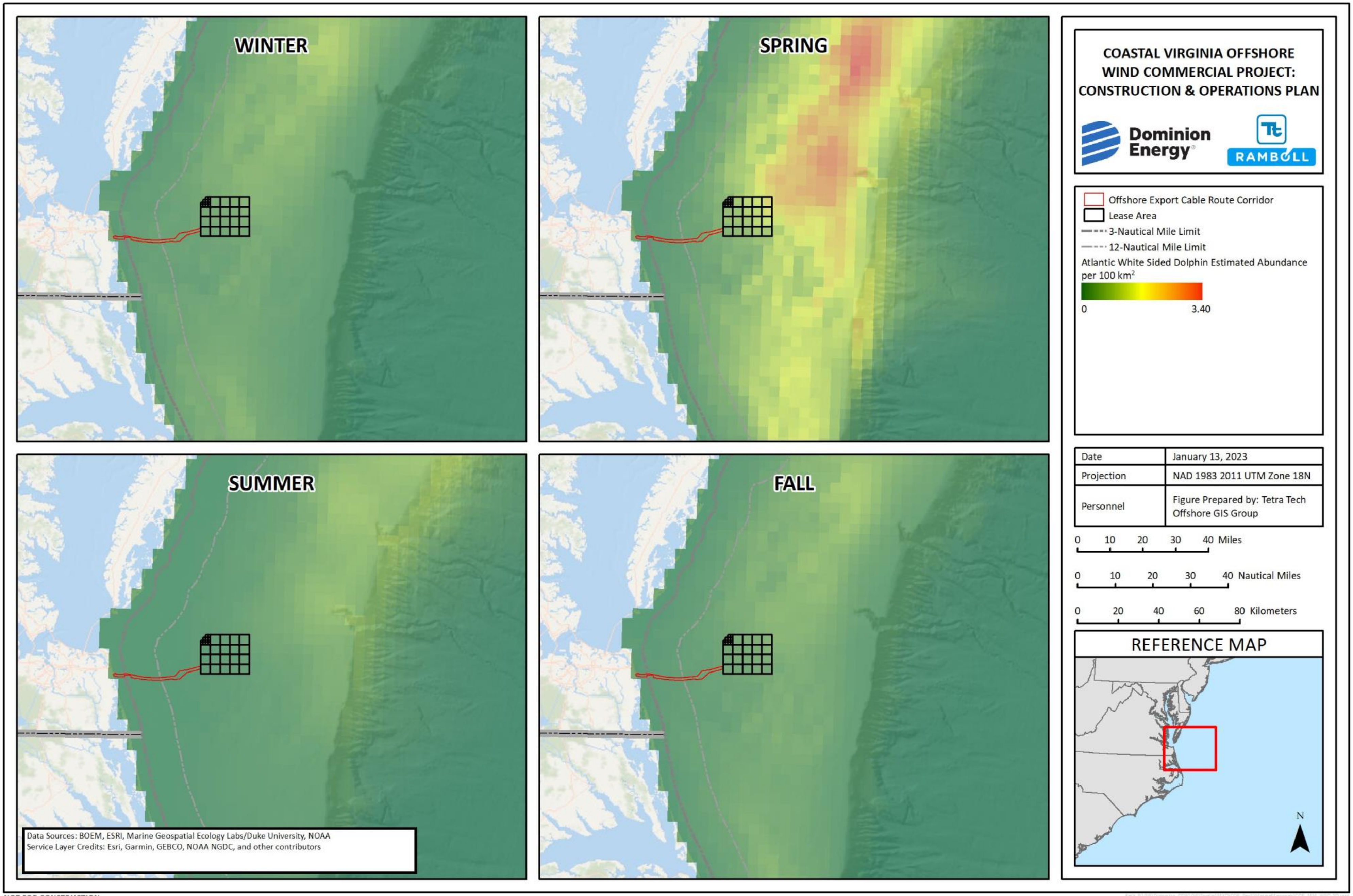


Figure 4.2-37. Seasonal Distribution of the Atlantic White-sided Dolphin in the Marine Mammal Study Area

Harbor Seal

The harbor seal (*Phoca vitulina vitulina*) is not ESA-listed, and NOAA Fisheries considers the North Atlantic stock as "non-strategic" under the MMPA (Hayes et al. 2022). Harbor seals have short, dog-like snouts. Coloration varies by individual, but has two basic patterns: light tan, silver, or blue-gray with dark speckling or spots, or a dark background with light rings (Jefferson et al. 2015). Male harbor seals are 5.6 and 6.2 ft (1.7 and 1.9 m) in length, with females being slightly smaller than males (Wynne and Schwartz 2014; Kenney and Vigness-Raposa 2010; Jefferson et al. 2015). Harbor seals prey upon small- to medium-sized fish, followed by octopus and squid, and lastly by shrimp and crabs (Kenney and Vigness-Raposa 2010). Fish eaten by harbor seals include commercially important species such as mackerel, herring, cod, hake, smelt, shad, sardines, anchovy, capelin, salmon, rockfish, sculpins, sand lance, trout, and flounders (Kenney and Vigness-Raposa 2010). They spend about 85 percent of the day diving, and much of the diving is presumed to be active foraging in the water column or on the seabed. They dive to depths ranging from 30 to 500 ft (10 to 150 m), depending on location. Harbor seals forage in a variety of marine habitats, including deep fjords, coastal lagoons and estuaries, and high-energy, rocky coastal areas. They may also forage at the mouths of freshwater rivers and streams, occasionally traveling several hundred miles upstream (Reeves et al. 2002). Except for a strong bond between mothers and pups, harbor seals are generally intolerant of close contact with other seals. Nonetheless, they are gregarious, especially during the molting season, which occurs between spring and autumn depending on geographic location. They may haul out to molt at a tide bar, sandy or cobble beach, or exposed intertidal reef. During this haul-out period, they spend most of their time sleeping, scratching, yawning, and scanning for potential predators such as humans, foxes, coyotes, bears, and raptors (Reeves et al. 2002). In late autumn and winter, harbor seals may be at sea continuously for several weeks or more, presumably feeding to recover body mass lost during the reproductive and molting seasons and to fatten up for the next breeding season (Reeves et al. 2002). They have an underwater hearing range of 50 Hz to 86 kHz and are functionally grouped with other phocid (true/earless) seals (NOAA Fisheries 2018a).

Harbor seals are the most abundant seals in the waters of the eastern U.S. and are commonly found in all nearshore waters of the Atlantic Ocean from Newfoundland, Canada southward to northern Florida (Hayes et al. 2022). While harbor seals occur year-round north of Cape Cod, they only occur south of Cape Cod (southern New England to New Jersey) during winter migration, typically September through May (Kenney and Vigness-Raposa 2010; Hayes et al. 2022). During the summer, most harbor seals can be found north of Massachusetts within the coastal waters of central and northern Maine as well as the Bay of Fundy (Hayes et al. 2021).

In Virginia, the relative abundance and density of harbor seals peaks in winter and spring in nearshore portions of the continental shelf and is lowest in summer and fall according to predictive density mapping based on long-term survey data (Roberts et al. 2020; see Figure 4.2-38). Sightings also peak in the winter and spring and decrease in the summer and fall (OBIS 2020; see Figure 4.2-22).

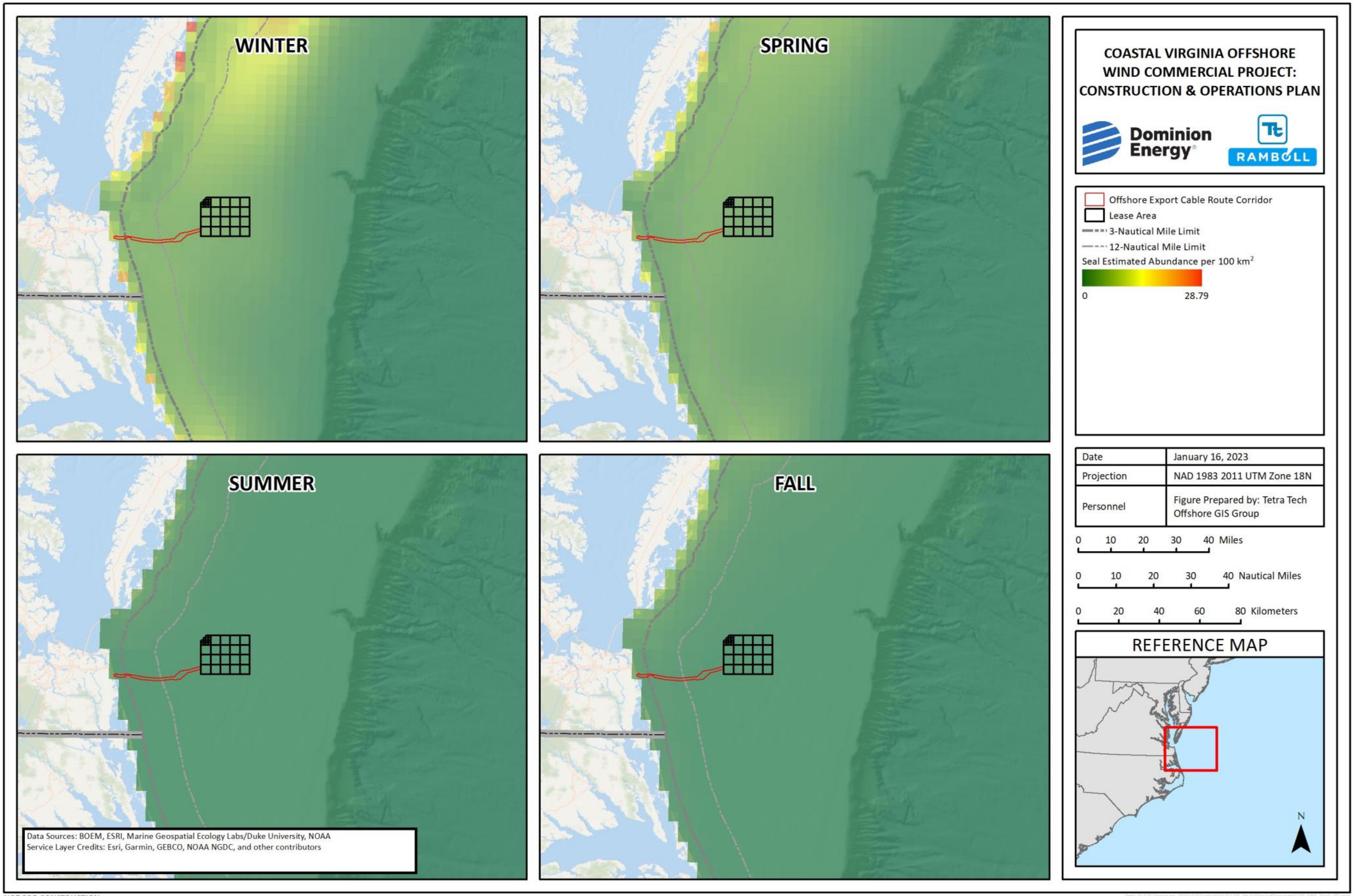


Figure 4.2-38. Seasonal Distribution of Harbor Seals in the Marine Mammal Area

The current western North Atlantic stock based on the most recent SAR is estimated to consist of 61,336 individuals, which is from a 2018 survey (Hayes et al. 2022). Historically, these seals have been hunted for several hundred to several thousand years. Harbor seals are still killed legally in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al. 2002). From 2014 to 2018, the average rate of mortality for the western North Atlantic harbor seal stock from anthropogenic causes was approximately 365.2 per year (Hayes et al. 2022). From 2014 to 2018, a total of 2,156 harbor seal stranding mortalities were reported between Maine and South Carolina: 3.9 percent showing signs of human interaction including fisheries entanglement (13 individuals), shooting (1 individuals), and vessel strike (13 individuals) and the remainder of unknown causes (57 individuals; Hayes et al. 2022). Average annual fisheries-related mortality and serious injury does not exceed the PBR for this species (Hayes et al. 2021). From July to December 2018, 1,100 harbor seal mortalities occurred across Maine, New Hampshire, and Massachusetts, and as a result NOAA Fisheries declared a UME (NOAA Fisheries 2020b). The UME was expanded to cover all seal strandings from Maine to Virginia (the UME also includes gray, harp, and hooded seals). The main cause seems to be illness as a result of phocine distemper virus (Hayes et al. 2022). The UME is currently inactive and pending closure (NOAA Fisheries 2021).

Harbor seals are present seasonally in Virginia's waters, especially in nearshore portions of the continental shelf and their likelihood of occurrence peaks in winter and spring months (Roberts and Halpin 2022). Based on available survey data, the overall likelihood of harbor seal occurrence in the Study Area is high, particularly along the Offshore Export Cable Route Corridor.

Basis for Estimating Number of Marine Mammals that Might be Taken by Harassment from Foundation Installation Activities

4.2.5.2 Marine Mammal Density Estimates

The Roberts and Halpin (2022) marine mammal density estimates for the U.S. Atlantic represent the best available marine mammal data for the Study Area. These density data are delineated by 5 km x 5 km grid cells in U.S. Atlantic waters and by species or species groups (if sufficient data were available to estimate an individual species density) and month, unless sufficient data were only available to estimate an annual density. Note that while grid cells are 25 km^2, density values are still reported per 100 km^2. A discrete density is designated for each grid cell within the datasets. The methodology employed to derive these data is described in Roberts et al. (2016).

For foundation installation, density estimates were extracted to represent the density within a buffered area, defined as the Lease Area buffered by the range to the 120 decibel (dB) sound pressure level (SPL) behavioral threshold from vibratory pile driving mitigated by 10 dB. A buffer range of 5 mi (8.9 km) was chosen because it represents the furthest extent where potential impacts to marine mammals could be expected, as it is the farthest distance to the Level B acoustic isopleth when the sound fields are attenuated by 10 dB (see Table 4.2-23).

For all other activities, density estimates from the Roberts and Halpin 2022 dataset were extracted and were associated with the location of the specified activity, extending to the furthest extent where potential impacts to marine mammals could be expected.

Table 4.2-23. Updated Mean Seasonal Density Estimates for the Potentially Occurring Marine Mammal Species in the Project Buffered (8.9 km) Lease Area. Endangered Species Act (ESA)-listed Marine Mammal Species Highlighted

Marine Mammal Species or Model Group	Mean Density (animals/km^2)		
	Spring (May)	Summer (June to August)	Fall (September to October)
Atlantic spotted dolphin	0.00507	0.05873	0.03822
Bottlenose dolphin a/ Western North Atlantic. Southern Coastal Migratory	0.13098	0.13509	0.13852
Bottlenose dolphin a/ Western North Atlantic, Offshore	0.07352	0.07415	0.06439
Common dolphin (short-beaked)	0.05355	0.00559	0.00103
Common minke whale	0.00519	0.00028	0.00011
Fin whale	0.00069	0.00036	0.00019
Harbor porpoise	0.00315	0.00000	0.00000
Humpback whale	0.00136	0.00023	0.00040
North Atlantic right whale	0.00015	0.00004	0.00005
Pantropical spotted dolphin b/	0.00008	0.00008	0.00008
Pilot whale *spp.* (long- and short-finned pilot whales) c/	0.00098	0.00098	0.00098
Risso's dolphin	0.00084	0.00042	0.00021
Seals d/	0.01828	0.00001	0.00047
Sei whale	0.00021	0.00001	0.00004
Sperm whale	0.00003	0.00000	0.00000

Notes:

a/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock.

b/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).

c/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp.*" and not species-specific.

d/ Pinniped density values attributed 50% to harbor seals and 50% to gray seals.

Maximum monthly densities (i.e., the maximum density of each grid cell), as reported by Roberts and Halpin (2022), were averaged by season over the planned duration of cofferdam installation activities (spring [May], summer [June through August], and fall [September through October]) for the entire Study Area. To be conservative, the maximum average seasonal density for each species was then selected for inclusion in the take calculations. For pinnipeds, because the seasonality of, and habitat use by, gray seals roughly overlaps and the density data, as presented by Roberts and Halpin (2022), does not differentiate between pinniped species, the estimated takes were split evenly between harbor and gray seals.

The data used as the basis for estimating species density for the Study Area are derived from data provided by Duke University's Marine Geospatial Ecology Lab and the Marine-life Data and Analysis Team. This dataset is a compilation of the best available marine mammal data (1994-2022) and was prepared in a collaboration between Duke University, Northeast Regional Planning Body, University of North Carolina, the Virginia Aquarium and Marine Science Center, and NOAA Fisheries (Roberts and Halpin 2022). Recently, these data have been updated with new modeling results and have included density estimates for pinnipeds in addition to revised estimates for right whales (Roberts and Halpin 2022). Pinniped density data (as presented in Roberts and Halpin 2022) were used to estimate pinniped densities in the planned construction area with 50 percent of take accrued to harbor seals and 50 percent accrued to gray seals.

Two bottlenose dolphin stocks (Southern Migratory Coastal and Offshore) are present within the Study Area, but density estimates area only available in the Roberts and Halpin (2022) density data for the bottlenose species in its entirety. Hayes et al. (2021) defines the boundary between the Western North Atlantic, Southern Migratory Coastal stock and the Western North Atlantic, offshore stock of bottlenose dolphins as the 20-meter (m) isobath north of Cape Hatteras, NC. Thus, the 20-m isobath was used to define and differentiate the stock boundaries within the Roberts and Halpin (2022) data and derive density estimates for each stock of the bottlenose dolphin. All bottlenose dolphin density grid cells less than 20 m in the Project modeling area or buffered lease areas were used to calculate the density of the Southern Migratory Coastal stock, while all density grid cells greater than 20 m in the modeling and buffered lease areas were used to calculate the density of the offshore stock of bottlenose dolphins.

One of the undifferentiated species groups in the Study Area is the "seal" group, which includes the harbor and gray seals. The summer density for the seal group is 0.00001 animals/square kilometer (km^2) (see Attachment A), which is not the density derived from Roberts and Halpin (2022). Higher density estimates, 0.0003 animals/km^2 (within buffered Lease Area) and 0.0022 animals/km^2 (within Project modeling area), were derived from Roberts and Halpin (2022) for the summer season for this species group. However, the Roberts and Halpin (2022) derived density estimates were considered unrealistic given that neither seal species are expected to occur in the waters of the modeling or buffered Lease Area during summer (Hayes et al. 2021). For harbor seals, Hayes et al. (2021) estimates the occurrence of harbor seals in mid-Atlantic waters to range only from September through May, not during summer. The summer distribution of both species is well documented in more northern waters. To reconcile the known distribution of these species with the need for a density estimate, the conservative density estimate of 0.00001 animals/km^2 was used to represent the summer density of both seal species within the Project modeling area and buffered Lease Area.

Note that NOAA Fisheries added take for four marine mammal species that might otherwise be considered rare but were detected through PAM/visually observed by marine mammal monitors during survey work under previous Incidental Harassment Authorizations (88 FR 28656). These species include: false killer whales (*Pseudorca crassidens*; one detection of five individuals), pygmy sperm whales (*Kogia breviceps*; one detection of one individual), Clymene dolphin (*Stenella clymene*; one detection of five individuals), and melon-headed whales (*Peponocephala electra;* one detection of five individuals). NOAA fisheries proposed additional Level B take authorization for these species despite the low detection numbers as these additional species were detected within locations near the Study Area where NOAA Fisheries considers it reasonably likely that these species may be observed during the 5-year rulemaking.

4.2.5.3 Impacts Analysis for Construction, Operations and Maintenance, and Decommissioning

The potential impacts resulting from the construction, O&M, and decommissioning of the Project are based on the Preferred Layout from the PDE (See Section 3, Description of Proposed Activity). For the purpose of the assessments presented within this COP, the WTG design envelope has been defined by minimum and maximum parameters, which are representative of the minimum and maximum number of structures to be constructed within the Offshore Project Study Area. Dominion Energy is permitting up to 176 WTGs and three Offshore Substations. Seven spare WTG positions are included in the assessment herein, consistent with the LOA application. Spare positions will be utilized in the event that originally selected positions are unable to yield successful WTG installations for any reason. Acoustic analyses for estimation of impacts to marine mammals are based on 176 WTGs with seven spare positions.

As discussed above, the Study Area does not intersect any designated critical habitat for marine mammals. While there are several haul-out areas for pinnipeds in Chesapeake Bay (Jones and Reese 2020), none of these areas are located in the vicinity of the Nearshore Trenchless Installation Area or Cable Landing Locations. Furthermore, the Offshore Export Cables will be brought to shore via trenchless installation to minimize impacts to the sensitive beach and dune area; therefore, cable installation is not expected to impact onshore marine mammals due to reduced proximity to and short duration of construction activities in area where onshore marine mammals might occur. As such, this section focuses on the potential impacts to marine mammals in the offshore environment, including waters within and in the vicinity of the Offshore Project Area.

Construction

During construction, the potential impact-producing factor to marine mammals may include installation of the Offshore Project Components. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project construction. The following impacts may occur as a consequence of the factor identified above:

- Short-term disturbance of habitat;
- Short-term loss of local prey species;
- Short-term introduction of marine debris;
- Short-term increase in risk of entanglement and entrapment;
- Short-term increase in underwater noise;
- Short-term increase in risk of ship strike due to the increase in vessel traffic; and
- Short-term change in water quality, including oil spills.

Short-term disturbance of habitat. Benthic and pelagic habitat within the Study Area would be temporarily disturbed by installation of WTG Monopile and Offshore Substation Jacket Foundations and Offshore Export and Inter-Array Cables. WTG Monopile and Offshore Substation Jacket Foundations would be installed either simultaneously or sequentially, and cables would be installed both simultaneously and linearly, depending on cable type, resulting in localized areas of disturbance in any given time period. Marine mammals are highly mobile species and as such may avoid potential construction-related impacts by leaving the immediate area of activity. Marine mammals that may be collocated with construction-related habitat disturbances are not expected to be impacted from loss of habitat. Marine habitats are expected to return to pre-construction conditions following localized disturbances within a relatively short timeframe (See Section 4.1.2, Water Quality, and Appendix J, Sediment Transport Analysis). Additionally, due to local habitat uniformity, ample suitable habitat is available in the vicinity of the Study Area (See

Section 4.2.4, Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat). Temporarily displaced marine mammals would still have access to similar-quality habitat in adjacent areas and are expected to return to the Study Area upon the completion of construction. Dominion Energy has sited Offshore Project Components, including WTG Monopile and Offshore Substation Jacket Foundations and Offshore Export Cable Route Corridors, to avoid sensitive benthic habitats and minimize disturbance of benthic features to the extent practical. Therefore, no permanent habitat disturbance or long-term marine mammal displacement is anticipated in the Study Area.

Short-term loss of local prey species. Seafloor preparation, cable installation, pile-driving, and associated construction activities would temporarily impact prey species by increasing turbidity in the water column, disturbing benthic habitat, and generating underwater sound associated with vessels and equipment. Such impact-producing factors may provoke mobile prey species to leave the area of activity and/or cause injury or mortality in less mobile species. This may indirectly inhibit marine mammal foraging activities within the Study Area.

Marine mammals consume a variety of organisms including benthic invertebrates (e.g., cephalopods and crustaceans), copepods, krill, small schooling fish (e.g., capelin, herring, and mackerel), and squid. Foraging preferences vary by species and prey availability and foraging locations span benthic, coastal, and pelagic environments. Marine mammal species that exhibit preferences for benthic prey would be most impacted by seafloor preparation, installation, and associated prey mortality, while those that exhibit preferences for coastal or pelagic prey would be most impacted by predator evasion and displacement from construction sites. Copepods and other planktonic prey remain suspended in the water column and have limited mobility; they are unlikely to be affected by Project-related construction activities. Their primary predators, including the North Atlantic right whale, would therefore, be less impacted by prey evasion as a result of Project construction than other marine mammal predators.

Just as marine mammals would have access to suitable habitat in the vicinity of the Study Area, their mobile prey base would have access to ample similar-quality habitat nearby. Mobile forage species would only be displaced temporarily by Project-related construction, as benthic and pelagic habitats are expected to return to pre-construction conditions within a short timeframe (see Section 4.1.2, Water Quality, and Appendix J, Sediment Transport Analysis). Dominion Energy has sited Offshore Project Components, including WTG Monopile and Offshore Substation Jacket Foundations and Offshore Export Cable Route Corridors, to avoid sensitive benthic habitats and minimize disturbance of associated forage species to the extent practical. Section 4.2.4, Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat, details further assessments on potential impacts to prey species, including embedded and proposed mitigation measures.

Short-term introduction of marine debris. Construction activities and Project vessels can introduce debris into the marine environment. Such marine debris may potentially be mistaken for prey by marine mammals, which could result in accidental ingestion. Debris can also cause entanglement, entrapment, injury, or death. Marine mammal interactions with marine debris are well documented globally and have been attributed as a source of marine mammal mortality in Virginia's offshore waters (Nelson et al. 2007; Kenney 2009; Bettridge et al. 2015; Waring et al. 2014, 2015, 2016; Hayes et al. 2019; 2020). 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, and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. Additionally, all Project-related vessels will operate in accordance with regulations pertaining to at-sea discharges of vessel-generated waste and Dominion Energy would require Project-related personnel and vessel contractors to implement appropriate debris control practices and protocols. Therefore, due to implementation of these measures, the release of marine debris into the Study Area is not anticipated and as a result, impacts are expected to be minimal.

Short-term increase in risk of entrapment and entanglement. Marine mammals could be susceptible to entrapment or entanglement in Project-related cables or lines present in the water column during seafloor preparation and installation activities. Such events occur when marine species are inadvertently caught, captured, or restrained by strong and flexible anthropogenic materials, such as fishing lines or buoy lines. For example, transiting pinnipeds and feeding whales are commonly entangled in smaller fisheries-related marine debris (e.g., weight line and netting) along the U.S. coastline. Within the last decade, research into marine mammal entrapment and entanglement has expanded to include offshore renewable development (Reeves et al. 2003; Benjamins et al. 2012, 2014; Harnois et al. 2015). Such risk assessments have examined tension characteristics, line swept volumes ratio, and line curvature of moorings. Results indicate that taut cable and line configurations reduce the risk of entanglement to all marine mammals.

Project-related marine mammal entanglements would be unlikely to occur given the weight of equipment-related lines and the tension under which cables would be operating. While some small dolphin species are more likely to approach installation vessels, and thus would be subject to potential entanglements, baleen whale species (e.g., fin, humpback, right or minke whales) would be less likely to be collocated with construction vessels due to Project related BMPs and monitoring and mitigation protocols. Construction activities that involve cables and lines in the water column would be short-term, localized, and restricted to a small fraction of available marine mammal habitat. Project monitoring-related fisheries survey and 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 the risk of marine mammal entanglement. Furthermore, Dominion Energy would implement practices to prevent Project personnel from commencing or continuing certain construction activities should marine mammals be observed within monitoring and exclusion zones based on required NOAA Fisheries monitoring and mitigation protocols and stipulations of the Lease.

Short-term increase in underwater noise. Underwater noise in the Study Area would temporarily increase with the presence of Project-related vessels and during cable installation, pile-driving, and associated construction activities. Project-related noise may impact marine mammals both behaviorally and physiologically, because all marine mammals employ sound while foraging, orienting and navigating, interacting with conspecifics (e.g., during recognition, mate selection, parent-offspring bonding), and detecting predators.

Most marine animals can perceive underwater sounds spanning approximately 10 Hz to more than 10 kHz (Southall et al. 2007, 2019). This broad range of frequencies allows marine animals to detect baseline oceanic sounds generated from ambient physical processes. Such processes vary in volume depending on location among other factors; for example, tidal environments often have louder baseline noise than offshore environments. Anthropogenic noise, including Project-related noise may rise above baseline ambient noise and potentially cause marine mammals discomfort or mask sounds that serve as behavioral cues. Project-related noise would primarily be generated by pre-construction HRG surveys to support design finalization, cofferdam installation via vibratory installation, percussive and vibratory pile-driving of WTG Monopile and Offshore Substation Jacket Foundations, and increased vessel presence. Vessel traffic transiting along the coast and to and from the nearby Chesapeake Bay generates significant anthropogenic noise in Virginia's offshore waters. Project-related vessel traffic described by the maximum design scenario would occur sporadically throughout the construction period and is not expected to increase noise significantly above existing levels.

Vessel sound and physical vessel traffic have been shown to elicit short-term behavioral responses in whales and other marine mammals (see Section 4.1.5, Underwater Acoustic Environment) (Baker et al. 1981; Watkins 1986; Magalhães et al. 2002). However, it can be difficult to discern if an acoustic source is the cause of a marine mammal behavioral change. Anthropogenic noise, physical vessel presence, and vocalizations from conspecifics, predators, or prey may all elicit a response in a given individual present in the Study Area. Marine mammal responses to anthropogenic noise may also vary by species, distance from acoustic source, and behavioral context (e.g., reproductive state or presence of offspring; Ellison et al. 2012). Various acoustic triggers can result in changes to marine mammal vocalizations, dive and surface times, swimming speeds and directions, respiration rates, feeding patterns, and social interactions (Au and Green 2000; Williams et al. 2014; Richter et al. 2003).

Dominion Energy conducted underwater sound propagation modeling in a variety of environments throughout the Study Area to predict the level of underwater noise generated by construction activities (see Appendix Z, Underwater Acoustic Assessment, for descriptions of modeling methodology and data inputs). Consultations with Project design and engineering teams provided descriptions of the expected construction activities to inform representative acoustic modeling scenarios. Each modeling scenario included proxy source levels derived from engineering guidelines, publications, and underwater source measurements of similar equipment and activities. Table 4.2-24 provides a summary of the construction scenarios included in the modeling analysis.

Table 4.2-24. Underwater Acoustic Modeling Scenarios

Scenario	Activity Description	Maximum Hammer Energy (kilojoules)	Duration of Pile Installation (minutes)	Total Hammer Blows	Modeling Location (UTM Coordinates)	Sound Source Level (No Attenuation)
Scenario 1: Standard Driving Installation	Monopile Foundation (includes 1 pile per day): 9.5 m	Vibratory Pile Driving	60	N/A	Deep: 480,666 m, 4,089,018 m Shallow: 459,846 m, 4,075,324 m	202 $L_{E,\ 1sec}$
		Impact Pile Driving: 4,000	85	3,240		249 $L_{p,pk}$ 226 $L_{E,\ 1sec}$ 236 L_{p}
Scenario 2: Hard to Drive Installation	Monopile Foundation (includes 1 pile per day): 9.5 m	Vibratory Pile Driving	30	N/A	Deep: 480,666 m, 4,089,018 m Shallow: 459,846 m, 4,075,324 m	202 $L_{E,\ 1sec}$
		Impact Pile Driving: 4,000	99	3,720		249 $L_{p,pk}$ 226 $L_{E,\ 1sec}$ 236 L_{p}
Scenario 3: One Standard and One Hard to Drive Installation	Monopile Foundation (includes 2 piles per day): 9.5 m	Vibratory Pile Driving	90	N/A	Deep: 480,666 m, 4,089,018 m Shallow: 459,846 m, 4,075,324 m	202 LE, $_{1sec}$
		Impact Pile Driving: 4,000	184	6,960		249 $L_{p,pk}$ 226 $L_{E,\ 1sec}$ 236 Lp

Scenario	Activity Description	Maximum Hammer Energy (kilojoules)	Duration of Pile Installation (minutes)	Total Hammer Blows	Modeling Location (UTM Coordinates)	Sound Source Level (No Attenuation)
Scenario 4: Offshore Substation Piled Jacket Foundation	Piled Jacket Foundation (includes 2 piles per day): 2.8 m	Vibratory Pile Driving	120	N/A	Offshore Substation: 474,075 m, 4,085,595 m	194 $L_{E,\ 1sec}$
		Impact Pile Driving: 3,000	410	15,120		240 $L_{p,pk}$ 214 $L_{E,\ 1sec}$ 224 L_p
Scenario 5: Cofferdam Installation	Cofferdam Installation, Vibratory Pile-Driving	Vibratory Pile Driving	60	N/A	Cofferdam: 414,213 m, 4,074,917 m	195 $L_{E,\ 1sec}$
Scenario 6: Goal Post Pile Installation	Goal Post Piles (2 per day)	Impact Pile Drive	130	260	Goal Post: 414,396 m, 4,074,917m	210 $L_{p,pk}$ 183 $L_{E,\ 1sec}$ 193 L_p

Notes:
SEL = sound exposure level; LPK = peak sound pressure (dB re 1 μPa)
N/A Not applicable for this installation methodology

The representative acoustic modeling scenarios were derived from descriptions of the expected construction activities and operational conditions through consultations between the Project design and engineering teams. The scenarios modeled were ones where potential underwater noise impacts of marine species were anticipated and included impact and vibratory pile driving associated with WTG Jacket and Offshore Substation Jacket Foundation installation and vibratory pile-driving associated with cofferdam construction. All impact and vibratory pile-driving modeling scenarios of WTGs occur at representative locations; one at a shallow water depth (21 m) within the Wind Development Area, and another at a deep-water depth (37 m) within the Wind Development Area. These two locations were selected so that the effects of sound propagation at the range of water column depths occurring within the Wind Development Area could be observed. The vibratory pile-driving needed for cofferdam installation in most cases occurs at depths less than 328 ft (100 m); therefore, only a single modeling location was completed for the vibratory pile-driving scenario. Goal Post piles were modeled using simple spread in the GARFO ESA Acoustic tool spreadsheets (NOAA Fisheries 2020d) and therefore a location was not incorporated into the modeling. However, the resulting area was then mapped using geospatial analysis to determine how much of the ensonified area would be truncated by land.

The results for impact and vibratory pile-driving of monopiles for the representative WTG location at the deep-water depth are shown in Table 4.2-25, Table 4.2-26, and Table 4.2-27 while the results for the shallow-water location are shown in Table 4.2-28, Table 4.2-29, and Table 4.2-30. Results for impact and vibratory pile-driving are presented without mitigation and with two different levels of mitigation: a 6 dB reduction and a 10 dB reduction. Results for the impact and vibratory pile-driving for pin pile installation are shown in Table 4.2-31, Table 4.2-32, and Table 4.2-33. As noise mitigation design has not been finalized at this stage of permitting, these two levels of reduction were applied to potentially mimic the use of noise mitigation options, such as bubble curtains. The results for cofferdam vibratory pile driving are shown in Table 4.2-34, and were not modeled with mitigation. The results for goal post installation are shown in Table 4.2-35, and were not modeled with mitigation. The presence of minor irregularities in results as noted below is attributed to model resolution and methodology; further details are provided in Appendix Z, Underwater Acoustic Assessment Section Z-7.

Table 4.2-25. Marine Mammal PTS Onset Criteria Threshold Distances (meters) for Impact Pile-Driving - Deep Location (Monopile)

Scenario	Pile Type	Maximum Hammer Energy (kilojoules)	Installation Duration (minutes)	Mitigation (dB)	Hearing Group a/							
					Low-Frequency Cetaceans		Mid-Frequency Cetaceans		High-Frequency Cetaceans		Phocid Pinnipeds	
					219 $L_{p,pk}$	183 $L_{E, 24hr}$	230 $L_{p,pk}$	185 $L_{E, 24hr}$	202 $L_{p,pk}$	155 $L_{E, 24hr}$	218 $L_{p,pk}$	185 $L_{E, 24hr}$
Scenario 1: Standard Driving Scenario	9.5 m Monopile	4,000 b/	85	0	344	11,325	116	598	1,621	5,686	371	3,405
				6	182	6,020	67	320	927	2,946	213	1,852
				10	132	4,396	29	170	663	2,139	141	1,267
Scenario 2: Hard Driving Scenario	9.5 m Monopile	4,000 b/	99	0	344	12,423	116	664	1,621	6,273	371	3,809
				6	182	6,738	67	354	927	3,230	213	1,987
				10	132	4,980	29	187	663	2,304	141	1,358
Scenario 3: One Standard and One Hard Driving Scenario	9.5 m Monopile (2 piles per day)	4,000 b/	184	0	344	14,363	116	840	1,621	7,647	371	4,651
				6	182	7,997	67	443	927	3,933	213	2,570
				10	132	5,663	29	226	663	2,884	141	1,756

Source: NOAA Fisheries 2018b

dB = decibel; Lp,pk = peak sound pressure level; L_E = sound exposure level; 24h = 24-hour

Notes:

Same information is presented in COP Section 4.1.5 and Appendix Z.
a/ Level A Injury
b/ Corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less.

Table 4.2-26. Marine Mammal PTS Onset Criteria Threshold Distances (meters) for Vibratory Hammer – Deep Location (Monopile)

Scenario	Pile Type	Installation Duration (minutes)	Mitigation (dB)	Hearing Group a/			
				LF Cetaceans	MF Cetaceans	HF Cetaceans	Phocid Pinnipeds
				199 $L_{E, 24hr}$	198 $L_{E, 24hr}$	173 $L_{E, 24hr}$	201 $L_{E, 24hr}$
Scenario 1: Standard Driving Scenario	9.5 m Monopile	60	0	414	0	341	128
			6	199	0	161	51
			10	141	0	103	12
Scenario 2: Hard Driving Scenario	9.5 m Monopile	30	0	356	0	278	84
			6	150	0	129 b/	23
			10	113	0	87	3
Scenario 3: One Standard and One Hard Driving Scenario	9.5 m Monopile (2 piles per day)	90	0	488	0	409	146
			6	224	0	185	67
			10	158	0	125 b/	31

Source: NOAA Fisheries 2018b

dB = decibel; L_E = sound exposure level; 24h = 24-hour

Notes:

Same information is presented in COP Section 4.1.5 and Appendix Z
a/ Level A Injury
b/ Refer to Appendix Z Section Z.7 for further details

Table 4.2-27. Marine Mammal Response Criteria Threshold Distances (meters) for the Deep Location

Location	Pile Type	Hammer Energy (kilojoules)	Installation Duration (minutes)	Mitigation (dB)	Hearing Group (m)	
					Marine Mammals	Marine Mammals
					160 L_P	120 L_p
Scenario 1: Standard Driving Installation	9.5 m Monopile	Vibratory	60	0	N/A	21,404
				6	N/A	12,267
				10	N/A	8,866
		Impact: 4,000 a/	85	0	15,010	N/A
				6	8,700	N/A
				10	6,182	N/A
Scenario 2: Hard to Drive Installation	9.5 m (31.2 ft) Monopile	Vibratory	30	0	N/A	21,404
				6	N/A	12,267
				10	N/A	8,866
		Impact: 4,000 a/	99	0	15,010	N/A
				6	8,700	N/A
				10	6,182	N/A
Scenario 3: One Standard and One Hard to Drive Installation	9.5 m (31.2 ft) Monopile (includes two piles per day)	Vibratory	90	0	N/A	21,404
				6	N/A	12,267
				10	N/A	8,866
		Impact: 4,000 a/	184	0	15,010	N/A
				6	8,700	N/A
				10	6,182	N/A

dB = decibel; Lp = sound pressure level; N/A = thresholds not applicable for source type
Notes:
Level B values are presented in COP Section 4.1.5 and Appendix Z
a/ 4,000 kilojoules corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less

Table 4.2-28. Marine Mammal PTS Onset Criteria Threshold Distances (meters) for Impact Pile-Driving - Shallow Location (Monopile)

Scenario	Pile Type	Maximum Hammer Energy (kilojoules)	Installation Duration (minutes)	Mitigation (dB)	Hearing Group a/ c/							
					Low-Frequency Cetaceans		Mid-Frequency Cetaceans		High-Frequency Cetaceans		Phocid Pinnipeds	
					219 $L_{p,pk}$	183 $L_{E,\ 24hr}$	230 $L_{p,pk}$	185 $L_{E,\ 24hr}$	202 $L_{p,pk}$	155 $L_{E,\ 24hr}$	218 $L_{p,pk}$	185 $L_{E,\ 24hr}$
Scenario 1: Standard Driving Scenario	9.5 m Monopile	4,000 b/	85	0	326	7,406	117	411	1,583	4,056	355	2,707
				6	176	4,416	61	221	919	2,383	201	1,588
				10	128	3,138	26	99	607	1,659	138	1,059
Scenario 2: Hard Driving Scenario	9.5 m Monopile	4,000 b/	99	0	326	7,887	117	472	1,583	4,585	355	2,947
				6	176	4,587	61	254	919	2,560	201	1,735
				10	128	3,363	26	108	607	1,888	138	1,171
Scenario 3: One Standard and One Hard Driving Scenario	9.5 m Monopile (2 piles per day)	4,000 b/	184	0	326	9,925	117	570	1,583	5,587	355	3,759
				6	176	5,783	61	306	919	3,170	201	2,099
				10	128	4,152	26	134	607	2,314	138	1,464

Source: NOAA Fisheries 2018b
dB = decibel; Lp,pk = peak sound pressure level; LE = sound exposure level; 24h = 24-hour
Notes:
Same information is presented in COP Section 4.1.5 and Appendix Z
a/ Level A Injury
b/ Corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less.

Table 4.2-29. Marine Mammal PTS Onset Criteria Threshold Distances (meters) for Vibratory Hammer – Shallow Location (Monopile)

Scenario	Pile Type	Installation Duration (minutes)	Mitigation (dB)	Hearing Group a/			
				LF Cetaceans	MF Cetaceans	HF Cetaceans	Phocid Pinnipeds
				199 $L_{E, 24hr}$	198 $L_{E, 24hr}$	173 $L_{E, 24hr}$	201 $L_{E, 24hr}$
Scenario 1: Standard Driving Scenario	9.5 m Monopile	60	0	385	0	317	102
			6	149	0	133	44
			10	107	0	93	31
Scenario 2: Hard Driving Scenario	9.5 m Monopile	30	0	292	0	237	76
			6	112	0	99	33
			10	88	0	67	21
Scenario 3: One Standard and One Hard Driving Scenario	9.5 m Monopile (2 piles per day)	90	0	449	0	372	121
			6	174	0	160	51
			10	135	0	110	36

Source: NOAA Fisheries 2018b
dB = decibel; LE = sound exposure level; LF = low-frequency; MF = mid-frequency; HF = high frequency; 24h = 24-hour
Notes:
Same information is presented in COP Section 4.1.5 and Appendix Z
a/ Level A Injury

Table 4.2-30. Marine Mammal Response Criteria Threshold Distances (meters) for the Shallow Location

Location	Pile Type	Hammer Energy (kilojoules)	Installation Duration (minutes)	Mitigation (dB)	Hearing Group (m)	
					Marine Mammals	Marine Mammals
					160 L_p	120 L_p
Scenario 1: Standard Driving Installation	9.5 m Monopile	Vibratory	60	0	N/A	16,308
				6	N/A	9,508
				10	N/A	6,485
		Impact: 4,000 a/	85	0	12,976	N/A
				6	7,473	N/A
				10	5,503	N/A
Scenario 2: Hard to Drive Installation	9.5 m Monopile	Vibratory	30	0	N/A	16,308
				6	N/A	9,508
				10	N/A	6,485
		Impact: 4,000 a/	99	0	12,976	N/A
				6	7,473	N/A
				10	5,503	N/A
Scenario 3: One Standard and One Hard to Drive Installation	9.5 m Monopile (includes two piles per day)	Vibratory	90	0	N/A	16,308
				6	N/A	9,508
				10	N/A	6,485
		Impact: 4,000 a/	184	0	12,976	N/A
				6	7,473	N/A
				10	5,503	N/A

Source: NOAA Fisheries 2020d
dB = decibel; Lp = sound pressure level; N/A = thresholds not applicable for source type
Notes:
Same information is presented in COP Section 4.1.5 and Appendix Z
a/ 4,000 kilojoules corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less

Table 4.2-31. Marine Mammal PTS Onset Criteria Threshold Distances (meters) for Impact Pile-Driving – Offshore Substation Location

Scenario	Pile Type	Maximum Hammer Energy (kilojoules)	Installation Duration (minutes)	Mitigation (dB)	Hearing Group a/							
					Low-Frequency Cetaceans		Mid-Frequency Cetaceans		High-Frequency Cetaceans		Phocid Pinnipeds	
					219 $L_{p,pk}$	183 $L_{E,24hr}$	230 $L_{p,pk}$	185 $L_{E,24hr}$	202 $L_{p,pk}$	155 $L_{E,24hr}$	218 $L_{p,pk}$	185 $L_{E,24hr}$
Scenario 4: Offshore Substation Piled Jacket Foundation	2.8 m Pin Pile	3,000 b/	410	0	35	6,807	0	258	508	3,485	55	3,188
				6	0	3,697	0	121	284	1,938	0	1,746
				10	0	2,680	0	48	197	1,435	0	1,283

Source: NOAA Fisheries 2018b
dB = decibel; Lp,pk = peak sound pressure level; LE = sound exposure level; 24h = 24-hour
Notes:
Same information is presented in COP Section 4.1.5 and Appendix Z
a/ Level A Injury
b/ Corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less

Table 4.2-32. Marine Mammal PTS Onset Criteria Threshold Distances (meters) for Vibratory Hammer – Offshore Substation Location

Scenario	Pile Type	Installation Duration (minutes)	Mitigation (dB)	Hearing Group a/			
				LF Cetaceans	MF Cetaceans	HF Cetaceans	Phocid Pinnipeds
				199 $L_{E,24hr}$	198 $L_{E,24hr}$	173 $L_{E,24hr}$	201 $L_{E,24hr}$
Scenario 4: Offshore Substation Piled Jacket Foundation	2.8 m Pin Pile	120	0	218	0	190	63
			6	130	0	112	35
			10	75	0	68	0

Source: NOAA Fisheries 2018
dB = decibel; LE = sound exposure level; LF = low-frequency; MF = mid-frequency; HF = high frequency; 24h = 24-hour
Notes:
a/ Level A Injury

Table 4.2-33. Marine Mammal Response Criteria Threshold Distances (meters) for Pile Driving - Offshore Substation Location

Scenario	Pile Type	Hammer Energy (kilojoules)	Installation Duration (minutes)	Mitigation (dB)	Hearing Group	
					160 L_p	120 L_p
Scenario 4: Offshore Substation Piled Jacket Foundation	2.8 m Pin Pile	Vibratory	120	0	N/A	8,912
				6	N/A	5,272
				10	N/A	3,601
		Impact: 3,000 a/	410	0	5,530	N/A
				6	3,291	N/A
				10	2,172	N/A

dB = decibel; Lp = sound pressure level; N/A = thresholds not applicable for source type
Notes:
Same information is presented in COP Section 4.1.5 and Appendix Z
a/ 3,000 kilojoules corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less

Table 4.2-34. Marine Mammal Level A and B Harassment Threshold Distances (meters) for Vibratory Hammer – Cofferdam

Location	PTS Onset by Hearing Group a/				Behavioral Response
	LF cetaceans (199 $L_{E,\ 24hr}$)	MF cetaceans (198 $L_{E,\ 24hr}$)	HF cetaceans (173 $L_{E,\ 24hr}$)	Phocid pinnipeds (201 $L_{E,\ 24hr}$)	All 120 L_p
Scenario 5: Cofferdam Installation	108	0	0	0	3,097

Source: NOAA Fisheries 2018b

dB = decibel; LE = sound exposure level; Lp = sound pressure; LF = low-frequency; MF = mid-frequency; HF = high frequency; 24h = 24-hour;

Notes:
Related information is presented in COP Section 4.1.5 and Appendix Z

a/ Level A Injury

Table 4.2-35. Marine Mammal Level A and B Harassment Threshold Distances (meters) for Impact Pile-Driving – Goal Post Installation

Activity	Marine Mammal Group PTS Onset				Behavioral
	LF cetaceans	MF cetaceans	HF cetaceans	Phocid pinnipeds	Lateral Distance (m) to Level B Thresholds Used in Take Analysis
	183 $L_{E,\ 24hr}$	185 $L_{E,\ 24hr}$	155 $L_{E,\ 24hr}$	185 $L_{E,\ 24hr}$	160 L_p
Scenario 6: Goal Post installation	591	21	704	316	1,450

dB = decibel; LF = low-frequency; MF = mid-frequency; HF = high frequency

Notes:
Related information is presented in COP Section 4.1.5 and Appendix Z

For impact and vibratory pile driving at the deep location, the results in Appendix Z, Underwater Acoustic Assessment indicates that the unmitigated distances to the peak sound pressure (L_{PK}) thresholds are generally below 4,921 ft (1,500 m) except for results for the HF cetaceans' group. Thresholds to the permanent threshold shift (PTS) onset thresholds in terms of SEL are also provided. Expectedly, the largest ranges to thresholds are the ones for the marine mammal behavioral response. Similar trends in results were observed for modeling results of impact pile and vibratory driving at the shallow WTG location, although in most cases distances to thresholds were less. For cofferdam vibratory pile-driving, the distance to the injury thresholds were negligible (<3.3 ft [<1 m]), except for LF cetaceans which would not be expected that close to shore, while the distances to the behavioral thresholds were greater. Note that the results of the analysis are based on conservative assumptions, including maximum hammer energy, number of strikes, and preliminary sediment data.

Marine Acoustics, Inc. (MAI) conducted animat modeling of the potentially occurring marine mammal species in the Study Area to determine their potential level of exposure to the underwater sounds generated during various noise-producing construction activities associated with the development of the Project (Appendix GG). The potential acoustic exposures of the protected marine mammals were estimated using the Acoustic Integration Model© (AIM). AIM is a Monte Carlo-based statistical model (Frankel, Ellison, & Buchanan, 2002) in which repeated simulations provide the ability of an acoustic exposure. AIM simulations create realistic animal movement tracks that, collectively, provides a reasonable representation of the movements of animals in a population. Since AIM records the exposure history for each individual animat, the potential impact is determined on an individual animal basis. The modeled sound exposure level (SEL) received by each individual animat over the duration of the construction activity and the peak sound pressure level were used to calculate the potential for that animat to have experienced PTS using the NOAA Fisheries (2018) physiological acoustic thresholds for marine mammals. If an animat was not predicted to experience PTS, then the sound energy received by each individual animat over the 24-hour modeled period was used to assess the potential risk of biologically significant behavioral reactions. The modeled root mean square (RMS) sound pressure levels were used to estimate the potential for marine mammal behavioral responses based on the NOAA Fisheries (2005) behavioral criteria. These modeled exposure estimates were then normalized by the ratio of real-world density estimates based on the Roberts and Halpin 2022 dataset to the modeled animat density for each modeled marine mammal species to obtain final exposure estimates. This results in the predicted number of exposures or takes for each marine mammal species or species group for each type of noise-producing construction activity, such as pile driving. These exposure estimates inform potential take by Level A and B Harassment (Table 4.2-36 through Table 4.2-41). The exposure histories of each marine mammal species or species group resulting from the animat modeling are subsampled to reflect the duty cycle of each construction activity to create multiple estimates of sound exposure for each source and marine mammal combination (e.g., the monopile is projected to be driven for about 3 hours, so eight different 3-hour exposure histories were extracted). Note that due to implementation of mitigation as described in Section 4.2.5.4 (shutdown at any distance, etc.), no Level A take of the North Atlantic right whale is anticipated.

Table 4.2-36. Updated Estimates of Potential Takes (Roberts and Halpin 2022) by Level A and B Harassment Resulting from Vibratory and Impact Pile Driving (2024) Assuming 10 dB Sound Attenuation

Species	Stock	Estimated Take	
		Level A	Level B
Atlantic spotted dolphin	Western North Atlantic	0	2,108
Bottlenose dolphin a/	Southern Migratory Coastal	0	0
	Western North Atlantic Offshore	0	4,290
Common dolphin (short-beaked)	Western North Atlantic	0	594
Atlantic white-sided dolphin e/	Western North Atlantic	NA	NA
Common minke whale	Canadian East Coast	8	53
Fin whale	Western North Atlantic	4	21
Harbor Porpoise	Gulf of Maine/Bay of Fundy	1	23
Humpback whale	Gulf of Maine	4	18
North Atlantic right whale f/	Western Atlantic	1	3
Pantropical spotted dolphin b/	Western North Atlantic	0	4
Pilot whale *spp.* (long- and short-finned pilot whales) c/	Western North Atlantic	0	61
Risso's dolphin	Western North Atlantic	0	25
Gray seal d/	Western North Atlantic	1	62
Harbor seal d/	Western North Atlantic	1	62
Sei whale	Nova Scotia	1	3
Sperm whale	North Atlantic	0	1

Notes:

a/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as “bottlenose” and not identified to stock. Given the foundation installation sound would be confined to beyond the 20 m isobath, where the offshore stock is anticipated to predominate, estimated Level B take for foundation installation was accrued to the offshore stock.

b/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).

c/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as “*Globicephala spp.*” and not species-specific. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

d/ Pinniped estimated take density values attributed 50% to harbor seals and 50% to gray seals.

e/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species. Take was not estimated for this species and is reported as N/A, Not Applicable.

f/ Mitigation measures described in Section 4.2.5.4 of this COP will be implemented to ensure there is no Level A take of North Atlantic right whales; therefore, no Level A take is requested for this species as presented below in Table 4.2-36

Table 4.2-37. Updated Requested Takes by Level A and B Harassment Resulting from Vibratory and Impact Pile Driving (2024) Assuming 10 dB Sound Attenuation Incorporating Group Size Adjustments

Species	Stock	Requested Take	
		Level A	Level B
Atlantic spotted dolphin	Western North Atlantic	0	2,108
Bottlenose dolphin a/	Southern Migratory Coastal	0	0
	Western North Atlantic Offshore	0	4,290
Common dolphin (short-beaked) i/	Western North Atlantic	0	1,720
Atlantic white-sided dolphin f/	Western North Atlantic	0	15
Common minke whale	Canadian East Coast	8	53
Fin whale g/	Western North Atlantic	4	112
Harbor Porpoise	Gulf of Maine/Bay of Fundy	1	23

Species	Stock	Requested Take	
		Level A	Level B
Humpback whale g/	Gulf of Maine	4	129
North Atlantic right whale e/	Western Atlantic	0	6
Pantropical spotted dolphin b/	Western North Atlantic	0	20
Pilot whale *spp.* (long- and short-finned pilot whales) c/	Western North Atlantic	0	61
Risso's dolphin	Western North Atlantic	0	25
Gray seal d/	Western North Atlantic	1	62
Harbor seal d/	Western North Atlantic	1	62
Sei whale	Nova Scotia	1	3
Sperm whale h/	North Atlantic	0	3

Notes:

a/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock. Given the foundation installation sound would be confined to beyond the 20 m isobath, where the offshore stock is anticipated to predominate, estimated Level B take for foundation installation was accrued to the offshore stock.

b/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).Takes are included to factor for this scenario and are adjusted based on 1 group size / year (20 per Reeves et al. 2002). c/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp.*" and not species-specific. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

d/ Pinniped requested take attributed 50% to harbor seals and 50% to gray seals.

e/ Mitigation measures described in Section 4.2.5.4 of this COP will be implemented to ensure there is no Level A take of North Atlantic right whales; therefore, no Level A take is requested for this species. Level B take for foundation installation adjusted for group size of 1 individual for months with monthly density < 0.01 when construction may occur (May – October) and 2 individuals for months with monthly density > 0.01 when construction may occur (May – October).

f/ Atlantic white-sided dolphins are not expected in the Study Area, but take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species. Adjusted based on 1 group size / year (15 per Reeves et al. 2002).

g/ Adjusted based on PSO data (max daily density x days of activity).

h/ Adjusted based on 1 group size / year (3 per Barkaszi et al. 2019).

i/ Adjusted based on 1 group size / day (20 per Dominion Energy 2021).

Table 4.2-38. Updated Estimates of Potential Takes (Roberts and Halpin 2022) by Level A and B Harassment Resulting from Vibratory and Impact Pile Driving (2025) Assuming 10 dB Sound Attenuation

Species	Stock	Estimated Take	
		Level A	Level B
Atlantic spotted dolphin	Western North Atlantic	0	1,896
Bottlenose dolphin a/	Southern Migratory Coastal	0	0
	Western North Atlantic Offshore	0	3,602
Common dolphin (short-beaked)	Western North Atlantic	0	559
Atlantic white-sided dolphin e/	Western North Atlantic	N/A	N/A
Common minke whale	Canadian East Coast	7	48
Fin whale	Western North Atlantic	3	19
Harbor Porpoise	Gulf of Maine/Bay of Fundy	1	20
Humpback whale	Gulf of Maine	4	14
North Atlantic right whale f/	Western Atlantic	1	2

Species	Stock	Estimated Take	
		Level A	Level B
Pantropical spotted dolphin b/	Western North Atlantic	0	4
Pilot whale *spp.* (long- and short-finned pilot whales) c/	Western North Atlantic	0	50
Risso's dolphin	Western North Atlantic	0	23
Gray seal d/	Western North Atlantic	1	53
Harbor seal d/	Western North Atlantic	1	53
Sei whale	Nova Scotia	1	2
Sperm whale	North Atlantic	0	1
Clymene dolphin	Western North Atlantic	0	5
False killer whale	Western North Atlantic	0	4
Melon-headed whale	Western North Atlantic	0	5
Pygmy sperm whale	Western North Atlantic	0	1

Notes:

a/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock. Given the foundation installation sound would be confined to beyond the 20 m isobath, where the offshore stock is anticipated to predominate, estimated Level B take for foundation installation was accrued to the offshore stock.

b/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).

c/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp*" and not species-specific. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

d/ Pinniped estimated take attributed 50% to harbor seals and 50% to gray seals.

e/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species. Take was not estimated for this species and is reported as N/A, Not Applicable.

f/ Mitigation measures described in Section 11 of the Request for Rulemaking and Letter of Authorization will be implemented to ensure there is no Level A take of North Atlantic right whales; therefore, no Level A take is requested for this species as presented below in Table 4.2-39.

Table 4.2-39. Requested Takes by Level A and B Harassment Resulting from Vibratory and Impact Pile Driving (2025) Assuming 10 dB Sound Attenuation Incorporating Group Size Adjustments

Species	Stock	Requested Take	
		Level A	Level B
Atlantic spotted dolphin	Western North Atlantic	0	1,896
Bottlenose dolphin a/	Southern Migratory Coastal	0	0
	Western North Atlantic Offshore	0	3,602
Common dolphin (short-beaked) i/	Western North Atlantic	0	1,380
Atlantic white-sided dolphin f/	Western North Atlantic	0	15
Common minke whale	Canadian East Coast	7	48
Fin whale g/	Western North Atlantic	3	90
Harbor Porpoise	Gulf of Maine/Bay of Fundy	1	20
Humpback whale g/	Gulf of Maine	4	104
North Atlantic right whale e/	Western Atlantic	0	6
Pantropical spotted dolphin b/	Western North Atlantic	0	20

Species	Stock	Requested Take	
		Level A	Level B
Pilot whale *spp.* (long- and short-finned pilot whales) c/	Western North Atlantic	0	50
Risso's dolphin	Western North Atlantic	0	23
Gray seal d/	Western North Atlantic	1	53
Harbor seal d/	Western North Atlantic	1	53
Sei whale	Nova Scotia	1	2
Sperm whale h/	North Atlantic	0	3
Clymene dolphin	Western North Atlantic	0	5
False killer whale	Western North Atlantic	0	4
Melon-headed whale	Western North Atlantic	0	5
Pygmy sperm whale	Western North Atlantic	0	1

Notes:

a/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock. Given the foundation installation sound would be confined to beyond the 20 m isobath, where the offshore stock is anticipated to predominate, estimated Level B take for foundation installation was accrued to the offshore stock.

b/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015). Takes are included to factor for this scenario and are adjusted based on 1 group size / year for all activities (20 per Reeves et al. 2002).

c/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp*" and not species-specific. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

d/ Pinniped requested take attributed 50% to harbor seals and 50% to gray seals.

e/ Mitigation measures described in Section 11 of the Request for Rulemaking and Letter of Authorization will be implemented to ensure there is no Level A take of North Atlantic right whales; therefore, no Level A take is requested for this species. Level B take for foundation installation adjusted for group size of 1 individual for months with monthly density < 0.01 when construction may occur (May – October) and 2 individuals for months with monthly density > 0.01 when construction may occur (May – October).

f/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species. Adjusted based on 1 group size / year (15 per Reeves et al. 2002).

g/ Adjusted based on PSO data (max daily density x days of activity).

h/ Adjusted based on 1 group size / year (3 per Barkaszi and Kelly 2018).

i/ Adjusted based on 1 group size / day (20 per Dominion Energy 2021).

Also, as noted above NOAA Fisheries added annual Level B take of five clymene dolphins, four false killer whale, five melon-headed whales, and one pygmy sperm whale for each year of pile driving (88 FR 28656).

Estimate of Potential Project Trenchless Installation - Cofferdam Installation Activities

Cofferdam installation activities resulting in potential marine mammal take are associated with unique animal density estimates defined by the anticipated extent of that Project Area "footprint," which includes the Offshore Export Cable Route Corridor and Lease Area. Densities were first derived from marine mammal density data via an updated 5-by-5-km raster dataset from Roberts and Halpin (2022) (Table 4.2-40). Through detailed consultation with NOAA Fisheries, certain species were expected to occur in the nearshore during Project construction activities, which required adjustments for group sizes. It should be noted that the take requested for species not expected to occur in the nearshore area was derived from using the density values within each 5-by-5-km cell that intersected the Project Area footprint rather than applying a buffer (Table 4.2-41). Group size adjustments for cetaceans expected to occur in the nearshore were made through consultation with NOAA Fisheries and are detailed below. This approach was deemed to be the most conservative for estimating the extent of acoustic impact and thereby estimating take of cetaceans based on the current best available information, as cited below. The 2022 updates to the North Atlantic right whale and humpback whale density models resulted in datasets with three different time spans for each species. We have selected the most recent of these for this analysis: version 11 (2009-2019) for humpback whales, and version 12 (2010-2019) for North Atlantic right whales.

Group size adjustments were included for the following species with references listed parenthetically:

- Atlantic spotted dolphin: Adjusted based on 1 group size / day (20 per Dominion Energy 2020; Jefferson et al. 2015)
- Bottlenose dolphin (Combined Southern Migratory Coastal, Western North Atlantic Offshore): Adjusted based on 1 group size / day (15 per Jefferson et al. 2015)
- Short-beaked common dolphin: Adjusted based on 1 group size / day (20 per Dominion Energy 2021).

Table 4.2-40. Updated Average Marine Mammal Densities (Roberts and Halpin 2022) Used in Exposure Estimates and Estimates of Potential Takes by Level B Harassment from Trenchless Installation - Cofferdams

Species	Stock	Average Seasonal Density a/ (No./100 km²)	Estimated Take by Level B Harassment
Atlantic spotted dolphin	Western North Atlantic	2.370	37.169
Bottlenose dolphin b/	Southern migratory coastal stock	17.054	267.462
Common dolphin (short beaked)	Western North Atlantic	1.808	28.355
Atlantic White-sided dolphin f/	Western North Atlantic	0.325	5.097
Common minke whale	Canadian east coast	0.124	1.945
Fin whale	Western North Atlantic	0.041	0.643
Harbor porpoise	Western North Atlantic	0.438	6.869
Humpback whale	Gulf of Maine	0.054	0.847
North Atlantic right whale	Western North Atlantic	0.024	0.376
Pantropical spotted dolphin c/	Western North Atlantic	0.007	0.110
Pilot whale spp. (long- and short-finned pilot whales) d/	Western North Atlantic	0.065	1.019
Risso's dolphin	Western North Atlantic	0.030	0.470
Gray seal e/	Western North Atlantic	1.775	13.919
Harbor seal e/	Western North Atlantic	1.775	13.919
Sei whale	Nova Scotia	0.015	0.235
Sperm whale	North Atlantic	0.001	0.016

Notes:

a/ Density values from Duke University (Roberts and Halpin 2022).

b/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock. Given the cofferdam installation sound would be confined to below the 20 m isobath, where the coastal stock is anticipated to predominate, estimated Level B take for cofferdam installation was accrued to the coastal stock.

c/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).

d/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp*." and not species-specific. Since the short-finned pilot whale is the smaller stock, take estimates have been assumed to be of this stock to be

Species	Stock	Average Seasonal Density a/ (No./100 km²)	Estimated Take by Level B Harassment

conservative. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

e/ Pinniped density values from Duke University (Roberts and Halpin 2022) reported as "seals" and not species-specific; therefore, for requested takes 50% accrued to harbor seals and 50% accrued to gray seals.

f/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species.

Table 4.2-41. Requested Takes by Level B Harassment due to Trenchless Installation - Cofferdams

Species	Stock	Requested Take by Level B Harassment
Atlantic spotted dolphin f/	Western North Atlantic	240
Bottlenose dolphin a/	Southern migratory coastal stock	180
Common dolphin (short beaked) g/	Western North Atlantic	240
Atlantic White-sided dolphin e/	Western North Atlantic	5
Common minke whale	Canadian east coast	2
Fin whale	Western North Atlantic	1
Harbor porpoise	Western North Atlantic	7
Humpback whale	Gulf of Maine	1
North Atlantic right whale	Western North Atlantic	0
Pantropical spotted dolphin b/	Western North Atlantic	0
Pilot whale spp. (long- and short-finned pilot whales) c/	Western North Atlantic	1
Risso's dolphin	Western North Atlantic	0
Gray seal d/	Western North Atlantic	14
Harbor seal d/	Western North Atlantic	14
Sei whale	Nova Scotia	0
Sperm whale	North Atlantic	0

Notes:

a/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock. Given the cofferdam installation sound would be confined to below the 20 m isobath, where the coastal stock is anticipated to predominate, estimated Level B take for cofferdam installation was accrued to the coastal stock. Adjusted based on 1 group size / day (15 per Jefferson et al. 2015).

b/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).

c/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp*." and not species-specific. Since the short-finned pilot whale is the smaller stock, take estimates have been assumed to be of this stock to be conservative. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

d/ Pinniped density values from Duke University (Roberts and Halpin 2022) reported as "seals" and not species-specific; therefore, for requested takes 50% accrued to harbor seals and 50% accrued to gray seals.

e/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species.

f/ Atlantic spotted dolphin adjusted based on 1 group size / day (20 per Dominion Energy 2020, Jefferson et al. 2015).

g/ Short-beaked common dolphin: Adjusted based on 1 group size / day (20 per Dominion Energy 2021).

Estimate of Potential Project Trenchless Installation – Goal Post Takes by Harassment

Using Roberts and Halpin (2022), estimates of potential take by Level B Harassment were updated (Table 4.2-42 and Table 4.2-43). Density data from Roberts and Halpin (2022) were mapped within the boundary of the Study Area for each segment using geographic information systems. The maximum densities (i.e., the maximum density of each grid cell) as reported by Roberts and Halpin (2022) were averaged by season over the activity duration (spring [May], summer [June through August], and fall [September through October]) for the construction area. The average seasonal density for each species was then selected for inclusion in the updated take calculations.

Table 4.2-42. Updated Marine Mammal Density (Roberts and Halpin 2022) and Estimated Level B Harassment Take Numbers from Trenchless Installation – Goal Posts

Species	Stock	Average Seasonal Density a/ (No./100 km²)	Estimated Take (No.)
Atlantic spotted dolphin	Western North Atlantic	2.370	6.373
Bottlenose dolphin b/	Southern Migratory Coastal	17.054	45.862
Common dolphin (short beaked)	Western North Atlantic	1.808	4.862
Atlantic White-sided dolphin f/	Western North Atlantic	0.325	0.874
Common minke whale	Canadian east coast	0.124	0.333
Fin whale	Western North Atlantic	0.041	0.110
Harbor porpoise	Western North Atlantic	0.438	1.178
Humpback whale	Gulf of Maine	0.054	0.145
North Atlantic right whale	Western North Atlantic	0.024	0.065
Pantropical spotted dolphin c/	Western North Atlantic	0.007	0.019
Pilot whale spp. (long- and short-Finned pilot whales) d/	Western North Atlantic	0.065	0.175
Risso's dolphin	Western North Atlantic	0.030	0.081
Gray seal e/	Western North Atlantic	1.775	2.387
Harbor seal e/	Western North Atlantic	1.775	2.387
Sei whale	Nova Scotia	0.015	0.040
Sperm whale	North Atlantic	0.001	0.003

Notes:

a/ Density values from Duke University (Roberts and Halpin 2022).

b/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock. Given the goal post pile driving sound would be confined to below the 20 m isobath, where the coastal stock is anticipated to predominate, estimated Level B take for goal post installation was accrued to the coastal stock.

c/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).

d/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp.*" and not species-specific. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

e/ Pinniped density values from Duke University (Roberts and Halpin 2022) reported as "seals" and not species-specific. The final calculated Level B estimated takes were accrued 50% to harbor seals and 50% to gray seals.

f/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species.

It should be noted that calculations do not take into account whether a single animal is harassed multiple times or whether each exposure is a different animal. Therefore, the numbers in Table 4.2-42 and Table 4.2-43 are the maximum number of animals that may be harassed during the trenchless installation (i.e., Dominion Energy assumes that each exposure event is a different animal).

For pinnipeds, because the seasonality of, and habitat use by, gray seals roughly overlap with harbor seals, the same estimated abundance has been applied to both gray and harbor seals. Pinniped density data (as presented in Roberts and Halpin 2022) were used to estimate pinniped numbers presented in Table 4.2-42 and Table 4.2-43. These data, as presented by Roberts and Halpin (2022), do not differentiate between pinniped species. The final calculated Level B estimated takes were accrued 50 percent to harbor seals and 50 percent to gray seals.

Table 4.2-43. Requested Takes by Level B Harassment due to Trenchless Installation – Goal Posts

Species	Stock	Requested Take (No.)
Atlantic spotted dolphin f/	Western North Atlantic	360
Bottlenose dolphin a/	Southern Migratory Coastal	270
Common dolphin (short beaked) g/	Western North Atlantic	360
Atlantic White-sided dolphin e/	Western North Atlantic	1
Common minke whale	Canadian east coast	0
Fin whale	Western North Atlantic	0
Harbor porpoise	Western North Atlantic	1
Humpback whale	Gulf of Maine	0
North Atlantic right whale	Western North Atlantic	0
Pantropical spotted dolphin b/	Western North Atlantic	0
Pilot whale spp. (long- and short-finned pilot whales) c/	Western North Atlantic	0
Risso's dolphin	Western North Atlantic	0
Gray seal d/	Western North Atlantic	2
Harbor seal d/	Western North Atlantic	2
Sei whale	Nova Scotia	0
Sperm whale	North Atlantic	0

Notes:

a/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock. Given the cofferdam installation sound would be confined to below the 20 m isobath, where the coastal stock is anticipated to predominate, estimated Level B take for cofferdam installation was accrued to the coastal stock. Adjusted based on 1 group size / day (15 per Jefferson et al. 2015).

b/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).

c/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "Globicephala spp." and not species-specific. Since the short-finned pilot whale is the smaller stock, take estimates have been assumed to be of this stock to be conservative. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

d/ Pinniped density values from Duke University (Roberts and Halpin 2022) reported as "seals" and not species-specific; therefore, for requested takes 50% accrued to harbor seals and 50% accrued to gray seals.

e/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species.

f/ Atlantic spotted dolphin adjusted based on 1 group size / day (20 per Dominion Energy 2020, Jefferson et al. 2015).

g/ Short-beaked common dolphin: Adjusted based on 1 group size / day (20 per Dominion Energy 2021).

For bottlenose dolphin densities, Roberts and Halpin (2022) does not differentiate by individual stock. The southern coastal migratory stock tends to be found shallower than 65 ft (20 m); therefore, bottlenose dolphins likely to be impacted by goal post installation activities are assumed to be of the coastal stock.

In the instance of the large whales (baleen and sperm), Dominion Energy has proposed a 3,280.8 ft (1,000 m) shutdown zone that exceeds the distance to the Level B harassment isopleth. In addition, given the proximity to land, large whales are not anticipated during Trenchless Installation. Given that the proposed mitigation effectively prevents Level B harassment and large whales would not be expected, take has been adjusted to zero individuals. Note that other mitigation measures may be imposed as part of other agreements that Dominion Energy must adhere to, such as the lease agreement with BOEM.

Estimate of Potential Project HRG Survey Takes by Harassment

Using Roberts and Halpin (2022), estimates of potential take by Level B Harassment were updated (Table 4.2-44 and Table 4.2-45). For this analysis of potential takes, the maximum range to the regulatory thresholds along each radial were combined to create a polygon that forms the impact area or zone of influence (ZOI) surrounding the sound source along the daily trackline distance for High Resolution Geophysical (HRG) survey activities. The parameters in Table 4.2-44 and Table 4.2-45 were used to estimate Level B harassment for marine mammals for the entire HRG Study Area utilizing the respective ZOI and duration for each segment of the survey. Density data from Roberts and Halpin (2022) were mapped within the boundary of the Study Area using geographic information systems. The boundary of the HRG Study Area corresponds to the Lease Area and Offshore Export Cable Route Corridor, which was not buffered. For each survey segment, the average densities (i.e., the average density of each grid cell) as reported by Roberts and Halpin (2022), were averaged by season over the survey duration (for spring, summer, fall, and winter) for the entire HRG Study Area. The average seasonal density within the HRG survey area was then selected for inclusion in the take calculations. The 2022 updates to the North Atlantic right whale and humpback whale density models resulted in datasets with three different time spans for each species. We have selected the most recent of these for this analysis: 2009-2019 for humpback whales, and 2010-2019 for North Atlantic right whales.

All noise-producing survey equipment planned to be used during HRG surveys is assumed to be operated concurrently. The ensonified area specific to Level B harassment, as well as the projected duration of each respective survey segment, was then used to produce the results of take calculations provided in Table 4.2-44 and Table 4.2-45. It should be noted that calculations do not take into account whether a single animal is harassed multiple times or whether each exposure is a different animal. Therefore, the numbers in Table 4.2-44 and Table 4.2-45 are the maximum number of animals that may be harassed during the HRG surveys (i.e., Dominion Energy assumes that each exposure event is a different animal).

For pinnipeds, because the seasonality of, and habitat use by, gray seals roughly overlaps with harbor seals, the same estimated abundance has been applied to both gray and harbor seals. Pinniped density data (as presented in Roberts and Halpin 2022) were used to estimate pinniped numbers presented in Table 4.2-44 and Table 4.2-45. These data, as presented by Roberts and Halpin (2022), do not differentiate between pinniped species. The final calculated Level B estimated takes were accrued 50 percent to harbor seals and 50 percent to gray seals.

For bottlenose dolphin densities, Roberts and Halpin (2022) does not differentiate by individual stock. Additionally, bottlenose dolphin takes for HRG survey activities cannot be attributed to stock because surveys will include both nearshore and offshore locations and percent delineation between nearshore and offshore survey effort is not yet known.

Adjustments were made to Atlantic white-sided dolphin, bottlenose dolphin (combined Southern Migratory Coastal and Western North Atlantic Offshore stocks), spotted dolphin, common dolphin, Risso's dolphin, and pilot whale take estimates to account for the potential of large groups of individuals. For common dolphins, two pods averaging 10 individuals each were assumed per day based on PSO data (Dominion Energy 2021); therefore, the total number of operational days was multiplied by the 20 individuals per day. For spotted dolphins, one pod averaging 20 was assumed per day based on PSO data (Dominion Energy 2020) and multiplied by the days of operation. For bottlenose dolphins, one pod averaging 15 individuals was assumed per day based on Jefferson et al. 2015 and multiplied by the days of operation. For Risso's dolphin and pilot whales, to account for the potential of interactions with groups of these species, the calculated take of one individual for Risso's dolphin and two individuals for pilot whale were adjusted to account for group size of each species (25 individuals for Risso's dolphins per Dominion Energy 2021 and Jefferson et al. 2015, and 20 for pilot whales per Reeves et al. 2002). For Atlantic white-sided dolphins, take estimates were adjusted by one group size / year (12 per Reeves et al. 2002) as a precautionary measure, based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species. These increases were applied to the initial calculated Level B harassment take request, as indicated in Table 4.2-46 and Table 4.2-47 in this COP. Although pantropical spotted dolphins are expected to be rare in the Study Area, their range extends to 40°N latitude (Jefferson et al. 2015); therefore, one group size of 20 animals per year is accounted for in take estimation.

Table 4.2-44. Updated Marine Mammal Density (Roberts and Halpin 2022) and Estimated Level B Harassment Take Numbers from HRG Surveys

Species	Stock	Average Seasonal Density a/ (No./100 km²)	Estimated Take (No.)											
			HRG Survey 2024		HRG Survey 2025		HRG Survey 2026		HRG Survey 2027		HRG Survey 2028		HRG Survey 2029	
			Estimated	Requested	Estimated	Requested	Estimated	Requested	Estimated	Requested	Estimated	Requested	Estimated	Requested
North Atlantic right whale	Western North Atlantic	0.095	0.318	0	1.217	1	0.283	0	1.798	2	1.798	2	0	0
Humpback whale	Gulf of Maine	0.103	0.454	0	1.738	2	0.405	0	2.569	3	2.569	3	0	0
Fin whale	Western North Atlantic	0.080	0.378	0	1.448	1	0.337	0	2.140	2	2.140	2	0	0
Sei whale	Nova Scotia	0.038	0.144	0	0.550	1	0.128	0	0.813	1	0.813	1	0	0
Sperm whale	North Atlantic	0.002	0.008	0	0.029	0	0.007	0	0.043	0	0.043	0	0	0
Common minke whale	Canadian east coast	0.344	0.786	1	3.012	3	0.702	1	4.452	4	4.452	4	0	0
Pantropical spotted dolphin b/	Western North Atlantic	0.007	0.053	20	0.203	20	0.047	20	0.300	20	0.300	20	0	0
Pilot whale spp. (long- and short-Finned pilot whales) c/	Western North Atlantic	0.065	0.491	20	1.883	20	0.439	20	2.783	20	2.783	20	0	0
Bottlenose dolphin d/	Southern Migratory Coastal, Western North Atlantic Offshore	24.157	109.021	975	417.634	3,735	97.280	870	617.227	5,520	617.227	5,520	0	0
Atlantic White-sided Dolphin h/	Western North Atlantic	0.678	2.397	15	9.182	15	2.139	15	13.571	15	13.571	15	0	0
Common dolphin (short beaked) e/	Western North Atlantic	6.599	22.730	1,300	87.072	4,980	20.282	1,160	128.685	7,360	128.685	7,360	0	0

Species	Stock	Average Seasonal Density a/ (No./100 km²)	Estimated Take (No.)											
			HRG Survey 2024		HRG Survey 2025		HRG Survey 2026		HRG Survey 2027		HRG Survey 2028		HRG Survey 2029	
			Estimated	Requested	Estimated	Requested	Estimated	Requested	Estimated	Requested	Estimated	Requested	Estimated	Requested
Atlantic spotted dolphin e/	Western North Atlantic	4.649	13.618	1,300	52.168	4,980	12.152	1,160	77.100	7,360	77.100	7,360	0	0
Risso's dolphin f/	Western North Atlantic	0.057	0.280	25	1.072	25	0.250	25	1.584	25	1.584	25	0	0
Harbor porpoise	Western North Atlantic	1.477	5.278	5	20.218	20	4.710	5	29.881	30	29.881	30	0	0
Harbor seal g/	Western North Atlantic	5.402	5.070	5	19.422	19	4.524	5	28.704	29	28.704	29	0	0
Gray seal g/	Western North Atlantic	5.402	5.070	5	19.422	19	4.524	5	28.704	29	28.704	29	0	0

Notes:

a/ Density values from Duke University (Roberts and Halpin 2022).

b/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015). Takes are adjusted based on 1 group size / year (20 per Reeves et al. 2002).

c/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp.*" and not species-specific. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters. A group size of 20 animals per year (Jefferson et al. 2015) was used for requested take as a precautionary measure.

d/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as "bottlenose" and not identified to stock. Given the lack of spatial resolution at this state of survey planning, estimates could not be split based on bottlenose dolphin stock preferred water depths and so are presented for the combined stock (Reeves et al. 2002; Hayes et al. 2022). Adjusted to one group size per day (15 individuals per Jefferson et al. 2015).

e/ Since Roberts and Halpin 2022 does not account for group size, the estimated take was adjusted to account for two groups of 10 animals each for a total of 20 animals per day of short-beaked common dolphins and Atlantic spotted dolphins.

f/ For Risso's dolphins, a group size of 25 animals per year was used for requested take as a precautionary measure (Dominion Energy 2021, Jefferson et al. 2015).

g/ Pinniped density values from Duke University (Roberts and Halpin 2022) reported as "seals" and not species-specific. The final calculated estimated and requested takes were accrued 50% to harbor and 50% to gray seals.

h/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species. Adjusted based on 1 group size / year (15 per Reeves et al. 2002).

Table 4.2-45. Requested Takes by Level B Harassment due to HRG Surveys Incorporating Group Size Adjustment

Species	Stock	HRG 2024	HRG 2025	HRG 2026	HRG 2027	HRG 2028	HRG 2029 h/
North Atlantic right whale	Western Atlantic	0	1	0	2	2	0
Humpback whale	Gulf of Maine	0	2	0	3	3	0
Fin whale	Western North Atlantic	0	1	0	2	2	0
Sei whale	Nova Scotia	0	1	0	1	1	0
Sperm whale	North Atlantic	0	0	0	0	0	0
Common minke whale	Canadian East Coast	1	3	1	4	4	0
Pantropical spotted dolphin a/	Western North Atlantic	20	20	20	20	20	0
Pilot whale spp. (long- and short-finned pilot whales) b/	Western North Atlantic	20	20	20	20	20	0
Bottlenose dolphin c/	Southern Migratory Coastal, Western North Atlantic Offshore	975	3,735	870	5,520	5,520	0
Atlantic white-sided dolphin g/	Western North Atlantic	15	15	15	15	15	0
Common dolphin (short-beaked) d/	Western North Atlantic	1,300	4,980	1,160	7,360	7,360	0
Atlantic spotted dolphin d/	Western North Atlantic	1,300	4,980	1,160	7,360	7,360	0
Risso's dolphin e/	Western North Atlantic	25	25	25	25	25	0
Harbor porpoise	Gulf of Maine/Bay of Fundy	5	20	5	30	30	0
Gray seal f/	Western North Atlantic	5	19	5	29	29	0
Harbor seal f/	Western North Atlantic	5	19	5	29	29	0

Notes:
a/ Pantropical spotted dolphins are expected to be rare in the Study Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015). Takes are adjusted based on 1 group size / year (20 per Reeves et al. 2002).
b/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp*" and not species-specific. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters. A group size of 20 animals per year (Jefferson et al. 2015) was used for requested take as a precautionary measure.
c/ Bottlenose dolphin density values from Duke University (Roberts and Halpin 2022) reported as “bottlenose” and not identified to stock. Given the lack of spatial resolution at this state of survey planning, estimates could not be split based on bottlenose dolphin stock preferred water depths and so are presented for the combined stock (Reeves et al. 2002; Hayes et al. 2022). Adjusted to one group size per day (15 individuals per Jefferson et al. 2015).
d/ Short-beaked common dolphins and Atlantic spotted dolphins estimated take numbers adjusted based on 1 group size / day of HRG activity (20 per Dominion Energy 2021, Dominion Energy 2020, and Jefferson et al. 2015).
e/ For Risso’s dolphins, when calculated take was less than 1, a group size of 25 animals per year was used for requested take as a precautionary measure (Dominion Energy 2021, Jefferson et al. 2015).
f/ Pinniped density values from Duke University (Roberts and Halpin 2022) reported as "seals" and not species-specific. The final calculated estimated and requested takes were accrued 50% to harbor and 50% to gray seals.
g/ Atlantic white-sided dolphins are not expected in the Study Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species. Adjusted based on 1 group size / year (15 per Reeves et al. 2002).
h/ Given that the LOA is not anticipated to be begin until March 2024, the 5-year period that it covers will extend into several months of 2029, however no activities are planned during that time and therefore no take is requested for 2029.

Table 4.2-46. Updated (Roberts and Halpin 2022) Summary of Annual Requested Takes by Level A and B Harassment Incorporating Group Size Adjustments

Species	Stock	2024			2025			2026			2027		2028		2029 e/	
		Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	% Stock	Requested Take (No.) Behavior	% Stock	Requested Take (No.) Behavior	% Stock
North Atlantic right whale	Western North Atlantic	6	0	1.63	7	0	1.90	0	0	0.00	2	0.54	2	0.54	0	0
Humpback whale	Gulf of Maine	130	4	9.60	106	4	7.88	0	0	0.00	3	0.22	3	0.22	0	0
Fin whale	Western North Atlantic	113	4	1.72	91	3	1.38	0	0	0.00	2	0.03	2	0.03	0	0
Sei whale	Nova Scotia	3	1	0.06	3	1	0.06	0	0	0.00	1	0.02	1	0.02	0	0
Sperm whale	North Atlantic	3	0	0.07	3	0	0.07	0	0	0.00	0	0.00	0	0.00	0	0
Common minke whale	Canadian east coast	56	8	0.29	51	7	0.26	1	0	0.01	4	0.02	4	0.02	0	0
Pantropical spotted dolphin a/	Western North Atlantic	40	0	0.61	40	0	0.61	20	0	0.30	20	0.30	20	0.30	0	0
Pilot whale *spp.* (long- and short-finned pilot whales) b/	Western North Atlantic	82	0	0.21	70	0	0.18	20	0	0.05	20	0.05	20	0.05	0	0
Bottlenose dolphin	Western North Atlantic Offshore	4,290	0	6.83	3,602	0	5.73	0	0	0.00	0	0.00	0	0.00	0	0
	Southern Migratory Coastal	450	0	12.00	0	0	0.00	0	0	0.00	0	0.00	0	0.00	0	0

Species	Stock	2024			2025			2026			2027		2028		2029 e/	
		Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	% Stock	Requested Take (No.) Behavior	% Stock	Requested Take (No.) Behavior	% Stock
	Southern Migratory Coastal; Western North Atlantic Offshore	975	0	1.46	3,735	0	5.61	870	0	1.31	5,520	8.29	5,520	8.29	0	0
Common dolphin (short beaked)	Western North Atlantic	3,620	0	2.09	6,360	0	3.677	1,160	0	0.67	7,360	4.26	7,360	4.26	0	0
Atlantic spotted dolphin	Western North Atlantic	4,008	0	10.04	6,876	0	17.22	1,160	0	2.91	7,360	18.44	7,360	18.44	0	0
Atlantic white-sided dolphin c/	Western North Atlantic	36	0	0.04	30	0	0.03	15	0	0.02	15	0.02	15	0.02	0	0
Risso's dolphin	Western North Atlantic	50	0	0.14	48	0	0.14	25	0	0.07	25	0.07	25	0.07	0	0
Harbor porpoise	Gulf of Maine/Bay of Fundy	36	1	0.04	40	1	0.04	5	0	0.01	30	0.03	30	0.03	0	0
Harbor seal d/	Western North Atlantic	83	1	0.14	72	1	0.12	5	0	0.01	29	0.05	29	0.05	0	0
Gray seal d/	Western North Atlantic	83	1	0.31	72	1	0.27	5	0	0.02	29	0.11	29	0.11	0	0

Species	Stock	2024			2025			2026			2027		2028		2029 e/	
		Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	Requested Take (No.) Injury	% Stock	Requested Take (No.) Behavior	% Stock	Requested Take (No.) Behavior	% Stock	Requested Take (No.) Behavior	% Stock

Notes:

a/ Pantropical spotted dolphins are expected to be rare in the Project Area but are included in the analysis since their range extends to 40°N latitude (Jefferson et al. 2015).

b/ Pilot whale density values from Duke University (Roberts and Halpin 2022) reported as "*Globicephala spp*." and not species-specific. Since the short-finned pilot whale is the smaller stock, take estimates have been assumed to be of this stock to be conservative. As described in Section 4.1.4, both the short-finned and long-finned pilot whale occur in the Mid-Atlantic, though the short-finned pilot whale tends to occur in more southern waters.

c/ Atlantic white-sided dolphins are not expected in the Project Area, but consideration of take has been included as a precautionary measure based on recommendation from NOAA Fisheries to account for potential future shift in habitat use by the species.

d/ Pinniped density values from Duke University (Roberts and Halpin 2022) reported as "seals" and not species-specific. The final calculated estimated and requested takes were accrued 50% to harbor seals and 50% to gray seals.

e/ Given that the LOA is not anticipated to begin until March 2024, the 5-year period that it covers will extend into several months of 2029; however, no activities are planned during that time and therefore no take is requested for 2029.

Table 4.2-47. Updated Summary of 5-Year Requested Take Totals by Level A and Level B Harassment Incorporating Group Size Adjustments

Species	Stock	5 Year Take Total (No.) Behavior	5 Year Take Total (No.) Injury
North Atlantic right whale	Western North Atlantic	17	0
Humpback whale	Gulf of Maine	242	8
Fin whale	Western North Atlantic	208	7
Sei whale	Nova Scotia	8	2
Sperm whale	North Atlantic	6	0
Common minke whale	Canadian east coast	116	15
Pantropical spotted dolphin	Western North Atlantic	140	0
Pilot whale *spp.* (long- and short-finned pilot whales)	Western North Atlantic	212	0
Bottlenose dolphin	Western North Atlantic Offshore	7,892	0
	Southern Migratory Coastal	450	0
	Southern Migratory Coastal; Western North Atlantic Offshore	16,620	0
Common dolphin (short beaked)	Western North Atlantic	25,860	0
Atlantic spotted dolphin	Western North Atlantic	26,764	0
Atlantic white-sided dolphin	Western North Atlantic	111	0
Risso's dolphin	Western North Atlantic	173	0
Harbor porpoise	Gulf of Maine/Bay of Fundy	141	2
Harbor seal	Western North Atlantic	218	2
Gray seal	Western North Atlantic	218	2
Clymene dolphin	Western North Atlantic	10	0
False killer whale	Western North Atlantic	8	0
Melon-headed whale	Western North Atlantic	10	0
Pygmy sperm whale	Western North Atlantic	2	0

Dominion Energy would implement several measures to avoid, minimize, and mitigate the generation of underwater noise at thresholds that may potentially impact marine mammals. During pile-driving of WTG Monopile and Offshore Substation Jacket Foundations, Dominion Energy would apply monitoring and exclusion zones as appropriate to underwater noise assessments and impact thresholds. Qualified NOAA Fisheries-approved PSOs, real-time monitoring systems, PAM systems, and reduced visibility monitoring tools will be employed to enforce these zones. Construction personnel will employ soft starts/ramp-up and shut-down procedures as appropriate to thresholds of noise-emitting survey equipment. Dominion Energy would use commercially and technically available noise-reducing technologies as appropriate and will provide marine mammal sighting and reporting training for each specific stage of construction to emphasize individual responsibility for marine mammal awareness and protection. Dominion Energy would ensure continued engagement with regulatory agencies regarding potential best practices.

Short-term increase in risk of ship strike due to the increase in vessel traffic. Project-related construction and support vessels would increase vessel traffic in the Study Area and along transit routes to and from staging and construction areas. Relative to baseline traffic conditions within and in vicinity of the Study Area, this increase in vessel traffic is expected to be insignificant. Project vessels risk physically disturbing, striking, or colliding with marine mammals present at the surface, all of which may cause injury or mortality.

When marine mammals and vessels fail to detect one another, a ship strike or collision may occur. Marine mammal interactions with vessels are well documented globally and have been attributed as a source of mortality in Virginia's offshore waters (Hayes et al. 2019). Mortality from ship strikes has the potential to cause population-level changes to susceptible species (Laist et al. 2001; Van Waerebeek et al. 2007; Van der Hoop et al. 2012; Conn and Silber 2013; Laist et al. 2014). An individual's potential for collision may be influenced by vessel size, vessel speed, and visibility as well as its behavioral state, presence of a calf, etc. Serious injury or mortality is most likely to be caused by vessels larger than 262 ft (80 m) or traveling at speeds greater than 14 knots (25.9 km/h) (Laist et al. 2001; Van der Hoop et al. 2012; Conn and Silber 2013; Laist et al. 2014; Silber et al. 2014). The probability of a lethal ship strike decreases dramatically as vessel speeds decrease. Vanderlaan and Taggart (2007) determined that vessel speeds of 20 knots (27 km/h) or greater yield 100 percent mortality, while vessel speeds of 9 knots (16.7 km/h) yield just 20 percent mortality. This difference in mortality was most apparent between vessel speeds of 10 and 14 knots: 14 knots (25.9 km/h) yielded a 60 to 80 percent chance of lethal strike, 12 knots (22.2 km/h) yielded a 45 to 60 percent chance, and 10 knots (18.5 km/h) yielded a 35 to 40 percent chance. Slower vessel speeds directly decrease the chance of marine mammal mortality by physical impact and indirectly decrease the chance of mortality by reducing the hydrodynamic draw known to pull whales toward vessels (Silber et al. 2014; Conn and Silber 2013; Laist et al. 2014). North Atlantic right whales have particularly limited maneuverability around vessels and are vulnerable to this hydrodynamic draw.

Regulations such as designated speed restrictions can reduce ship strike mortality by up to 90 percent (Conn and Silber 2013). Currently, ships subject to U.S. jurisdiction that are longer than 65 ft (20 m) cannot exceed speeds of 10 knots (18.5 km/h) in right whale SMAs between November 1 and April 30, per the Ship Strike Reduction Rule passed in 2008 (50 CFR § 224.105). Prior to the passing of this rule, right whale deaths by ship strike in U.S. waters numbered approximately one per year across 18 years of documentation; since the passing of this rule, ship strike deaths have been reduced to approximately 0.47 deaths per year (MMC 2020). The nearshore waters of the Mid-Atlantic Bight have been designated as the Mid-Atlantic U.S. SMA.

Large whale species, including fin, humpback, minke, right, and sei whales, are more susceptible to vessel strike than smaller marine mammals given their size, speed, respiration patterns, propensity to surface rest, long migratory ranges, and surface lunge feeding patterns. Due to their limited maneuverability around vessels, North Atlantic right whales are particularly susceptible to physical disturbance and ship strike. In contrast, pinnipeds and small dolphins are highly mobile and are capable of rapid swim speeds. Thus, they can use agile avoidance maneuvers to escape oncoming vessels when they are detected.

Large slow moving installation vessels and small rapidly moving support vessels would both be present in the Study Area and in transit routes to and from staging areas during construction (see Section 3, Description of Proposed Activity). Because portions of the Study Area fall within the Mid-Atlantic U.S. SMA, all Project-related vessels larger than 65 ft (20 m) will be required to abide by speed restrictions when transiting within the SMA from November 1 to April 30. Additionally, NOAA Fisheries may establish DMAs, or areas of temporary protection for high-risk marine mammals, in response to sighting reports within Virginia shipping channel designated TSS navigation lanes and along the broader North Atlantic coast. DMAs are published through the NOAA Fisheries government website and distributed through marine communication systems. Finally, NOAA Fisheries developed the Right Whale Sighting Advisory System to reduce the risk of right whale vessel strikes in any DMA or SMA. Dominion Energy would conduct monitoring of NOAA's website for updates to DMA locations.

Dominion Energy would implement several measures to avoid, minimize, and mitigate marine mammal physical disturbances, strikes, and collisions. All Project-related vessels will be required to comply with the Ship Strike Reduction Rule speed restrictions within the Mid-Atlantic U.S. SMA and any DMA that intersects the Study Area (10 knots [18.5 km/h] or less for vessels 65 ft [20 m] or longer). Dominion Energy would require Project-related vessels to maintain a distance of 328 ft (100 m) or greater from all marine mammals and 1,640 ft (500 m) from right whales. Vessels larger than 300 gross tons (305 metric tons) will receive whale sighting updates and vessel speed reminders when transiting right whale territory by reporting to the right whale Mandatory Ship Reporting System. Project personnel, particularly marine mammal observers, will check the NOAA Fisheries website for DMA locations. Finally, Dominion Energy would provide Project personnel with marine mammal sighting, take and harassment, and reporting training to emphasize individual responsibility for marine mammal awareness and protection.

Short-term change in water quality, including oil spills. Temporary increases in turbidity and sedimentation would occur in the Study Area during seabed preparation, foundation and cable installation, and associated construction activities. Section 4.1.2, Water Quality, and Appendix J, Sediment Transport Analysis, discuss potential impacts to water quality resulting from these activities. Marine mammal species are not expected to suffer any negative or long-term impacts associated with these localized, short-term increases in turbidity and sedimentation other than from an oil spill. Studies have documented marine mammals foraging in low visibility conditions and comfortably inhabiting turbid waters (Fristrup and Harbison 2002; Hanke and Dehnhardt 2013; Cronin et al. 2017).

Oil spills, fuel spills, and other releases (e.g., grout used to seal monopiles to transition pieces) from Project-related vessels and equipment could directly contaminate or destroy sensitive foraging and reproductive habitats. Construction vessels would primarily use petroleum products that if spilled, would remain at the sea surface upon release and volatize before sinking into the marine environment; such spills would only be toxic to marine mammals present directly at the release site. Breaching marine mammals could potentially inhale or ingest heavier petroleum products prone to creating a persistent sheen at the sea surface. Should toxins enter the marine environment, marine mammals may also be exposed indirectly by consuming contaminated prey resources. Short-term symptoms including inflammation, bleeding, and potential tissue damage in the liver, kidneys, and brain of exposed marine mammals could occur following ingestion of toxic oil and fuel compounds (Godard-Codding and Collier 2018). Long-term symptoms including reproductive failure, respiratory impairments, and increased susceptibility to disease could also occur in more acute cases. The impacted species and nature of the spill both determine the degree and duration of such symptoms. Large baleen whales, for example, may experience reduced filter-feeding abilities and increased likelihood of petroleum-related physical damage should their baleen be fouled by an oil spill (Godard-Codding and Collier 2018). Thus, an oil spill, regardless of its size, would be an impact on marine mammals located in the Study Area.

Contaminants sequestered in buried sediments may be resuspended by seafloor preparation and cable installation activities. This is primarily of concern near industrialized and densely populated coasts. Dominion Energy has selected cable routes to avoid currently active dumping grounds and sediments in the Study Area have not been subjected to any known oil spills or industrial releases. Dominion Energy has also developed an Oil Spill Response Plan (Appendix Q), proposing measures to avoid inadvertent releases and spills and a protocol to be implemented should an event occur. Project-related vessels will operate in accordance with laws regulating at-sea discharges of vessel-generated waste.

Operations and Maintenance

During O&M, the potential impact-producing factors to marine mammals may include presence of new permanent structures (i.e., WTG Monopile and Offshore Substation Jacket Foundations, and additional underwater cable protection, such as concrete mattresses) and new buried Offshore Export Cables and Inter-Array Cables. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project O&M. The following impacts may occur as a consequence of the factors identified above:

- Modification of habitat;
- Project-related electromagnetic fields (EMF);
- Project-related marine debris;
- Project-related underwater noise;
- Increase in risk for ship strike due to the increase in vessel traffic; and
- Changes in water quality, including oil spills.

Modification of habitat. The installation of WTG Monopile and Offshore Substation Jacket Foundations and full scour protection under the maximum design scenario (see Section 3, Description of Proposed Activity) would convert some softbottom habitat to hardbottom habitat in the Study Area. This new hardbottom substrate would replace a small fraction of existing softbottom habitat but would create a "reef effect" and increase the availability of new prey assemblages (Langhamer et al. 2009; Miller et al. 2013). Attaching and encrusting species would colonize novel structures, thereby creating secondary habitat, increasing biodiversity, and attracting benthic and pelagic forage species (Causon and Gill 2018). Many of these forage species may be recreationally and commercially valuable and may increase fishing activity and associated netted gear, longlines, ropes, traps, or buoy lines in the Study Area. Though unlikely, additional gear present in the area may increase marine mammal susceptibility to ingestion or entanglement. However, local marine mammal populations are more likely to benefit from the introduction of novel hard substrates and associated prey increases. This has been demonstrated by studies of seal and harbor porpoise foraging patterns near operational wind facilities (Russell et al. 2014, 2016; Todd et al. 2015).

Project-related EMF. Anthropogenic EMF may be introduced to the Study Area by novel Inter-Array and Offshore Export Cables (see Section 4.4.12, Public Health and Safety, and Appendix AA, Offshore Electric and Magnetic Field Assessment). The three primary natural sources of EMF in the marine environment include Earth's geomagnetic field, electric fields introduced by the movement of charged objects, and bioelectric fields produced by marine animals (Normandeau et al. 2011). Many marine mammals rely on magneto sensitivity, electro sensitivity, or a combination of the two for specific behaviors. Cetaceans, for example, employ Earth's geomagnetic field for orientation and navigation during seasonal migrations (Normandeau et al. 2011).

While it is unclear how anthropogenic EMF may disrupt such behaviors, sensitive species appear to have a detection threshold for magnetic sensitivity gradients of 0.1 percent of Earth's geomagnetic fields and are likely to perceive minor changes related to introduced EMF (Collin and Marshall 2003; Normandeau et al. 2011). HVDC cables emit EMF at frequencies that may be detectable to local marine mammals, potentially inducing changes in swimming direction or migratory path. However, Dominion Energy proposes to use HVAC cables for the Project; such cables emit EMF below levels documented to have adverse effects on fish or marine mammal behavior (Gill et al. 2005; Gill and Desender 2020). EMF specifications for the Offshore Export Cables and Inter-Array Cables are described in Appendix AA, Offshore EMF Assessment. Furthermore, pelagic forage species would be entirely unaffected by cable EMF and marine mammals would therefore experience no indirect impacts from alterations in prey behavior.

Project-related marine debris. Operational activities may introduce debris into the marine environment. Interactions with such marine debris, including accidental ingestion or entanglement, could cause injury or mortality in marine mammals. Dominion Energy would require all Project personnel to implement appropriate practices and protocols to prevent the release of marine debris. 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, and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements.

Project-related underwater noise. O&M activities would generate a slight increase in baseline underwater noise in the Study Area (see Appendix Z, Underwater Acoustic Assessment). However, construction activities are the primary sources of elevated baseline noise and operational wind facilities have been shown to produce minimal noise both above and below the surface of the water (Eco R.I. News 2018). Operational noise would be confined to the immediate area around WTGs and would likely only be measurable above ambient levels at frequencies below 500 Hz (Tougaard et al. 2009). These low frequencies are not expected to change marine mammal behaviors in the Study Area. Studies have demonstrated the complete return of local marine mammals such as harbor porpoises to operational wind facilities once construction has been finalized (Dahne et al. 2017; Graham et al. 2017; Vallejo et al. 2017).

Supply vessels would transport maintenance crews and supplies during O&M activities. Noise associated with Project-related vessel traffic to and from the Study Area would be consistent with the existing acoustic environment, particularly in the nearshore environment where vessels would be concentrated in established industrial port areas and shipping channels. Marine mammals are known to reside in and transit through such areas and any vessel traffic introduced by the Project would not generate a scalable acoustic change for these species. While marine mammals may exhibit short-term, localized behavioral changes (e.g., change in swimming speed and direction) around Project vessels, these changes would be consistent with marine mammal behavior around all anthropogenic traffic and would not yield population-level impacts.

Increase in risk of ship strike due to increased vessel traffic. As mentioned, vessel traffic associated with O&M activities transiting to and stationed within the Study Area would not be greater than existing anthropogenic traffic in the area (see Section 4.4.7, Marine Transportation and Navigation, and Appendix

S, Navigation Safety Risk Assessment). As with any other vessel traffic, Project-related vessels may increase marine mammal susceptibility to physical disturbances, strikes, or collisions.

Dominion Energy would implement several measures to avoid, minimize, and mitigate marine mammal physical disturbances, strikes, and collisions. All Project-related vessels will be required to comply with the Ship Strike Reduction Rule speed restrictions within the Mid-Atlantic U.S. SMA and any DMA that intersects the Study Area (10 knots [18.5 km/h] or less for vessels 65 ft [20 m] or longer). Dominion Energy would require Project-related vessels to maintain a distance of 328 ft (100 m) or greater from all marine mammals and 1,640 ft (500 m) from right whales. Vessels larger than 300 gross tons (305 metric tons) will receive whale sighting updates and vessel speed reminders when transiting right whale territory by reporting to the right whale Mandatory Ship Reporting System. Project personnel, particularly marine mammal observers, will check the NOAA Fisheries website for DMA locations. As any strike, should it occur, to a marine mammal would be a significant impact to the individual and potentially to the population (i.e., North Atlantic right whale), Dominion Energy would provide Project personnel with marine mammal sighting and reporting training to emphasize individual responsibility for marine mammal awareness, protection, and vessel strike avoidance.

Change in water quality, including oil spills. Short-term and localized increases in turbidity and sedimentation may result from routine maintenance activities. Section 4.1.2, Water Quality and Appendix J, Sediment Transport Analysis discuss potential impacts to water quality stemming from these activities. Such increases would be transient and within natural background levels and marine mammals would not be exposed to conditions exceeding their natural environment. Dominion Energy has also developed an Oil Spill Response Plan (Appendix Q) proposing measures to avoid inadvertent releases and spills and a protocol to be implemented, should a potential vessel oil and fuel spill or contaminant release from resuspended sediments occur. Project-related vessels will operate in accordance with laws regulating at-sea discharges of vessel-generated waste.

Decommissioning

Impacts resulting from decommissioning of the Project are expected to be similar to or less than those experienced during construction. Decommissioning techniques are expected to advance during the lifetime of the Project. A full decommissioning plan will be provided to the appropriate regulatory agencies for approval prior to decommissioning activities, and potential impacts will be re-evaluated at that time.

4.2.5.4 Summary of Avoidance, Minimization, and Mitigation Measures

Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate the potential impacts described in Table 4.2-48. In addition, Dominion Energy will implement all avoidance, minimization, and mitigation measures included in the NOAA Fisheries-approved Letter of Authorization and Construction Mitigation and Monitoring Plan (CMMP) for the Project. Dominion Energy submitted a draft Protected Species Mitigation and Monitoring Plan (now referred to as the CMMP) for the Project to NOAA Fisheries on December 8, 2022, and will continue discussions and engagement with the appropriate regulatory agencies and environmental non-governmental organizations throughout the life of the Project to develop an adaptive mitigation approach that provides the most flexible and protective mitigation measures.

Table 4.2-48. Summary of Avoidance, Minimization, and Mitigation Measures

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
Construction; Decommission-ing	Offshore Project Area	Short-term disturbance of habitat Short-term loss of local prey species Short-term introduction of marine debris Short-term increase in risk of entanglement and entrapment Short-term increase in underwater noise Short-term increase in risk of ship strike due to the increase in vessel traffic Short-term change in water quality, including oil spills	• Dominion Energy has sited Offshore Project Components, including wind turbine generators (WTG) Monopile and Offshore Substation Jacket Foundations and Offshore Export Cable Route Corridors, to avoid sensitive benthic habitats and minimize disturbance of benthic features to the extent practical; • Dominion Energy would implement practices to prevent Project personnel from commencing or continuing certain construction activities should marine mammals be observed within monitoring and exclusion zones based on required National Oceanic and Atmospheric Administration (NOAA) Fisheries monitoring and mitigation protocols and stipulations of the Lease; • During pile-driving of WTG Monopile and Offshore Substation Jacket Foundations, Dominion Energy would apply monitoring and exclusion zones as appropriate to underwater noise assessments and impact thresholds; • Qualified NOAA Fisheries-approved Protected Species Observers, real-time monitoring systems, Passive Acoustic Monitoring systems, and reduced visibility monitoring tools (e.g., night vision, infrared, and/or thermal cameras) will be employed to enforce these zones; • Construction personnel will employ soft starts and shut-down procedures as appropriate to thresholds of noise-emitting survey equipment; soft starts will last 30 minutes at the onset of pile-driving; • Dominion Energy would use commercially and technically available noise-reducing technologies as appropriate and will provide marine mammal sighting and reporting training for each specific stage of construction to emphasize individual responsibility for marine mammal awareness and protection; • Dominion Energy would ensure continued engagement with regulatory agencies regarding potential best practices; • All Project-related fisheries surveys and 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; • All Project-related vessels larger than 65 feet (ft; 20 meters [m]) will be required to abide by speed restrictions when transiting within the Seasonal Management Area (SMA) from November 1 to April 30; • Dominion Energy would conduct monitoring of NOAA's website for updates to Dynamic Management Area (DMA) locations; • All Project-related vessels will be required to comply with the Ship Strike Reduction Rule speed restrictions within the Mid-Atlantic U.S. SMA and

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
			any DMA that intersects the Study Area (10 knots [18.5 km/h] or less for vessels 65 ft [20 m] or longer); • Dominion Energy would require all Project-related vessels to maintain a separation distance of 1,640 ft (500 m) or greater from any sighted ESA-listed whale. All Project-related vessels would maintain a separation distance of 328 ft (100 m) or greater from any sighted non-ESA baleen whale. All Project-related vessels would maintain a separation distance of 50 m (164 ft) or greater from any sighted dolphins or pinnipeds with an exception made for those that approach the vessel (e.g. bow-riding dolphins); • Vessels larger than 300 gross tons (305 metric tons) will receive whale sighting updates and vessel speed reminders when transiting right whale territory by reporting to the right whale Mandatory Ship Reporting System; • Project personnel, particularly marine mammal observers, will check the NOAA Fisheries website for DMA locations; • Dominion Energy would provide Project personnel with marine mammal sighting, take and harassment, and reporting training to emphasize individual responsibility for marine mammal awareness and protection; • Dominion Energy has developed a Construction Mitigation and Monitoring Plan (CMMP) with detailed protocols regarding Protected Species Observer (PSO) and Passive Acoustic Monitoring (PAM) coverage to reduce potential negative impacts from project-related vessel traffic, HRG surveys or construction activities; • Dominion Energy would ensure that all Project personnel 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, and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements; and • Dominion Energy has also developed an Oil Spill Response Plan (Appendix Q), proposing measures to avoid inadvertent releases and spills and a protocol to be implemented should an event occur. Project-related vessels will operate in accordance with laws regulating at-sea discharges of vessel-generated waste.

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
Operations and Maintenance	Offshore Project Area	Modification of habitat Project-related electromagnetic fields (EMF) Project-related marine debris Project-related underwater noise Increase in risk for ship strike due to the increase in vessel traffic Changes in water quality, including oil spills	• Dominion Energy proposes to use HVAC cables for the Project; such cables emit EMF below levels documented to have adverse effects on fish or marine mammal behavior; • Dominion Energy would require all Project personnel to implement appropriate practices and protocols to prevent the release of marine debris; and • Dominion Energy would implement several measures to avoid, minimize, and mitigate marine mammal physical disturbances, strikes, and collisions. • All Project-related vessels will be required to comply with the Ship Strike Reduction Rule speed restrictions within the Mid-Atlantic U.S. SMA and any DMA that intersects the Study Area (10 knots [18.5 km/h] or less for vessels 65 ft [20 m] or longer); • Dominion Energy would require Project-related vessels to maintain a distance of 328 ft (100 m) or greater from all marine mammals and 1,640 ft (500 m) from right whales; • Vessels larger than 300 gross tons (305 metric tons) will receive whale sighting updates and vessel speed reminders when transiting right whale territory by reporting to the right whale Mandatory Ship Reporting System; • Project personnel, particularly marine mammal observers, will check the NOAA Fisheries website for DMA locations; • Dominion Energy would provide Project personnel with marine mammal sighting and reporting training to emphasize individual responsibility for marine mammal awareness and protection; • Dominion Energy has developed a CMMP with detailed protocols regarding PSO and PAM coverage to reduce potential negative impacts from operations and maintenance related vessel traffic; • Dominion Energy would ensure that all Project personnel 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; and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements; • Dominion Energy has also developed an Oil Spill Response Plan (Appendix Q) proposing measures to avoid inadvertent releases and spills and a protocol to be implemented, should a potential vessel oil and fuel spill or contaminant release from resuspended sediments occur; • All Project-related fisheries surveys and 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; and • Project-related vessels will operate in accordance with laws regulating at-sea discharges of vessel-generated waste.

Project Stage	Location	Impact	Avoidance, Minimization and Mitigation
HRG Surveys	Offshore Project Area	Short-term increase in risk of ship strikes due to the increase in vessel traffic	• All vessels associated with survey activities (transiting or actively surveying) would comply with the vessel strike avoidance measures specified below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. ○ If any ESA-listed marine mammal is sighted within 1,640 ft (500 m) of the forward path of a vessel, the vessel operator must steer a course away from the whale at <10 knots (18.5 kph) until the minimum separation distance has been established. Vessels may also shift to idle if feasible. ○ If any ESA-listed marine mammal is sighted within 656 ft (200 m) of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 1,640 ft (500 m). If stationary, the vessel must not engage engines until the whale has moved beyond 1,640 ft (500 m).

4.2.6 Sea Turtles

This section describes the sea turtle species known to be present, traverse, or incidentally occur in the waters within and surrounding the Offshore Project Area (see Figure 4.2-39). Potential impacts to sea turtles resulting from construction, O&M, and decommissioning of the Project are discussed in more detail below. Proposed measures and BMPs are described in the section, with intent to avoid, minimize, and/or mitigate potential impacts to sea turtles as necessary. Other assessments detailed within this COP related to sea turtles include:

- Water Quality (Section 4.1.2);
- Underwater Acoustic Environment (Section 4.1.5);
- Benthic Resources and Finfish, Invertebrates and Essential Fish Habitat (Section 4.2.4);
- Marine Mammals (Section 4.2.5);
- Benthic Resource Characterization Report (Appendix D);
- Essential Fish Habitat Assessment (Appendix E);
- Sediment Transport Analysis (Appendix J);
- Oil Spill Response Plan (Appendix Q);
- Navigation Safety Risk Assessment (Appendix S);
- Underwater Acoustic Assessment (Appendix Z);
- Offshore Electric and Magnetic Field Assessment (Appendix AA); and
- Construction Mitigation and Monitoring Plan (Appendix FF).

This section was prepared in accordance with BOEM's site characterization requirements in 30 CFR § 585.626(3) and BOEM's Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 Subpart F (BOEM 2019).

For the purposes of this section, the Sea Turtle Study Area includes the waters and coastlines, inclusive of the beach areas in portions of the Onshore Project Area that intersect the Nearshore Trenchless Installation Area, within and in the vicinity of the Offshore Project Area (Figure 4.2-39).

This section relies upon several sources of data, reports, and studies in its assessment of sea turtles. These sources include region-specific data gathered by Dominion Energy, specifically Protected Species Observer (PSO) sighting data specific to the Study Area, which were also collected during Project-related vessel-based survey activities conducted 2018–2019. PSO sighting reports (Milne 2018) include sightings from the Lease Area, Offshore Export Cable Route Corridor, and surrounding waters. These most recent 2020 and 2021 PSO sighting data are summarized in Table 4.2-49. Additionally, this section relies upon publicly available information such as peer-reviewed literature and historical reporting of regional sea turtle sightings, as well as data provided by the Virginia Aquarium Stranding Response Program. These sources include NOAA Sea Turtle Directory data (NOAA Fisheries 2019), scientific publications, technical reports, and geospatial sighting information retrieved from OBIS datasets (Halpin et al. 2009; Kot et al. 2018; OBIS 2020).

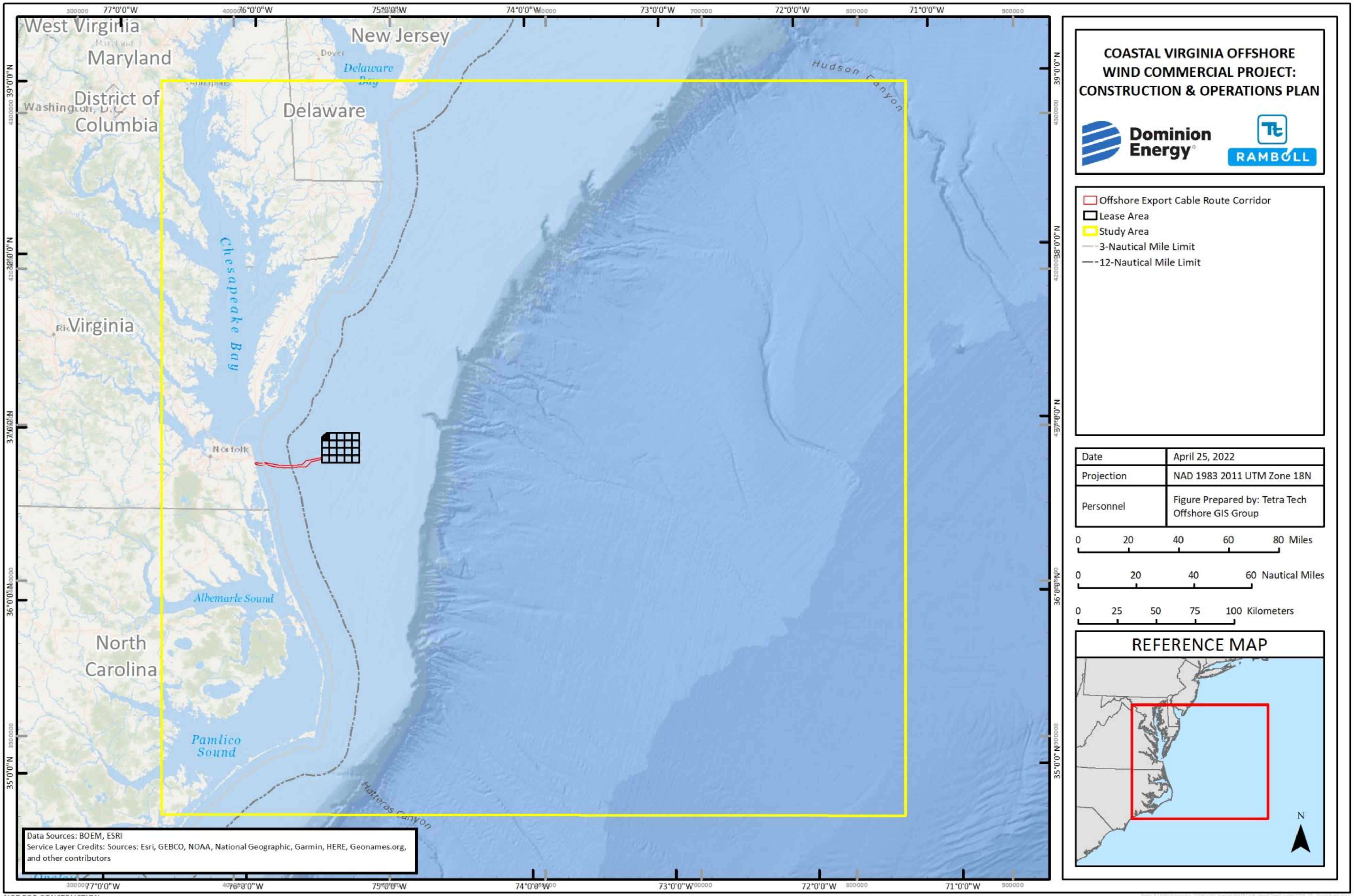


Figure 4.2-39. Sea Turtle Study Area

Table 4.2-49. Protected Species Observer Marine Wildlife Data Summary 2020–2021

Species	2020									2021								
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Green sea turtle	0	4	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Kemp's ridley sea turtle	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Leatherback sea turtle	0	1	31	38	64	37	29	5	3	0	0	0	0	1	2	0	0	N/A
Loggerhead sea turtle	2	58	107	126	87	66	111	51	2	0	0	0	9	322	14	4	3	N/A

N/A: PSO sightings data not available.

Regional data sources include both general Mid-Atlantic sources and sources highly specific to data collection efforts in Virginia's coastal waters. Detailed information regarding the marine resources found within and adjacent to the VACAPES are available in the Navy's Marine Resource Assessment (Navy 2008). Multi-year tagging, tracking, and stranding data is available through tagging studies (Barco and Lockhart 2016) and annual reports from the Virginia Aquarium & Marine Science Center Stranding Response Program (Barco and Swingle 2014; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). NOAA Fisheries' ESA Section 7 Mapper provides further information on the spatial and temporal range of ESA-listed species life stages, behaviors, and critical habitat (NOAA Fisheries 2018). Finally, older published reports such as the Cetacean and Turtles Assessment Program (CETAP 1982) are available.

The resources listed above indicate that certain species of sea turtles may occur within the Study Area. Additional resources indicate that these species generally occur seasonally within and around the Offshore Project Area. Species-specific details are described below.

4.2.6.1 Affected Environment

The affected environment includes areas where sea turtles are known to be present, traverse, or incidentally occur within the Study Area, which includes the waters and coastlines, inclusive of beaches, within and in the vicinity of the Offshore Project Area, and may be directly or indirectly affected by the construction, O&M, and decommissioning of the Project. Sea turtle species that occur in U.S. waters are protected under the ESA (16 U.S.C. § 1531). The ESA protects endangered and threatened species and their designated critical habitat by prohibiting the unauthorized take of listed animals. The ESA defines "take" as the means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect species listed as endangered or threatened, or to attempt to engage in any such conduct. The regulations also define "harm" as an act that injures or kills wildlife.

Occurrence in Study Area

Five species of sea turtles have historically been reported to occur in mid-Atlantic waters off the coast of Virginia, all of which are listed as threatened or endangered under the ESA. These species include the federally endangered Atlantic hawksbill (*Eretmochelys imbricata*), federally threatened green (*Chelonia mydas*), federally endangered Kemp's ridley (*Lepidochelys kempii*), federally endangered leatherback (*Dermochelys coriacea*), and federally threatened loggerhead (*Caretta caretta*). Table 4.2-50 provides a summary of key information for these species and their known distribution within the Study Area. The loggerhead and Kemp's ridley turtles are the most abundant species to occur in Virginia, although green and leatherback turtles are also observed annually in fewer numbers (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). Hawksbills have only been recorded twice in Virginia (Keinath et al. 1991; Barco and Lockhart 2016). As they are strongly affiliated with tropical environments, any occurrences within Virginia should be considered extralimital. There is no critical habitat designation for sea turtles in the Study Area (NOAA Fisheries 2018).

Table 4.2-50. Sea Turtles Known to Occur in the Marine Waters of Coastal and Offshore Virginia

Common Name	Scientific Name	Estimated Abundance of Population	Known Offshore Project Area Distribution	Occurrence a/ Seasonality	Federal Status	State of Virginia Status
Chelonioidea (sea turtles)						
Dermochelyidae (leatherback sea turtles)						
Leatherback Sea Turtle	*Dermochelys coriacea*	34,000–94,000 c/	Offshore, continental shelf and deeper	Uncommon/Year-round	Endangered	Endangered
Cheloniidae (hard-shelled sea turtles)						
Atlantic Hawksbill Sea Turtle	*Eretmochelys imbricata*	19,000 b/	N/A	Extralimital/Year-round	Endangered	Endangered
Green Sea Turtle (North Atlantic Distinct Population Segment	*Chelonia mydas*	215,000 b/	Coastal, bays, estuaries, and inlets	Uncommon/Year-round	Threatened	Threatened
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	248,300 c/	Coastal, bays, estuaries, and inlets	Common/Year-round	Endangered	Endangered
Loggerhead Sea Turtle (Northwest Atlantic Distinct Population Segment)	*Caretta caretta*	588,000 c/	Throughout: offshore, continental shelf and deeper; coastal, bays, estuaries, and inlets	Common/Year-round	Threatened	Threatened

Notes:

a/ Occurrence defined as:

Common: Occurrences are regularly documented, and the Study Area is generally considered within the typical range of the species.

Uncommon: Occurrences are occasionally documented, and the Study Area is generally considered within the typical range of the species.

Extralimital: Few occurrences have been documented, and the Study Area is generally considered outside the typical range of the species; any occurrences would likely be of incidental individuals.

b/ Abundance estimates based on current nesting female and sex ratio estimates (NOAA Fisheries and USFWS 1993, 2013a).

c/ Source: TEWG 2007; NOAA Fisheries and USFWS 2009, 2013a, 2013b, 2015; NEFSC 2011; NOAA Fisheries 2015

Sea turtles are long-lived, slow-growing reptiles found globally in tropical, subtropical, and temperate waters. Aside from nesting females, they spend their lives in the ocean in two distinct life stages: a pelagic (offshore) stage and a neritic (nearshore to the continental shelf break) stage (Barco and Swingle 2014). Hatchlings spend their first few years in offshore waters, drifting in convergence zones or *Sargassum* rafts and feeding on pelagic invertebrates (Navy 2008). Juveniles eventually transition from surface to benthic feeding and pursue larger items such as crustaceans, mollusks, sponges, coelenterates, fishes, and seagrasses. Adults often migrate thousands of kilometers between nesting beaches, mating areas, nursery habitats, and feeding grounds (Navy 2008). Cheloniid, or hardshell sea turtles (which exclude leatherbacks), undergo complex seasonal movements influenced by changes in ocean currents, food availability, reproductive requirements, and most importantly water temperatures (Musick and Limpus 1997). Adult sea turtles become lethargic at temperatures below 50°F (10°C) and may become cold-stunned. The leatherback has a wider range of preferred water temperatures due to its ability to maintain warm body temperatures in temperate waters and avoid overheating in tropical waters (Barco and Swingle 2014). In the western Atlantic off the coast of the U.S., sea turtles are known to migrate to warmer waters as a cold-water avoidance strategy (Musick and Limpus 1997; see Figure 4.2-40).

In Study Area waters, sea turtles are primarily migratory, appearing in the region in late spring when water temperatures approach 68°F (20°C), typically in mid-May, and leaving in fall as water temperatures drop to below 65°F (18°C), typically in October (Mansfield 2006, Barco and Lockhart 2016). They are most likely to occur near the Outer Continental Shelf (OCS) and the eastern edge of the Lease Area (Barco and Swingle 2014, Barco and Lockhart 2016). The Gulf Stream is a transportation vector for hatchlings as well as overwintering habitat for juveniles and adults (Navy 2008). Hatchlings may enter the Gulf Stream upon departing nesting beaches along the southeast coast of the U.S. Juveniles may also occur near the shore in the vicinity of the Offshore Export Cable Route landfall areas in pursuit of macroalgae or submerged aquatic vegetation. Virginia coastal and estuarine waters are important transitional foraging habitat for juvenile sea turtles, which exhibit seasonal foraging movements, migrating north in early spring to coastal developmental habitats and south in fall to warmer waters below Cape Hatteras, North Carolina (Morreale and Standora 2005). Only females of the loggerhead species nest with regularity on the Virginia coast, yielding 5–15 sightings per year along ocean-facing beaches such as Virginia Beach (Barco and Swingle 2014). One green turtle nest (2005) and two Kemp’s ridley nests (2012 and 2013) have been recorded in Virginia, marking the northernmost nesting territory for both species (Wright 2015, VDWR 2016). Because adult cheloniid turtles are generally restricted to lower latitudes, the majority of sea turtles observed in Virginia are the juveniles of these species (Barco and Lockhart 2016).

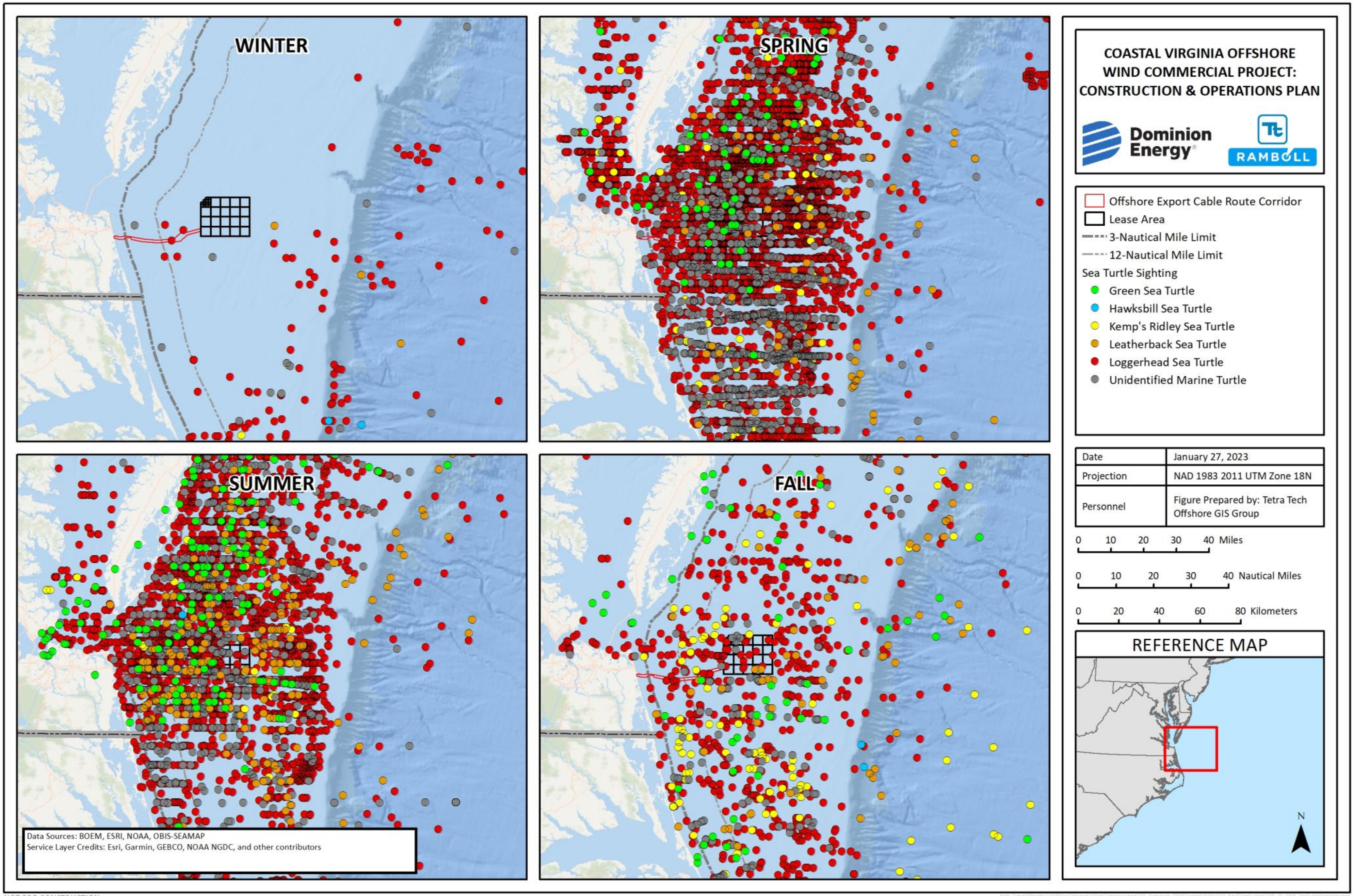


Figure 4.2-40. OBIS Seasonal Sea Turtle Sightings in the Study Area

Since 2000, Virginia has recorded more than 5,000 sea turtle strandings, with an average of 247 annual strandings from 2009 to 2018 (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). Strandings are defined as events in which sea turtles wash ashore sick, injured, or dead, or become entangled and are unable to return to their natural habitats; records of such events may be used to indicate seasonal trends in presence (Costidis et al. 2019). Sea turtles may also strand during winter months due to cold-stunning, a hypothermic reaction that occurs in response to prolonged cold-water temperatures (typically below 50°F [10°C]) that may manifest as decreased heart rate, decreased circulation, lethargy, shock, pneumonia, and possibly death. The majority of these events in Study Area waters involve juvenile loggerheads and Kemp's ridley turtles, both of which begin to appear in mid-May (Barco and Lockhart 2016). Juvenile green turtles appear later in the season, typically July, and leatherbacks strand in all months, although are most commonly observed from May to October (Barco and Lockhart 2016). In the past decade, the number of loggerheads has remained relatively stable, while Kemp's ridley and green turtle numbers have increased steadily (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019).

Sea turtles in Virginia waters can be negatively impacted by entanglements, vessel strikes, cold-stunning, disease, and other causes (Barco and Lockhart 2016; Swingle et al. 2016 2017, 2018; Costidis et al. 2019). Offshore in the mid-Atlantic coast, loggerheads and leatherbacks are caught as bycatch in the pelagic longline fishery (Garrison and Richards 2004). Broader anthropogenic threats include habitat degradation and climate change. Sea turtle species may experience foraging and nesting habitat loss via coastal development and light pollution. Large-scale climactic events may further impact turtles by limiting foraging habitat and by restricting nesting beach ranges as sea levels rise (Navy 2008).

The following subsections provide additional information on the status, natural history, habitat use, broad and regional distribution, threats, and Study Area sightings of the five threatened or endangered sea turtles that have been sighted in Virginia waters and that may occur at least seasonally in the Study Area.

Species Overview

Atlantic Hawksbill

Atlantic hawksbill sea turtles are both federally and state listed in Virginia as endangered. They are considered the second most endangered sea turtle, and Kemp's ridley turtles as the world's most endangered sea turtle species (Navy 2008).

Hawksbill sea turtles are small to medium-sized sea turtles, with an average adult weight of approximately 176 pounds (lbs) (80 kg) and carapace (top shell) length ranging from approximately 26 to 35 in (65 to 90 cm) (NOAA Fisheries and USFWS 1993). They are distinguished by their hawk-like beaks, posteriorly overlapping carapace scutes, and two pairs of claws on their flippers (Navy 2008). Their carapaces are brown or amber with radiating streaks of yellow, orange, black, and red-brown (Navy 2008).

Globally, hawksbill turtles occur from 30°N to 30°S within the Atlantic, Pacific, and Indian oceans (NOAA Fisheries and USFWS 1993). Early juveniles inhabit oceanic waters associated with pelagic *Sargassum* or other flotsam. They recruit to benthic foraging grounds when they are approximately 8 to 10 in (20 to 25 cm), and coral reefs are recognized as the optimal habitat for juvenile, sub-adult, and adult hawksbills (NOAA Fisheries and USFWS 1993). Developmental habitats for juvenile benthic-stage hawksbills are the same as primary feeding grounds for adults and include tropical nearshore waters (Musick and Limpus 1997).

Juveniles and adults are regularly found in the Gulf of Mexico, Caribbean Sea, and along the Atlantic coast of southern Florida; they are rarely found north of Florida (NOAA Fisheries and USFWS 1993). Sightings and strandings have been recorded in Massachusetts, Virginia, North Carolina, and Georgia (Navy 2008).

The hawksbill sea turtle is the rarest species observed in Virginia, with only two published sighting records (Keinath et al. 1991). As the species is typically tropical, any occurrences within Virginia should be considered extralimital and would most likely involve small juveniles entering from pelagic habitat (Navy 2008). The two historical records of hawksbill sea turtles in Virginia's offshore waters occurred during summer months (OBIS 2020; Figure 4.2-40).

The total population of hawksbill turtles in the North Atlantic is estimated to be 19,000 based on nesting female and population sex ratio estimates (NOAA Fisheries and USFWS 2013a). They are impacted by habitat loss due to coastal development, entanglement, vessel strikes, ingestion of marine debris, and intentional killing for the wildlife trade of their eggs (NOAA Fisheries 2019). There is a very low likelihood of hawksbill sea turtle occurrence in the Study Area.

Green Sea Turtle

Green sea turtles are divided into 11 Distinct Population Segments (DPSs) with varying federal (ESA) statuses. Individuals found in Virginia are members of the North Atlantic DPS, which is both federally and state listed as threatened.

They are the largest cheloniid (hard-shelled) species and typically reach maturity within 27 to 50 years, the longest age to maturity for any sea turtle species (NOAA Fisheries and USFWS 1991a). Green turtles in the Atlantic Ocean exhibit slower growth rates on average than their Pacific counterparts (Bjorndal et al. 2000). Adults commonly weigh more than approximately 220 lbs (100 kg) and are greater than approximately 39 in (100 cm) in length (NOAA Fisheries and USFWS 1991a). While hatchlings are black on the dorsal (top/back) surface and white on the ventral (bottom/belly) surface, adult carapaces (top shells) range in color from solid black to gray, yellow, green and brown, and plastrons (bottom shells) range from light yellow to white (NOAA Fisheries and USFWS 1991a). Early juveniles are omnivorous and feed on algae, invertebrates, and small fishes (Musick and Limpus 1997), while late juveniles and adults feed primarily on seagrasses, macroalgae, and reef-associated organisms (NOAA Fisheries 2019).

Globally, green sea turtles are distributed in tropical and subtropical waters and prefer temperatures above 68°F (20°C). Females nest on both island and continental beaches between 30°N and 30°S (Navy 2008); hatchling green turtles reside in convergence zones in the open ocean, where they spend an undetermined amount of time in the pelagic environment (Navy 2008). Once they reach a carapace length of approximately 8–10 in (20–25 cm), juveniles migrate to shallow areas where they use high-energy nearshore reef environments rich in macroalgae as developmental habitats (Holloway-Adkins and Provancha 2005). They then spend the majority of their late-juvenile and adult lives in shallow waters (e.g., approximately 10–16 ft (3–5 m) deep with abundant submerged aquatic vegetation and in close proximity to nearshore reefs or rocky areas (Musick and Limpus 1997, NOAA Fisheries 2019).

In U.S. Atlantic waters, green sea turtles are found around the U.S. Virgin Islands, Puerto Rico, and the continental U.S. from Texas to Massachusetts (NOAA Fisheries and USFWS 1991a). Juveniles utilize estuarine waters as summer developmental habitat as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Musick and Limpus 1997). Though adult and juvenile distributions may overlap in coastal feeding areas during non-breeding periods, adults are restricted more to southern latitudes (Navy 2008). Therefore, most sightings of individuals north of Florida are juveniles and occur between late spring and early fall (CETAP 1982, Epperly et al. 1995).

In Virginia, green sea turtles occur from spring through fall and are least common during the winter; their presence peaks during summer months when juveniles reside in summer developmental foraging habitats (Navy 2008). Since 2010, with the exception of 2015, green sea turtles have typically averaged 11 strandings per year (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). In 2015, a fall mortality event of unknown origin resulted in 69 green turtle strandings (Swingle et al. 2016). Strandings reflect higher occurrences of juveniles than of adults and typically begin occurring in July (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). Though Florida is near the northern extent of the green turtle's Atlantic nesting range, the first green turtle nest in Virginia was documented in 2005 at the Back Bay National Wildlife Refuge (USFWS 2005). In Virginia's waters, the relative occurrence of green sea turtles increases in spring on the continental shelf, peaks in summer, declines in fall, and is lowest during winter months according to biogeographic information data (OBIS 2020; see Figure 4.2-40). PSOs reported four sightings of green sea turtles in May, three in June, and two in August of 2020.

The regional population of the North Atlantic DPS is estimated to be 215,000 green sea turtles based on nesting female and population sex ratio estimates (NOAA Fisheries 2015). Green sea turtles are affected by catch, egg harvesting, loss of nesting habitat, entanglement, vessel strikes, and disease (Barco and Lockhart 2016; Swingle et al. 2018; Costidis et al. 2019; NOAA Fisheries 2019). Outside the U.S, some countries contribute to global declines in green turtle populations by harvesting eggs (NOAA Fisheries 2019). Coastal development, light pollution, and sea level rise contribute to loss of nesting habitat (NOAA Fisheries 2019). The species is also susceptible to fibropapillomatosis, a disease that causes both internal and external tumors that, while generally benign, may be debilitating and indirectly responsible for fatalities (NOAA Fisheries 2015). In Virginia specifically, the two most common causes of green sea turtle mortality are vessel strikes and entanglement (Costidis et al. 2019). There is a moderate likelihood of occurrence of green sea turtles in the Study Area.

Kemp's Ridley Sea Turtle

Kemp's ridley sea turtles are both federal- and state-listed in Virginia as endangered. They are considered the world's most endangered sea turtle (NOAA Fisheries and NOAA Fisheries 1992a), and their worldwide population declined from tens of thousands of nesting females in the late 1940s to approximately 300 nesting females in 1985 (TEWG 2000). Populations have risen since 1985, and there were an estimated 3,900 to 8,100 juveniles using developmental habitats annually along the western coast of the north Atlantic in 2005 (Seney and Musick 2005).

They are the smallest sea turtle and typically reach sexual maturity within 10 to 20 years (Shaver et al. 2005). Adults commonly weigh approximately 99 lbs (45 kg) and have straight carapace lengths of approximately 24–28 in (60–70 cm) (NOAA Fisheries and USFWS 1992a). Their carapaces are round to heart shaped and light-gray in color (Navy 2008). They feed primarily on portunid crabs (swimming crabs) but have also been known to prey on mollusks, shrimp, fish, and plant material (Navy 2008).

Globally, Kemp's ridley sea turtles are restricted to the North Atlantic waters. Their habitats include warm-temperate to subtropical sounds, bays, estuaries, tidal passes, and beachfront waters where their preferred food, the blue crab (*Callinectes sapidus*), is found (Navy 2008). Their optimal habitats occur in less than 33 ft (10 m) bottom depth and water temperatures between 72° and 90°F (22° and 32°C) (Coyne et al. 2000). Hatchlings reside in open-ocean habitats and are transported by the Gulf of Mexico hydrography until they reach a size of approximately 8–12 in (20–30 cm), generally at 2 years of age, when they actively migrate to nearshore developmental habitats (Musick and Limpus 1997). Adult males exhibit small range movements and may reside offshore near nesting beaches year-round due to prey availability and mating opportunities; females exhibit more extensive range movements to satisfy foraging and reproductive needs (Renaud and Williams 2005; Shaver et al. 2005). Females are known for nesting in large numbers during daylight hours in an activity known as an arribada (Navy 2008).

In U.S. Atlantic waters, coastal bays and estuaries serve as important developmental habitats for juvenile Kemp's ridley sea turtles, including Cape Cod Bay, Long Island Sound, Chesapeake Bay, and the bays and sounds from North Carolina south (Morreale and Standora 2005). Adults are largely confined to the Gulf of Mexico but are found in moderate numbers as far north as Nova Scotia (Morreale et al. 1992). Juveniles, and occasionally adults, migrate north from their overwintering grounds in the southeastern U.S. as temperatures increase (Morreale and Standora 2005), although the species seems particularly susceptible to cold-stunning and become vulnerable in waters colder than 55 °F (13°C) (Navy 2008).

In Virginia, Kemp's ridley sea turtles occur from spring through early fall and are the second most commonly observed turtle in the state (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). Virginia coastal and estuarine waters offer important seasonal developmental habitat; individual juveniles exhibit site fidelity and have been known to return to the same seasonal foraging areas in consecutive years (Barco and Lockhart 2016). Strandings have increased in recent years, with an annual average of 80–90 strandings since 2015 and a recent peak of 101 strandings in 2018 (Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). Records reflect higher occurrences of juveniles than of adults and show strandings typically beginning in mid-May and peaking in June (Barco and Swingle 2014; Barco and Lockhart 2016). Two nests have been recorded in Virginia in the past decade, marking the northernmost extent of their nesting territory (Wright 2015). In Virginia waters, the relative occurrence of Kemp's ridley sea turtles remain consistent throughout the year on the continental shelf, with a hotspot occurring within the eastern half of the Lease Area and covering much of the Study Area, according to biogeographic information data (OBIS 2020; see Figure 4.2-41). PSOs reported one sighting of Kemp's ridley sea turtles in June and one in July of 2020.

The total population of Kemp's ridley turtles aged 2 years and over is estimated to be 248,000 globally (NOAA Fisheries and USFWS 2015). As with green sea turtles, Kemp's ridley sea turtles are known to be affected by a number of anthropogenic stressors including bycatch, entanglement, marine debris, noise pollution, vessel strike, and habitat loss (Barco and Lockhart 2016; Swingle et al. 2018; Costidis et al. 2019; NOAA Fisheries 2019). There is a high likelihood of occurrence of Kemp's ridley sea turtles in the Study Area.

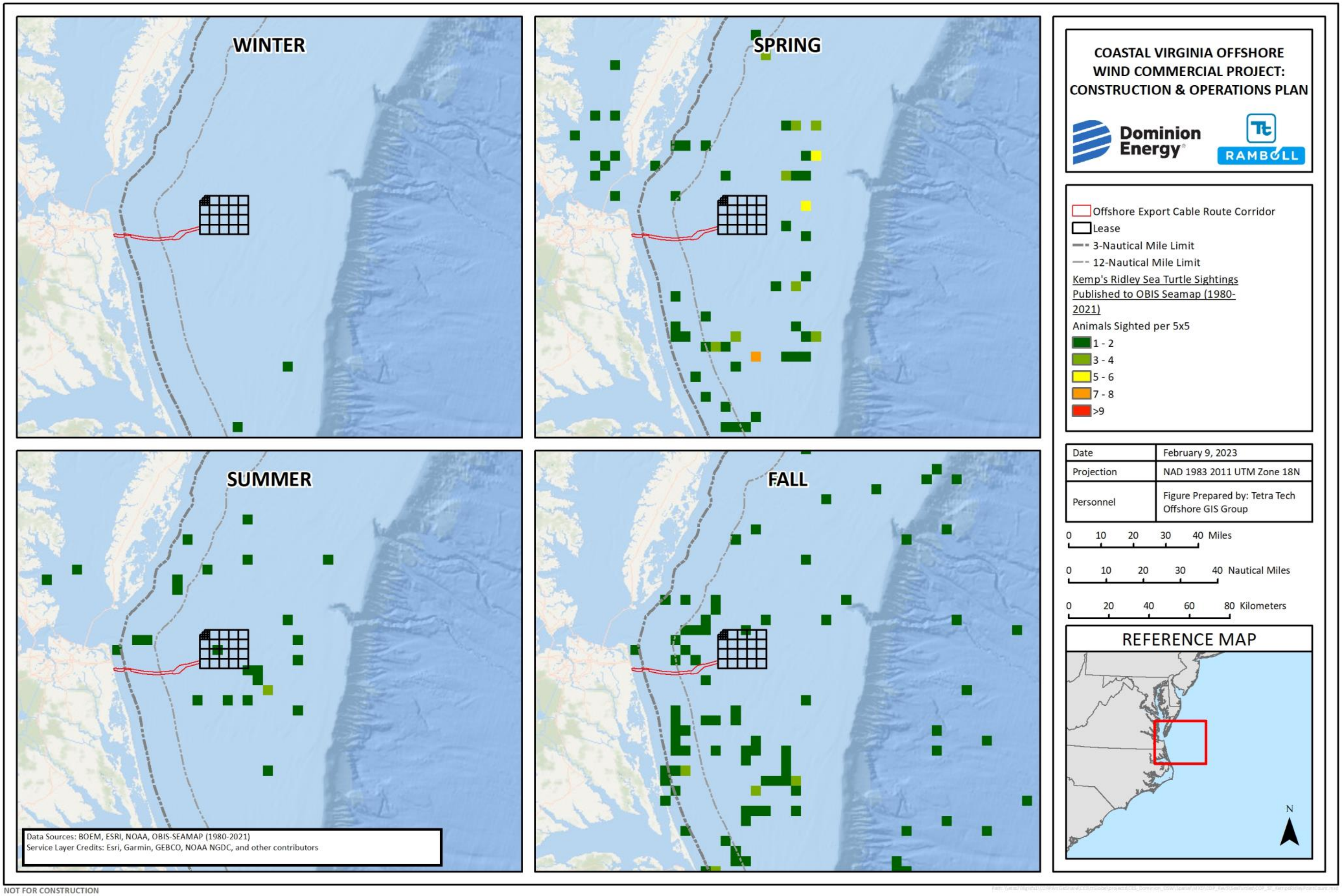


Figure 4.2-41. Seasonal Occurrence of Kemp's Ridley Sea Turtles in the Study Area

Leatherback Sea Turtle

Leatherback sea turtles are both federally and state listed in Virginia as endangered. They are the largest living sea turtle, with average weights of approximately 440 to 1,543 lbs (200 to 700 kg) and carapace lengths ranging from approximately 47 to 69 in (120 to 175 cm) (NOAA Fisheries and USFWS 1992b). Unlike cheloniid species, their carapaces lack an outer layer of horny scutes and are instead composed of a flexible layer of dermal bones under tough connective tissue and smooth skin. They have barrel-shaped bodies with tapered rears and seven longitudinal dorsal ridges. Their coloration is almost completely black with variable spotting and a unique pink spot on the dorsal surface of the head (Navy 2008).

Globally, leatherbacks are distributed in tropical and subtropical waters throughout the year and in temperate waters during late summer and early fall (NOAA Fisheries and USFWS 1992b). An essentially oceanic species, they are known to enter coastal waters for foraging and reproduction. Leatherbacks feed on gelatinous zooplankton such as cnidarians (jellyfish and siphonophores) and tunicates (salps and pyrosomes) (NOAA Fisheries and USFWS 1992b). Hatchlings and early juveniles are entirely oceanic; upwelling areas, like the Equatorial Convergence Zone, are nursery grounds and provide high biomass of gelatinous prey (Musick and Limpus 1997). Juvenile and adult foraging habitats include coastal feeding areas in temperate waters and offshore feeding areas in tropical waters (Navy 2008).

The largest populations of leatherbacks are located in the western Atlantic Ocean and Caribbean Sea. In the North Atlantic, leatherbacks are broadly distributed from the Caribbean to Nova Scotia, Newfoundland, Labrador, Iceland, the British Isles, and Norway (Navy 2008). This distribution is linked to seasonal prey availability and reproductive requirements and to their unique ability to maintain core body temperatures well above the ambient water temperature (Luschi et al. 2006). In U.S. Atlantic waters, they exhibit strong seasonal movements, beginning with a northward movement along the southeast coast of the U.S. in late winter/early spring and continuing as far north as the New England coast and Canada by late summer/early fall (CETAP 1982). In addition to north-south migrations, leatherbacks may exhibit east-west movements from coastal waters to the mid-Atlantic Bight in late summer (Eckert et al. 2006). The northernmost extent of nesting females is found in North Carolina from March through July (Rabon et al. 2003).

In Virginia, leatherback presence peaks from May to July, although they occur in small numbers year-round (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). They may occur in shelf waters or offshore waters just beyond the shelf break. Their annual strandings dropped to a record low of 0 in 2018, reversing a trend of increasing annual strandings since 2012 (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). The relative occurrence of leatherback sea turtles remains consistent throughout the year on the continental shelf, with a hotspot occurring just southeast of the Lease Area, based on biogeographic information data (OBIS 2020; see Figure 4.2-42). Occurrence in the Offshore Export Cable Route Corridor is relatively low. This hotspot shifts slightly south during summer months. Several sighting of leatherback sea turtles were reported by PSOs during 2020, from May through October; and again from May through June of 2021.

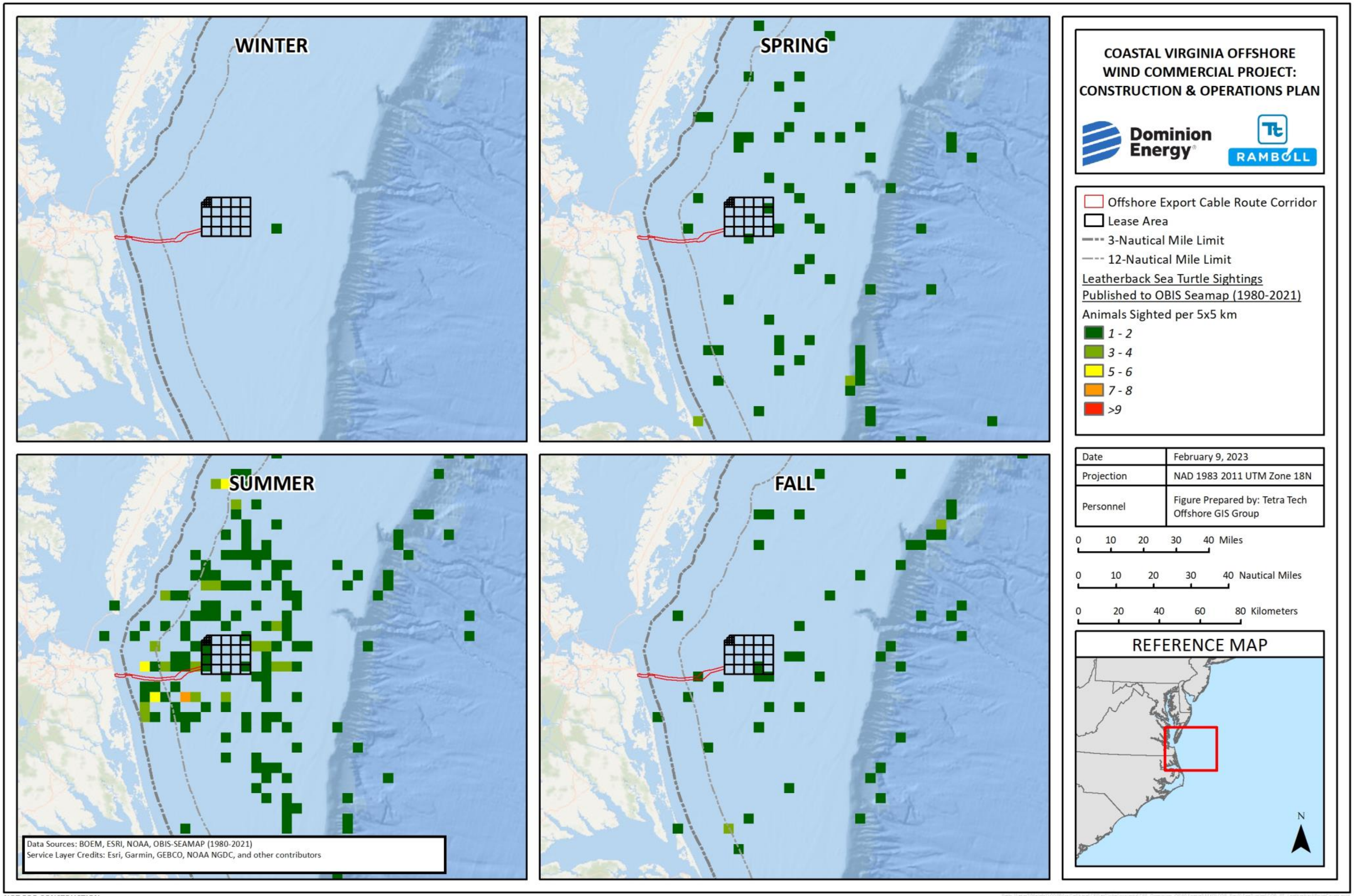


Figure 4.2-42. Seasonal Occurrence of Leatherback Turtles in Study Area

Long-term monitoring has indicated increases in nesting populations, with estimates of 34,000–94,000 individuals in North Atlantic waters alone (TEWG 2007). Leatherbacks are vulnerable to bycatch in fishing gear such as gillnets, longlines, trawls, and traps (Barco and Lockhart 2016; Swingle et al. 2018; Costidis et al. 2019; NOAA Fisheries 2019a). They frequently interact with the pelagic longline fishery in the western Atlantic and Gulf of Mexico, likely because they dive to depths targeted by longline fishermen (Garrison and Richards 2004). They also frequently interact with shrimp trawlers along the southeastern U.S. coast, especially during their spring migration period. A conservation zone was established in 1995 to protect them from the shrimp fishery from Cape Canaveral, Florida, to the North Carolina-Virginia border (NOAA Fisheries 1995). As their diet is primarily gelatinous, accidental ingestion of marine debris resembling their prey is another threat (NOAA Fisheries 2019). There is a moderate likelihood of occurrence of leatherback sea turtles in the Study Area.

Loggerhead Sea Turtle

Loggerhead sea turtles are divided into nine DPSs with varying federal (ESA) statuses. Individuals found in Virginia are members of the Northwest Atlantic DPS, which is both federally and state listed as threatened. They are the most abundant sea turtles in U.S. waters (Navy 2008).

They are large cheloniid turtles named for their proportionately large heads and powerful jaws (Navy 2008). Adults mature in 12–30 years and typically weigh approximately 220–330 lbs (100–150 kg), with average carapace lengths of approximately 35–37 in (90–95 cm) (NOAA Fisheries and USFWS 1991b). Adults possess reddish-brown carapaces with yellow scutes (plate-like scales similar in composition to the keratin of fingernails) (NOAA Fisheries and USFWS 1991b). Hatchlings consume *Sargassum*, zooplankton, jellyfish, larval shrimp and crabs, insects, and gastropods (Navy 2008). Late juveniles feed on pelagic crabs, mollusks, jellyfish, and vegetation captured at or near the surface; adults are generally carnivorous and forage on benthic invertebrates and sometimes fish in nearshore waters (Dodd 1988).

Globally, loggerheads occur in subtropical and temperate waters in habitats ranging from coastal estuaries, bays, and lagoons to pelagic waters (NOAA Fisheries and USFWS 1991b; Dodd 1988). Early juveniles occur in pelagic convergence zones where they are transported through the ocean by dominant currents such as the North Atlantic Gyre (Navy 2008). Once they reach approximately 15 in (40 cm) in length (approximately 8 years in age), they migrate toward the western Atlantic Ocean to nearshore feeding grounds near their natal beaches (Musick and Limpus 1997; Bjorndal et al. 2000). Late juveniles and adults most often occur on the continental shelf and along the shelf break of the U.S. and Gulf coasts as well as in coastal estuaries and bays (CETAP 1982). Adults inhabit deeper offshore feeding areas along the western Atlantic from mid-Florida to New Jersey (Roberts et al. 2005).

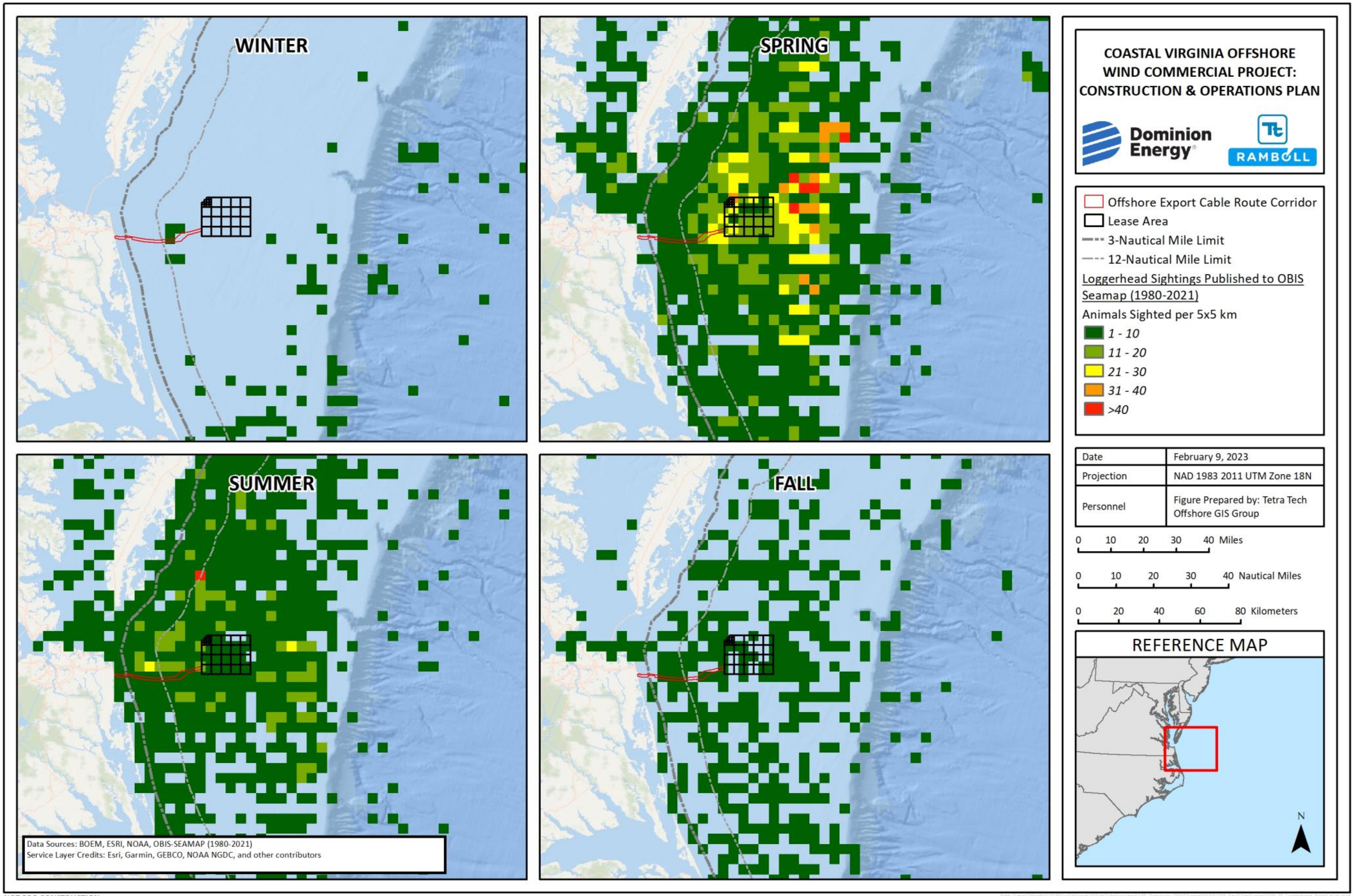
In U.S. Atlantic waters, loggerheads are found from Cape Cod to the Florida Keys, and from the shore to the shelf break during any season (CETAP 1982). Their distribution is determined by their preferred temperature range of 55° to 82°F (13° to 28°C), and they experience cold-stunning in waters below 50°F (10°C) (Navy 2008). Seasonal migrations take place both in the inshore/offshore and north/south directions (Navy 2008). Between June and September, loggerheads stay within 1 or 2 miles of the shore; the Gulf Stream serves as an overwintering area and as an access route to mid-Atlantic foraging grounds (Hawkes et al. 2007). In early spring, juveniles overwintering in the southeastern U.S. migrate north to developmental feeding habitats (Morreale and Standora 2005).

Loggerheads are the most common sea turtle found in Virginia waters and pass through Virginia en route to summer foraging areas or overwintering grounds (Hawkes et al. 2007; Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). They begin appearing in mid-May when surface water temperatures approach 60°F (20°C) and nest regularly on Virginia's ocean-facing beaches, with an average of 5 to 15 nests observed annually (Barco and Swingle 2014). They have been recorded nesting in the Back Bay National Wildlife Refuge and Virginia Beach (USFWS 2001, Mansfield 2006). Juveniles use Virginia estuaries, bays, and sounds as developmental feeding habitat during summer months, and exhibit site fidelity, often returning to the same seasonal foraging areas in consecutive years (Barco and Swingle 2014). They typically leave Virginia waters when temperatures fall below 65°F (18°C), usually in October (Barco and Swingle 2014). Strandings have remained consistent in the past decade, with an average of between 125 and 165 annual strandings (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). The relative occurrence of loggerhead sea turtles remains consistent throughout the year on the continental shelf, with a hotspot covering the entirety of the Lease Area and extending along the majority of the Offshore Export Cable Route Corridor (OBIS 2020; see Figure 4.2-43). This hotspot shifts slightly inland during summer months. Several sightings of loggerhead sea turtles were reported by PSOs during 2020, in all months from April through December. Additionally, loggerhead sightings were reported in April through August of 2021.

The calculated preliminary regional abundance estimate is about 588,000 loggerheads along the U.S. Atlantic coast (NEFSC 2011). As with other sea turtles, loggerheads are known to be affected by a number of anthropogenic stressors including bycatch, entanglement, vessel strikes, ingestion of marine debris, habitat loss, and harvest (Barco and Lockhart 2016; Swingle et al. 2018; Costidis et al. 2019). Adults are especially known to interact with the western Atlantic pelagic longline fishery (Garrison and Richards 2004). There is a high likelihood of occurrence of loggerhead sea turtles in the Study Area.

4.2.6.2 Impacts Analysis for Construction, Operations and Maintenance, and Decommissioning

The potential impacts resulting from the construction, O&M, and decommissioning of the Project are based on the Preferred Layout from the PDE (see Section 3, Description of Proposed Activity). Dominion Energy is permitting up to 176 WTGs and three Offshore Substations. Seven spare WTG positions are included in the assessment herein, consistent with the LOA application. Spare positions will be utilized in the event that originally selected positions are unable to yield successful WTG installations for any reason. Acoustic analyses for estimation of impacts to sea turtles are based on 176 WTGs with seven spare positions.



NOT FOR CONSTRUCTION

Figure 4.2-43. Seasonal Occurrence of Loggerhead Turtles in the Study Area

Although sea turtles are known to nest along Virginia Beach, Virginia (Barco and Swingle 2014), there is only one recent record of a loggerhead sea turtle nest in the Nearshore Trenchless Installation Area on July 1, 2020 (Virginia Aquarium, pers. comm). Given that the Offshore Export Cables would be brought to shore via trenchless installation to minimize impacts to the sensitive beach and dune area, any nesting areas would be unaffected, monitored, and subject to rigorous protections. Considering no onshore impacts are expected for sea turtles, this section describes only potential impacts in the offshore environment.

Construction

For most stressors other than noise- and light-related disturbances and ship strikes, sea turtles would experience construction-induced impacts similar to those described for marine mammals (see Section 4.2.5, Marine Mammals). In the Study Area, sea turtle abundance increases during late spring months as water temperatures rise to above 60°F (20°C) and decreases during early fall months as temperatures fall below 65°F (18°C) (Mansfield 2006, Barco and Lockhart 2016). The five species known to occur in the Offshore Project Area would be most exposed to Project-related construction activities during this spring-fall period. Based on multiple studies and surveys, four of the five species known to occur in Virginia have been consistently observed in the Study Area, meaning they have the potential to be collocated with Project activities; the exception is the hawksbill, which is unlikely to occur.

During construction, the potential impact-producing factor to sea turtles may include installation of the Offshore Project Components. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project construction. The following construction-induced impacts may occur as a consequence of the factor identified above:

- Short-term disturbance of habitat;
- Short-term decrease in local prey species;
- Short-term increase in construction-related lighting;
- Short-term increase in marine debris;
- Short-term increase in risk of equipment interaction;
- Short-term increase in underwater noise;
- Short-term increase in vessel traffic and risk of ship strike; and
- Short-term change in water quality, including potential oil spills.

Short-term disturbance of habitat. Installation of the WTG Monopile and Offshore Substation Jacket Foundations, Offshore Export Cables, and Inter-Array Cables would cause temporary disturbance to the seafloor. WTG Monopile and Offshore Substation Jacket Foundations would be installed either simultaneously or sequentially, and cable installation would be linear over time, meaning the actual area of disturbance at any given time would be localized. Nearshore construction activities may occur within or near preferred juvenile habitats and would therefore generate the greatest impacts to sea turtles (Musick and Limpus 1997, Morreale and Standora 2005, Barco and Lockhart 2016). Seagrasses (including eelgrasses), a preferred habitat and forage base for juvenile sea turtles, are present in the mouth of the Chesapeake Bay to the north of the Offshore Export Cable Route Corridor and in Currituck Sound to the south (Marine Cadastre 2020). However, there is no record of submerged aquatic vegetation along Virginia

Beach, and Dominion Energy has sited the Offshore Export Cable Route Corridor to avoid sensitive benthic habitats to the extent practical (including submerged aquatic vegetation).

Offshore construction activities may impact adult sea turtles by overlapping with their pelagic habitats. However, due to habitat uniformity within the Study Area, there is a large amount of suitable habitat outside the construction site that would be available to sea turtles, and construction activities would only temporarily displace sea turtles and their prey. Furthermore, the seafloor is expected to return to its pre-construction condition following disturbance within a relatively short timeframe (see Section 4.1.2, Water Quality, and Appendix J, Sediment Transport Analysis). Sea turtles would not experience permanent disturbance or displacement from suitable habitat in the Study Area.

Short-term decrease in local prey species. Construction activities may result in a temporary decrease in sea turtle foraging opportunity in the Study Area due to the disturbance of prey species. Some juveniles and adults may be found in nearshore portions of the Study Area where small forage invertebrates are found, although adult sea turtles are most likely to occur offshore (Musick and Limpus 1997, Morreale and Standora 2005, Barco and Lockhart 2016). It is difficult to determine which nearshore areas are utilized by foraging sea turtles; however, nearshore benthic habitat along Virginia Beach is relatively uniform, and there would be ample foraging habitat available outside of direct construction sites. Furthermore, Dominion Energy has sited the Offshore Export Cable Route Corridor to avoid sensitive benthic habitats to the extent practical (including submerged aquatic vegetation) to minimize impacts to sea turtles, particularly juveniles. As mentioned above, there are no documented eelgrass habitats within the Study Area.

Short-term increase in construction-related lighting. Project-related construction and support vessels would require deck and safety lighting while operating within and transiting to and from the Study Area. Construction-related lighting may impact various species or age groups of sea turtles differently (Gless et al. 2008). Loggerheads have exhibited greater attraction to lighting than leatherbacks; this is particularly true for the juveniles of both species (Wang et al. 2007). Lighting has the potential to affect hatchlings' ability to navigate from their natal beaches to the open ocean. Nests in the vicinity of the Study Area or the Cable Landing Location are extremely rare, and the potential impacts of Project-related lighting may be naturally mitigated as it would be concentrated offshore (away from potential nesting beaches) with a small radius of impact. Construction vessel lighting is not expected to affect sea turtle behavior.

Short-term increase in marine debris. Marine debris may accidentally be introduced into the marine environment by Project-related construction and support vessels. Sea turtles have been known to become entangled in or ingest marine debris mistaken for prey, which has resulted in injury and mortality. Such events have been well documented both globally and in Virginia (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). Dominion Energy would require all offshore personnel and vessel contractors to implement appropriate debris control practices and protocols to prevent the accidental release of marine debris. All Project-related vessels would operate in accordance with regulations pertaining to at-sea discharge of vessel-generated waste.

Short-term increase in risk of equipment interaction. Within the pelagic environment, sea turtles may experience increased risks of entanglement and entrapment in cables and lines associated with Project-related equipment during seafloor preparation and installation activities. Such entanglement or entrapment would only occur if an individual were in the direct path of a jet trencher or similar seafloor preparation equipment that would occupy a narrow path from installation vessel to seafloor (Murray 2011). Within the benthic environment, resting or foraging sea turtles may similarly experience increased risks of interaction with a jet trencher. This would be particularly concerning for loggerheads, greens, and Kemp's ridley sea turtles, whose diving and foraging patterns overlap with seafloor construction activities (Musick and Limpus 1997, Bjorndal et al. 2000, Roberts et al. 2005, Navy 2008). Entrained or entrapped individuals could experience injury or mortality. It is expected that these scenarios are unlikely as sea turtles are highly mobile species with the capability to avoid construction activities prior to interaction, and sea turtles have been documented to respond more strongly to slow-moving vessels than fast moving vessels (Hazel et al. 2009).

Short-term increase in underwater noise. Ambient underwater noise would temporarily increase in the Study Area during jet plowing, pile-driving, and associated vessel presence. This increase may potentially impact sea turtle behavior or physiology. Projected impacts of construction-related noise increase to sea turtles are presented in Section, 4.2.5, Marine Mammals, and Appendix Z, Underwater Acoustic Assessment.

The impacts of increased underwater sound are poorly documented, and data on the hearing capabilities of sea turtles remain insufficient. The best available information indicates that sea turtles appear to employ a combination of auditory and visual cues to detect objects in the water column (e.g., other organisms and vessels) and are therefore capable of responding to acoustic cues (Piniak et al. 2012, Willis 2016, Navy 2017, Moll et al. 2017, Kraus et al. 2019). Based on existing data, sea turtles may rely more heavily on visual cues than auditory cues for their avoidance tactics (e.g., increased swimming speeds and directional changes) (Hazel et al. 2009). Sea turtles may rely on auditory cues (e.g., breaking waves) to identify nesting beaches in addition to the use of other physical cues (e.g., magnetic fields and light). Sea turtles are not known to produce sound for communication. Ultimately, noise is believed to play a limited role in sea turtle life histories.

Sea turtles hear in the lower frequencies, typically below 2,000 Hz according to current research (Piniak et al. 2012, Navy 2017, Moll et al. 2017). One study listed lower and upper cutoff frequencies at 5 Hz and 2,000 Hz (Moll et al. 2017), while another study indicated the frequency range of greatest sea turtle sensitivity lies between 100 and 700 Hz (Piniak et al. 2012). Hearing sensitivity likely varies by life stage, and research indicates that juvenile ranges (up to 1,600 Hz) are more sensitive than those of adults (5 to 2,000 Hz) (Bartol et al. 1999, Martin et al. 2012, Piniak et al. 2012, Lavender et al. 2014, Moll et al. 2017). Hearing sensitivity may also vary by species. Known hearing ranges are as follows: Kemp's ridley frequencies span 100 to 500 Hz; loggerhead frequencies span 50 to 1,131 Hz; and leatherback, green, and hawksbill frequencies span 50 to 1,600 Hz (Martin et al. 2012, Piniak et al. 2012).

Pile-driving is not known to cause injury or mortality in sea turtles, although field observations during seismic surveys have revealed active sea turtle avoidance behaviors to impulsive sound (i.e., broadband signals characterized by sudden onset and short duration) (Weir 2007, DeRuiter and Doukara 2012). NOAA Fisheries has established sea turtle behavioral and injury thresholds at 166 dB re µPa and 180 dB re 1 µPa, respectively (NOAA Fisheries 2020). Based on prior observations, sea turtles are expected to actively avoid exposure to impact pile-driving at 175 dB re 1 µPa (Navy 2017). Data from the construction of the Block Island Wind Farm indicate a potential for sea turtles to be affected by pile-driving noise. Distances to measured sea turtle behavioral threshold isopleths during pile-driving ranged from 3,314 to 7,382 ft (1,010 to 2,250 m) from the pile source (Tetra Tech 2016). Distances to measured injury threshold isopleths ranged from 33 to 243 ft (10 to 74 m) from the pile source (Tetra Tech 2016). Impacts to sea turtles from pile-driving noise would most likely occur during sea turtle abundance peaks from late spring to early fall, although individuals would most likely avoid the zone of influence for the duration of pile-driving activities. There would be ample oceanic habitat outside of this zone for migrating turtles to adjust course without a significant migratory shift.

Dominion Energy conducted underwater sound propagation modeling to predict expected underwater noise levels across a variety of environments throughout the Study Area (see Appendix Z, Underwater Acoustic Assessment for a full description of modeling methodology and data inputs). Project design and engineering teams were consulted for descriptions of expected construction activities to inform the representative acoustic modeling scenarios. These scenarios were further informed by existing literature, engineering guidelines, and underwater source measurements of similar equipment and activities. Table 4.2-51 provides a summary of the construction and operation scenarios included in the underwater acoustic modeling analysis.

Table 4.2-51. Underwater Acoustic Modeling Scenarios

Scenario	Activity Description	Maximum Hammer Energy (kilojoules)	Duration of Pile Installation (minutes)	Total Hammer Blows	Modeling Location (UTM Coordinates)	Sound Source Level (No Attenuation)
Scenario 1: Standard Driving Installation	Monopile Foundation (includes 1 pile per day): 9.5 m	Vibratory Pile Driving	60	N/A	Deep: 480666 m, 4089018 m Shallow: 459846 m, 4075324 m	202 $L_{E,\ 1sec}$
		Impact Pile Driving: 4,000 a/	85	3240		249 $L_{p,pk}$ 226 $L_{E,\ 1sec}$ 236 L_p
Scenario 2: Hard to Drive Installation	Monopile Foundation (includes 1 pile per day): 9.5 m	Vibratory Pile Driving	30	N/A	Deep: 480666 m, 4089018 m Shallow: 459846 m, 4075324 m	202 $L_{E,\ 1sec}$
		Impact Pile Driving: 4,000	99	3,720		249 $L_{p,pk}$ 226 $L_{E,\ 1sec}$ 236 L_p
Scenario 3: One Standard and One Hard to Drive Installation	Monopile Foundation (includes 2 piles per day): 9.5 m	Vibratory Pile Driving	90	N/A	Deep: 480666 m, 4089018 m Shallow: 459846 m, 4075324 m	202 $L_{E,\ 1sec}$
		Impact Pile Driving: 4,000 a/	184	6,960		249 $L_{p,pk}$ 226 $L_{E,\ 1sec}$ 236 L_p
Scenario 4: Offshore Substation Piled Jacket Foundation	Piled Jacket Foundation (includes 2 piles per day): 2.8 m b/	Vibratory Pile Driving	120	N/A	Offshore Substation: 474075 m, 4085595 m	194 $L_{E,\ 1sec}$
		Impact Pile Driving: 3,000	410	15,120		240 $L_{p,pk}$ 214 $L_{E,\ 1sec}$ 224 L_p
Scenario 5: Cofferdam Installation	Cofferdam Installation, Vibratory Pile-Driving	Vibratory Pile Driving	60	N/A	Cofferdam: 414,213 m, 4,074,917 m	195 $L_{E,\ 1sec}$
Scenario 6: Goal Post Pile Installation	Goal Post Piles (2 per day)	Impact Pile Drive	130	260	Goal Post: 414,396m, 4,074,917m	210 $L_{p,pk}$ 183 $L_{E,\ 1sec}$ L_p

Scenario	Activity Description	Maximum Hammer Energy (kilojoules)	Duration of Pile Installation (minutes)	Total Hammer Blows	Modeling Location (UTM Coordinates)	Sound Source Level (No Attenuation)
Notes: a/ Source levels based on the SERO Pile Driving Noise Data Spreadsheet – Humboldt Bay Bridges (CALTRANS 2015). SEL = sound exposure level; LPK = peak sound pressure (dB re 1 μPa) N/A Not applicable for this installation methodology						

The representative acoustic modeling scenarios were derived from descriptions of the expected construction activities and operational conditions through consultations between the Project design and engineering teams. The scenarios modeled were ones where potential underwater noise impacts of marine species were anticipated and included impact and vibratory pile driving associated with WTG Monopile and Offshore Substation Jacket Foundation installation and vibratory pile-driving associated with cofferdam construction. All impact and vibratory pile-driving modeling scenarios of WTGs occur at representative locations; one at a shallow water depth (69 ft) (21 m) within the Lease Area, and another at a deep-water depth (121 ft (37 m) within the Lease Area. These two locations were selected so that the effects of sound propagation at the range of water column depths occurring within the Lease Area could be observed. The vibratory pile-driving needed for cofferdam installation will occur at depths less than 328 ft (100 m) and the proposed locations are in very close proximity to each other; therefore, only a single modeling location was completed for vibratory pile-driving. Goal Post piles were modeled using simple spread in the GARFO ESA Acoustic tool spreadsheets (NOAA Fisheries 2020) and, therefore, a location was not incorporated into the modeling. However, the resulting area was then mapped using geospatial analysis to determine how much of the ensonified area would be truncated by land.

The results for impact and vibratory pile driving of monopiles for the representative WTG location at the deep-water depth are shown in Table 4.2-52 and Table 4.2-53, while the results for the shallow-water location are shown in Table 4.2-54 and Table 4.2-55. Results for impact and vibratory pile-driving are presented without mitigation and with two different levels of mitigation, a 6 dB reduction and a 10 dB reduction. Results for the impact and vibratory pile-driving for pin pile installation are shown in Table 4.2-56 and Table 4.2-57. As noise mitigation design has not been finalized at this stage of permitting, these two levels of reduction were applied to potentially mimic the use of noise mitigation options, such as bubble curtains. The results for cofferdam vibratory pile-driving are shown in Table 4.2-58 and were not modeled with mitigation. The results for goal post installation are shown in Table 4.2-59 and were not modeled with mitigation. The presence of minor irregularities in results as noted below is attributed to model resolution and methodology; further details are provided in Appendix Z, Underwater Acoustic Assessment Section Z-7.

Table 4.2-52. Sea Turtle Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Impact Pile-Driving – Deep Location (Monopile)

Scenario	Pile Type	Hammer Energy (kilojoule)	Installation Duration (minutes)	Mitigation (dB)	Species				
					Sea Turtle Behavioral	Sea Turtle Temporary Threshold Shift (Temporary Threshold Shift)		Sea Turtle Permanent Threshold Shift (Permanent Threshold Shift)	
					175 L_p	226 $L_{p,pk}$	189 $L_{E,\ TUW,\ 24hr}$	232 $L_{p,pk}$	204 $L_{E,\ TUW,\ 24hr}$
Scenario 1: Standard Driving Scenario	9.5 m Monopile	4,000 a/	85	0	5,162	180	8,985	104	2,628
				6	2,829	104	5,010	48	1,408 b/
				10	2,146	67	3,575	10	1,044
Scenario 2: Hard Driving Scenario	9.5 m Monopile	4,000 a/	99	0	5,162	180	9,762	104	2,918
				6	2,829	104	5,560	48	1,533
				10	2,146	67	3,902	10	1,142
Scenario 3: One Standard and One Hard Driving Scenario	9.5 m Monopile (2 piles per day)	4,000 a/	184	0	5,162	180	11,998	104	3,685
				6	2,829	104	7,037	48	2,053
				10	2,146	67	4,812	10	1,410 b/

Source: NOAA Fisheries 2020

dB = decibel; Lp,pk = peak sound pressure level; LE = sound exposure level; TUW = sea turtles in water; 24h = 24-hour

Notes:

Same information is presented in COP Section 4.1.5 and Appendix Z

a/ Corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less

b/ Refer to Appendix Z Section Z.7 for further details..

Table 4.2-53. Sea Turtle Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Vibratory Hammer – Deep Location (Monopile)

Scenario	Pile Type	Installation Duration (minutes)	Mitigation (dB)	Species b/		
				Sea Turtle Behavioral	Sea Turtle Temporary Threshold Shift	Sea Turtle Permanent Threshold Shift
				175 L_p	200 $L_{E,\ TUW,\ 24hr}$	220 $L_{E,\ TUW,\ 24hr}$
Scenario 1: Standard Driving Scenario	9.5 m Monopile	60	0	189	522	65
			6	119	298	18
			10	82	179	6 a/
Scenario 2: Hard Driving Scenario	9.5 m Monopile	30	0	189	402	40
			6	119	241 a/	0 a/
			10	82	132	0
Scenario 3: One Standard and One Hard Driving Scenario	9.5 m Monopile (2 piles per day)	90	0	189	642	78
			6	119	358	24
			10	82	200 a/	8

Source: NOAA Fisheries 2020

dB = decibel; Lp = sound pressure; L_E = sound exposure level; TUW = sea turtles in water; 24h = 24-hour

Notes:

Same information is presented in COP Section 4.1.5 and Appendix Z

a/ Refer to Appendix Z Section Z.7 for further details

Table 4.2-54. Sea Turtle Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Impact Pile-Driving – Shallow Location (Monopile)

Scenario	Pile Type	Hammer Energy (kilojoule)	Installation Duration (minutes)	Mitigation (dB)	Species				
					Sea Turtle Behavioral	Sea Turtle Temporary Threshold Shift		Sea Turtle Permanent Threshold Shift	
					175 L_p	226 $L_{p,pk}$	189 $L_{E, TUW, 24hr}$	232 $L_{p,pk}$	204 $L_{E, TUW, 24hr}$
Scenario 1: Standard Driving Scenario	9.5 m Monopile	4,000 a/	85	0	4,776	162	6,897	90	2,150
				6	2,667	90	3,957	46	1,258
				10	1,951	61	2,758	7	900
Scenario 2: Hard Driving Scenario	9.5 m Monopile	4,000 a/	99	0	4,776	162	7,698	90	2,359
				6	2,667	90	4,334	46	1,482
				10	1,951	61	2,944	7	985
Scenario 3: One Standard and One Hard Driving Scenario	9.5 m Monopile (2 piles per day)	4,000 a/	184	0	4,776	162	9,136	90	3,024
				6	2,667	90	5,367	46	1,751
				10	1,951	61	3,607	7	1,225

Source: NOAA Fisheries 2020
dB = decibel; Lp = sound pressure level; Lp,pk = peak sound pressure level; LE = sound exposure level; TUW = sea turtles in water; 24h = 24-hour
Notes:
Same information is presented in COP Section 4.1.5 and Appendix Z
a/ Corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less

Table 4.2-55. Sea Turtle Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Vibratory Hammer – Shallow Location (Monopile)

Scenario	Pile Type	Installation Duration (minutes)	Mitigation (dB)	Species		
				Sea Turtle Behavioral	Sea Turtle Temporary Threshold Shift	Sea Turtle Permanent Threshold Shift
				175 L_p	200 $L_{E, 24hr}$	220 $L_{E, 24hr}$
Scenario 1: Standard Driving Scenario	9.5 m Monopile	60	0	175	490	50
			6	98	275	16
			10	52	164	0
Scenario 2: Hard Driving Scenario	9.5 m Monopile	30	0	175	364	37
			6	98	203 a/	0
			10	52	120	0
Scenario 3: One Standard and One Hard Driving Scenario	9.5 m Monopile (2 piles per day)	90	0	175	581	61
			6	98	321	20
			10	52	195 a/	0

Source: NOAA Fisheries 2020
dB = decibel; Lp = sound pressure level; LE = sound exposure level; 24h = 24-hour
Notes
Same information is presented in COP Section 4.1.5 and Appendix Z
a/ Refer to Appendix Z Section Z.7 for further details.

Table 4.2-56. Sea Turtle Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Impact Pile-Driving – Offshore Substation Location

Scenario	Pile Type	Hammer Energy (kilojoule)	Installation Duration (minutes)	Mitigation (dB)	Species				
					Sea Turtle Behavioral	Sea Turtle Temporary Threshold Shift		Sea Turtle Permanent Threshold Shift	
					175 L_p	226 $L_{p,pk}$	189 $L_{E, TUW, 24hr}$	232 $L_{p,pk}$	204 $L_{E, TUW, 24hr}$
Scenario 4: Offshore Substation Piled Jacket Foundation	2.8 m Pin Pile	3,000 a/	410	0	2,041	0	5,900	0	1,695
				6	1,134	0	3,197	0	914
				10	742	0	2,303	0	653

Source: NOAA Fisheries 2020
dB = decibel; Lp,pk = sound pressure level; Lp,pk = peak sound pressure level; LE = sound exposure level; TUW = sea turtles in water; 24h = 24-hour
Notes:
Same information is presented in COP Section 4.1.5 and Appendix Z
a/ Corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less.

Table 4.2-57. Sea Turtle Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Vibratory Hammer – Offshore Substation Location

Scenario	Pile Type	Installation Duration (minutes)	Mitigation (dB)	Species		
				Sea Turtle Behavioral	Sea Turtle Temporary Threshold Shift	Sea Turtle Permanent Threshold Shift
				175 L_p	200 $L_{E, TUW, 24hr}$	220 $L_{E, TUW, 24hr}$
Scenario 4: Offshore Substation Piled Jacket Foundation	2.8 m Pin Pile	120	0	85	239	14
			6	38	142	0
			10	7	94	0

Source: NOAA Fisheries 2020

dB = decibel; Lp = sound pressure level; LE = sound exposure level; TUW = sea turtles in water; 24h = 24-hour Note: Same information is presented in COP Section 4.1.5 and Appendix Z

Table 4.2-58. Sea Turtle Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Vibratory Hammer – Cofferdam

Scenario	Pile Type	Installation Duration (minutes)	Species		
			Sea Turtle Behavioral	Sea Turtle Temporary Threshold Shift	Sea Turtle Permanent Threshold Shift
			175 L_p	200 $L_{E, 24hr}$	220 $L_{E, 24hr}$
Scenario 5: Cofferdam Installation	Sheet Pile	60	0	5	0

Source: NOAA Fisheries 2020

dB = decibel; Lp = sound pressure level; LE = sound exposure level; TUW = sea turtles in water; 24h = 24-hour

Note: Same information is presented in COP Section 4.1.5 and Appendix Z

Table 4.2-59. Sea Turtle Behavioral and Acoustic Injury Criteria Threshold Distances (meters) for Impact Pile-Driving – Goal Post Installation

Scenario	Pile Type	Hammer Energy (kilojoule)	Installation Duration (minutes)	Species				
				Sea Turtle Behavioral	Sea Turtle Temporary Threshold Shift		Sea Turtle Permanent Threshold Shift	
				175 L_p	226 $L_{p,pk}$	189 $L_{E, TUW, 24hr}$	232 $L_{p,pk}$	204 $L_{E, TUW, 24hr}$
Scenario 6: Goal Post Installation	Goal Post Piles	N/A	130	156	0	0	0	0

Source: NOAA Fisheries 2020

dB = decibel; Lp = sound pressure level; Lp pk = peak sound pressure level; LE = sound exposure level; TUW = sea turtles in water; 24h = 24-hour

Note: Same information is presented in COP Section 4.1.5 and Appendix Z

For impact and vibratory pile-driving for the representative WTG location at the deep-water depth, distances to the peak sound pressure and Permanent Threshold Shift (PTS) onset thresholds are provided. Expectedly, the largest ranges to thresholds are the ones for the sea turtle behavioral response. Similar trends in results were observed for modeling results of impact and vibratory pile-driving at the shallow WTG location, although in most cases distances to thresholds were less. For cofferdam vibratory pile-driving, the distances to the injury thresholds were minimal (less than 65 ft [20 m]), and the distance to the behavioral threshold was minimal (278 ft) (85 m). Note that the results of the analysis are based on conservative assumptions, including maximum hammer energy, number of strikes, and preliminary sediment data. Dominion Energy would implement the following measures as appropriate to avoid, minimize, and mitigate potential impacts of construction-related underwater noise:

- Implement clearance zones where pile-driven Foundations are installed, enforced by qualified NOAA Fisheries-approved PSOs;
- Implement real-time monitoring systems;
- Employ soft starts/ramp-ups and shut-down procedures where technically feasible;
- Use reduced visibility monitoring tools/technologies (e.g., night vision, infrared, and/or thermal cameras);
- Use commercially and technically available noise-reducing technologies; and
- Provide sea turtle sighting and reporting procedures for appropriate Project-related personnel specific to construction and its potential impacts to sea turtles.

Marine Acoustics, Inc. conducted animat modeling of the potentially occurring sea turtle species in the Project Area to determine their potential level of exposure to the underwater sounds generated during various noise-producing construction activities associated with the development of the Project. The modeled sound exposure level received by each individual animat over the duration of the construction activity and the peak sound pressure level were used to calculate the potential for that animat to have experienced PTS and TTS using the acoustic thresholds for sea turtles. If an animat was not predicted to experience PTS or TTS, then the sound energy received by each individual animat over the 24-hr modeled period was used to assess the potential risk of biologically significant behavioral reactions. These modeled exposure estimates were then normalized by the ratio of real-world density estimates to the modeled animat density for each modeled sea turtle species to obtain final exposure estimates. This results in the predicted number of exposures or takes for each marine mammal species or species group for each type of noise-producing construction activity, such as pile driving (Table 4.2-60 and Table 4.2-61).

Table 4.2-60. Estimates of Potential Exposures Resulting from Pile Driving (2024) Assuming 10 dB Sound Attenuation

Sea Turtle Species	Density Reference	Estimated Take	
		Injury (PTS)	Behavioral
Green	DoN NODES	24	114
Kemp's Ridley	DoN NODES	24	112
Leatherback	DoN NODES	1	5
Loggerhead	DoN NODES	56	267
	BARCO et al. (2018)	657	3,134

Sources: DON 2007, 2017; Barco et al. 2018

Table 4.2-61. Estimates of Potential Exposures Resulting from Pile Driving (2025) Assuming 10 dB Sound Attenuation

Sea Turtle Species	Density Reference	Estimated Take	
		Injury (PTS)	Behavioral
Green	DoN NODES	22	101
Kemp's Ridley	DoN NODES	20	91
Leatherback	DoN NODES	1	3
Loggerhead	DoN NODES	48	227
	BARCO et al. (2018)	557	2,630

Sources: DON 2007, 2017; Barco et al. 2018

Density estimates extracted for the buffered lease area were used to predict exposures assuming 10 dB of sound reduction due to the use of sound mitigation measured (Table 4.2-62). The buffered Lease Area includes the Lease Area and a perimeter buffer equal to the maximum distance to the Level B isopleth, which represents the furthest extent where potential behavioral impacts from construction noise can be expected for marine mammals or sea turtles. Two sources of sea turtle densities represent the best available at-sea density data for sea turtles: DoN (2007) and Barco et al. (2018). The DoN (2007) density estimates were prepared for the Navy's U.S. Atlantic operating areas (OPAREA), which include the Project Area. The Navy OPAREA Density Estimates (NODE) (DoN 2007) are also grid-cell based. The Navy derived optimal grid cell sizes for each species based on segment length of the underlying survey data; the NODE grid cell size for the loggerhead turtle densities is 10 km^2 while the grid cell size for all other turtle species (including the hard-shelled guild) is 20 km^2 (DoN, 2007). More recent loggerhead turtle density estimates for the Project Area are available in Barco et al. (2018). These more recent loggerhead densities presented in Barco et al. (2018) are much higher than the older DoN (2007) estimates for the loggerhead turtle. Additionally, Barco et al. (2018) included a seasonal availability correction factor. Instead of selecting one of these loggerhead density estimates to apply to the animat modeled output, both the DoN (2007) and Barco et al. (2018) density estimates for the loggerhead turtle have been included (Table 4.2-62). Although green turtles may occur seasonally in the Project Area, no at-sea density estimates are available for this more rarely occurring species. Since available occurrence data for the green turtle were included in the "Hardshelled Guild" in the DoN (2007) density dataset, the seasonal density estimates from this guild were used as surrogate densities for the green turtle. The U.S. Navy set the precedent for using the hard-shelled guild's density estimates to represent the green turtle (DoN, 2018). The DoN (2007) NODE hard-shelled guild density estimate for the green turtle represents the best available data for this species in the Project Area.

Table 4.2-62. Sea Turtle Species Commonly Occurring in the Project Area and their Associated Seasonal Density Estimates

Sea Turtle Species	Mean Density (animals/km^2)		
	Spring (May)	Summer (June to August)	Fall (September to October)
	Buffered Lease Area	Buffered Lease Area	Buffered Lease Area
Green turtle (*Chelonia mydas*) a/	0.04584	0.06558	0.04584
Kemp's ridley turtle (*Lepidochelys kempii*)	0.05472	0.05472	0.05472

Sea Turtle Species	Mean Density (animals/km^2)		
	Spring (May)	Summer (June to August)	Fall (September to October)
	Buffered Lease Area	Buffered Lease Area	Buffered Lease Area
Leatherback turtle (*Dermochelys coriacea*)	0.00301	0.00137	0.00301
Loggerhead turtle (*Caretta caretta*) b/	0.12118	0.14142	0.12118
Loggerhead turtle (*Caretta caretta*) c/	2.51400	1.38500	1.28900

Notes:
a/ Population data were insufficient to determine an individual species density estimate for the green turtle in the NODE dataset (DON 2007). However, the available data for the green turtle were included in the Hard-shelled Guild density estimate. Thus, the Hard-shelled Turtle Guild density estimate was used a surrogate density for the green turtle.
b/ DON 2007
c/ Barco et al. 2018

Dominion Energy would also ensure continued engagement with regulatory agencies regarding potential best practices. In general, the dominant source of underwater noise in the ocean at low frequencies is vessel noise, which ranges from 20 to 200 Hz (Hildebrand 2009). Vessel noise is typically in the range of 140 dB (re µPA^2/hz at 1 m) for small fishing vessels and 195 dB for fast-moving (i.e., above 20 knots) tankers, although individual ships have different noise signatures (NRC 2003). This range would be audible to sea turtles but lies within the typical range of ambient underwater acoustic noise; natural physical processes, including wind and wave energy, also produce noise in this frequency range. Therefore, sea turtles would be expected to experience minimal impacts from vessel-traffic noise. Vessel-traffic noise may elicit sea turtle behavioral changes including diving, changing swimming speed, or changing direction, although these behavioral changes are expected to be temporary.

Short-term increase in vessel traffic and risk of ship strike. Vessel traffic within and along transit routes to and from the Study Area would increase with the added presence of Project-related construction and support vessels. This would increase the risk of physical disturbances and vessel strikes to sea turtles, which may cause injury or mortality.

Sea turtles appear to respond less strongly to fast-moving vessels (5.9 knots or greater) than to slow-moving vessels (2.2. knots) (Hazel et al. 2009). Sea turtles can likely detect approaching vessels both by sight and sound, but individuals may not be capable of avoiding all collisions, particularly those with faster-moving vessels. Stranding data frequently document vessel collisions as a source of mortality in Virginia (Barco and Lockhart 2016; Swingle et al. 2016, 2017, 2018; Costidis et al. 2019). These collisions typically occur in shallow coastal and inshore waters, where densities of fast-moving vessels are greater.

The most commonly occurring and susceptible species in the Study Area are loggerhead and Kemp's ridley sea turtles. Adults occurring offshore would be susceptible to vessel strike if collocated with transiting vessels. Juveniles occurring nearshore for foraging or resting purposes would be susceptible to vessel strike given their smaller size, which increases the difficulty in detecting them. Additionally, Kemp's ridley sea turtles are particularly susceptible to cold-stunning, during which time they may experience restricted diving capabilities that would increase their susceptibility to vessel strike (Hochscheid et al. 2010). Dominion Energy's proposed measures to avoid, minimize, and mitigate vessel collisions with marine mammals (Section 4.2.5, Marine Mammals) may also indirectly provide limited additional protection for sea turtles.

Short-term change in water quality, including oil spills. Temporary increases in turbidity and sedimentation would result from construction activities in the Study Area. Section 4.1.2, Water Quality, and Appendix J, Sediment Transport Analysis, discuss potential impacts to water quality resulting from Project construction. The introduction of contaminants, including the potential for oil and fuel spills by Project-related vessels or grout used to seal monopiles to transition pieces, may also impact water quality. Jet trenching has the potential to release chemicals by resuspending sediments, although this is primarily of concern near densely populated and industrialized coasts. Study Area sediments have not been subjected to any known oil spills or industrial releases and are assumed uncontaminated.

Currents and winds carry oil across a variety of habitats utilized by sea turtles in the period following an offshore oil spill. Sea turtles break the surface regularly during their normal breathing cycles and subsequently would be exposed intermittently to floating oil slicks, potentially resulting in ingestion and physiological damage. Turtles may also swim through oil drifting throughout the pelagic zone or resuspend it from seafloor sediments while foraging for food. Females exposed to hydrocarbon compounds may pass them to their developing young, and laid eggs may further absorb oil found in the sands of the nest. Finally, nesting turtles and their hatchlings may crawl through overlying oil on contaminated beaches. Any oil spill in the Study Area would have an impact on sea turtles present.

Dominion Energy has developed an Oil Spill Response Plan (Appendix Q) detailing all proposed measures to avoid accidental spills and a protocol to be implemented should such an event occur. Additional information may be found in Section 4.4.12, Public Health and Safety. All Project-related vessels would operate in accordance with regulations pertaining to at-sea discharge of vessel-generated waste.

Operations and Maintenance

During O&M, the potential impact-producing factors to sea turtle species may include presence of new permanent structures (i.e., WTG Monopile and Offshore Substation Jacket Foundations, additional underwater cable protection such as concrete mattresses) and presence of new buried Offshore Export Cables. Dominion Energy proposes to implement measures, as appropriate, to avoid, minimize, and mitigate impacts during Project O&M. The following O&M-induced impacts may occur as a consequence of the factors identified above:

- Modification of habitat;
- Project-related electromagnetic fields (EMF);
- Project-related lighting;
- Project-related marine debris;
- Project-related underwater noise;
- Project-related vessel traffic and increased risk for ship strike; and
- Changes in water quality, including oil spills.

Modification of habitat. The maximum design scenario involves up to 202 WTGs, three Offshore Substations, Offshore Export Cable Routes, scour protection, and Inter-Array Cables. WTG Monopile and

Offshore Substation Jacket Foundation and scour protection installation would necessarily convert some softbottom benthic habitat to hardbottom habitat. Long-term impacts to sea turtle habitat are not anticipated as eelgrasses and other submerged aquatic vegetation are not present in the Study Area. Limited reductions in softbottom habitat may reduce available infaunal/epifaunal forage species; however, the associated introduction of hardbottom habitat would create a "reef effect" that would increase the availability of new forage species assemblages. Secondary habitat would emerge from encrusting and attaching organisms colonizing the novel structures, thereby increasing biodiversity and attracting mobile fishes and invertebrates (Causon and Gill 2018). This increase in biodiversity may include jellyfish and algae that would directly serve as forage species for sea turtles. Furthermore, hard substrates may offer shelter for sea turtles and potentially serve as cleaning structures for flippers and carapaces (Causon and Gill 2018).

Project-related EMF. EMF would be introduced to the Study Area from the alternating currents within subsea cables (see Section 3, Description of Proposed Activity, and Appendix AA, Offshore Electric and Magnetic Field Assessment for additional information). Little research exists regarding sea turtle sensitivity to EMF, although sea turtles are known to possess geomagnetic (but not electromagnetic) sensitivity used for orientation, navigation, and migration (Normandeau Associates, Inc. 2011). On the surface of the earth, magnetic field lines intersect at a specific and predictable angle of inclination. Sea turtles are capable of detecting both the inclination angle and field intensity of these lines and use this information to maintain a heading or assess their position relative to a specific geographic destination (Lohmann and Lohmann 1996, Lohmann et al. 1999). Loggerheads have exhibited magneto sensitivity and behavioral responses to field intensities ranging from 0.0047 to 4,000 micro-Tesla (µT), while green turtles have exhibited similar responses to intensities of 29.3 to 200 µT (Normandeau Associates, Inc. 2011).

Sea turtles would likely be capable of sensing the EMF emitted from Project-related subsea cables. Changes in inclination angle and field intensity may cause individuals to deviate from their original path of movement (Lohmann and Lohmann 1996, Lohmann et al. 1999). However, sea turtles are not entirely dependent on magnetic cues for navigation and may potentially use olfactory and visual cues to compensate for any magnetic variations caused by Project-related EMF (Normandeau Associates, Inc. 2011). Therefore, potential EMF-induced impacts are not expected to result in population-level changes or substantial changes to individual behavior, growth, survival, or reproductive success. In addition, the subsea cables introduced by the Project would emit relatively low-intensity EMF. Dominion Energy has identified areas where sufficient cable burial is achievable, further buffering the pelagic environment from cable EMF, and cable protection would serve as an alternative barrier where sufficient cable burial is not feasible.

Project-related lighting. Deck and safety lighting would be necessary for O&M and support vessels stationed within or transiting to and from the Study Area. WTGs and Offshore Substations would also require lighting. Such lighting would have a small radius of impact and would not intentionally illuminate surrounding waters. Therefore, operational lighting is not expected to negatively impact sea turtles. Dominion Energy would consult appropriate regulatory agencies regarding operational lighting requirements.

Project-related marine debris. Marine debris may accidentally be introduced into the marine environment via operational activities. Such debris may entangle or be accidentally ingested by sea turtles, causing injury or mortality. The release of marine debris would not be anticipated as Dominion Energy would require all offshore personnel to implement appropriate practices and protocols to avoid and minimize the release of marine debris.

Project-related underwater noise. Operational activities may cause a slight increase in the ambient underwater noise in the Study Area (see Appendix Z, Underwater Acoustic Assessment). No impacts to sea turtles would be anticipated from Project O&M activities as offshore wind areas typically produce noise levels well below the injurious thresholds established by NOAA Fisheries. In fact, measurements of operational noise at existing wind farms have proven difficult to distinguish from ambient noise (Cheesman 2016). Sea turtle behavioral responses, such as diving, increased swimming speeds, or changes in direction, have not been noted in response to noise levels below 166–175 dB re 1 µPa root mean square (McCauley et al. 2000, Navy 2017). Underwater noise from full WTG rotational operations would not approach these levels to any appreciable distance.

Vessel traffic associated with operational activities includes transportation of supplies and maintenance crews. Project-related supply and crew vessels transiting to and from the Study Area would not increase the ambient noise levels above existing vessel traffic in the area. Nearshore Project-related vessel activity would be concentrated in industrial port areas and established shipping channels and would therefore be consistent with the existing acoustic environment. Any associated changes in sea turtle behaviors would not be uniquely attributable to Project O&M activities.

Project-related vessel traffic and increased risk for ship strike. Project-related vessel traffic would not be greater than ambient traffic conditions (see Section 4.4.7, Marine Transportation and Navigation, and Appendix S, Navigation Safety Risk Assessment). Sea turtles in surface waters within the Study Area would be susceptible to physical disturbance or vessel strike, which may cause injury or mortality. Anticipated annual vessel activity during O&M activities is further described in Section 3, Description of Proposed Activity. Dominion Energy has developed a Construction Mitigation and Monitoring Plan (CMMP), submitted to BOEM and NOAA Fisheries on December 8, 2022, with information on the following measures to be implemented as appropriate to avoid, minimize, and mitigate potential vessel-related impacts:

- Vessel speed restrictions while transiting to and from the review area, as defined in Dominion Energy's CMMP; and
- Vessel collision avoidance measures for vessels working in or transiting to and from the Study Area, including a 164 ft (50 m) separation distance from all sea turtle species.

Changes in water quality, including oil spills. Increases in turbidity and sedimentation may result from routine maintenance activities in the Study Area. Such activities may yield impacts to water quality, as discussed in Section 4.1.2, Water Quality, and Appendix J, Sediment Transport Analysis. Increases in turbidity, suspended sediments, and associated contaminant releases would be transient and fall within natural background levels, and sea turtles would not be exposed to conditions exceeding their natural environment. Dominion Energy has developed an Oil Spill Response Plan (Appendix Q) that details all measures proposed to avoid an inadvertent spill of vessel oil or fuel and a protocol to be implemented should such an event occur. Additional information may be found in the Oil Spill Response Plan (Appendix Q).

Dominion Energy would implement the following measures as appropriate to avoid, minimize, and mitigate potential impacts to water quality:

- Vessel operation in accordance with regulations pertaining to at-sea discharges of vessel-generated waste; and
- Development and enforcement of an Oil Spill Response Plan (Appendix Q).

Decommissioning

Impacts resulting from decommissioning of the Project are expected to be similar to or less than those experienced during construction. Decommissioning techniques are further expected to advance during the lifetime of the Project. A full decommissioning plan will be provided to the appropriate regulatory agencies for approval prior to decommissioning activities, and potential impacts will be re-evaluated at that time.

4.2.6.3 Summary of Avoidance, Minimization, and Mitigation Measures

Dominion Energy proposes to implement the following measures to avoid, minimize, and mitigate the potential impact-producing factors described (Table 4.2-63). In addition, Dominion Energy will implement all avoidance, minimization, and mitigation measures included in the NOAA Fisheries-approved Letter of Authorization and CMMP for the Project. Dominion Energy will continue discussions and engagement with the appropriate regulatory agencies and environmental non-governmental organizations throughout the life of the Project to develop an adaptive mitigation approach that provides the most flexible and protective mitigation measures.

Table 4.2-63. Summary of Avoidance, Minimization, and Mitigation Measures

Project Stage	Location	Impact	Avoidance, Minimization, and Mitigation
Construction; Decommissioning	Offshore Project Area	Short-term disturbance of habitat Short-term loss of local prey species Short-term increase in construction-related lighting Short-term accidental release of marine debris Short-term increase in risk of equipment interaction Short-term increase in underwater noise Short-term increase in risk of ship strikes due to the increase in vessel traffic Short-term change in water quality, including potential oil spills	• Dominion Energy has sited the Offshore Export Cable Route Corridor to avoid sensitive benthic habitats to the extent practical (including submerged aquatic vegetation) to minimize impacts to sea turtles, particularly juveniles; • Dominion Energy would require all offshore personnel and vessel contractors to implement appropriate debris control practices and protocols to prevent the accidental release of marine debris. All Project-related vessels would operate in accordance with regulations pertaining to at-sea discharge of vessel-generated waste; • 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, and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. • Dominion Energy would ensure sampling gear is 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.

Project Stage	Location	Impact	Avoidance, Minimization, and Mitigation
			• Dominion Energy would implement the following measures as appropriate to avoid, minimize, and mitigate potential impacts of construction-related underwater noise: o Implement monitoring and exclusion zones where pile-driven foundations are installed, enforced by qualified NOAA Fisheries-approved Protected Species Observers; o Implement real-time monitoring systems; o Employ soft starts and shut-down procedures where technically feasible; o Employ soft starts for a duration of 30 minutes at the onset of pile-driving activities; o Use reduced visibility monitoring tools/technologies (e.g., night vision, infrared, and/or thermal cameras); o Use commercially and technically available noise-reducing technologies; o Provide sea turtle sighting and reporting procedures for appropriate Project-related personnel specific to construction and its potential impacts to sea turtles; • 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. • Vessels deploying fixed gear (e.g., pots/traps) would have adequate disentanglement equipment (i.e., knife and boathook) onboard, and would implement if feasible; • The NOAA Fisheries Greater Atlantic Regional Fisheries Office (GARFO) would be notified as soon as possible of all observed takes of sea turtles occurring as a result of any fisheries survey. Specifically, GARFO would be notified within 24 hours of any interaction with a sea turtle (nmfs.gar.incidental-take@noaa.gov); • Dominion Energy would ensure continued engagement with regulatory agencies regarding potential best practices; • Dominion Energy has developed a Construction Mitigation and Monitoring Plan (CMMP) with detailed protocols regarding Protected Species Observer (PSO) coverage and vessel speed restrictions to reduce potential negative impacts from Project-related vessel traffic, HRG surveys, or other construction activities; • Dominion Energy has developed an Oil Spill Response Plan (Appendix Q), detailing all proposed measures to avoid accidental spills and a protocol to be implemented should such an event occur. Additional information may be found in Section 4.4.12, Public Health and Safety. All Project-related vessels would operate in accordance with regulations pertaining to at-sea discharge of vessel-generated waste; and

Project Stage	Location	Impact	Avoidance, Minimization, and Mitigation
			• Dominion Energy would provide a full decommissioning plan to the appropriate regulatory agencies for approval prior to decommissioning activities, and potential impacts will be re-evaluated at that time.
Operations and Maintenance	Offshore Project Area	Modification of habitat Project-related electromagnetic fields (EMF) Project-related lighting Project-related marine debris Project-related underwater noise Project-related vessel traffic and increased risk for ship strike Changes in water quality, including oil spills	• Dominion Energy has identified areas where sufficient cable burial is achievable, further buffering the pelagic environment from cable EMF, and cable protection would serve as an alternative barrier where sufficient cable burial is not feasible; • Dominion Energy would consult appropriate regulatory agencies regarding operational lighting requirements; • Dominion Energy would require all offshore personnel to implement appropriate practices and protocols to avoid and minimize the accidental release of marine debris; • 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, and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. • Dominion Energy has developed a CMMP with detailed protocols regarding PSO coverage and vessel speed restrictions to reduce potential negative impacts from Project-related operations and maintenance vessel traffic. • Dominion Energy has developed an Oil Spill Response Plan (Appendix Q) that details all measures proposed to avoid an inadvertent spill of vessel oil or fuel and a protocol to be implemented should such an event occur; and • Project-related vessels will operate in accordance with laws regulating at-sea discharges of vessel-generated waste.