Atlantic Shores Offshore Wind South Biological Assessment

For the United States Fish and Wildlife Service

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

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ABBREVIATIONS AND ACRONYMS

Acronym	Definition
ACE	Atlantic City Electric
ACJV	Atlantic Coast Joint Venture
AIS	Automatic Identification System
AMSL	above mean sea level
APM	Applicant-Proposed Measure
Atlantic County	Atlantic Landfall in Atlantic City
BA	Biological Assessment
BMPs	best management practices
BOEM	Bureau of Ocean Energy Management
COP	Construction and Operations Plan
CVOW	Coastal Virginia Offshore Wind
DAS	distributed acoustic sensing
DOI	U.S. Department of Interior
DP	dynamic positioning
DTS	distributed temperature system
EA	Environmental Assessment
ECC	Export Cable Corridor
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FLiDARs	floating light and detection ranging buoys
FONSI	Finding of No Significant Impact
GIS	geographic information system
GPS	Global Positioning System
HDD	horizontal directional drilling
HDPE	high density polyethylene
HLV	heavy lift vessel
HVAC	high-voltage alternating current
HVDC	high-voltage direct current
IpaC	Information for Planning and Conservation
IPF	impact-producing factor
JCP&L	Jersey Central Power & Light
kV	kilovolt
$L_{Aeq,1m}$	decibels equivalent continuous sound pressure level
Lease Area	Lease Area OCS-A 0499
m/s	meters per second;
MDAT	Marine-life Data and Analysis Team
MW	megawatt

Acronym	Definition
NEPA	National Environmental Policy Act
NGTC	National Guard Training Center
NJ WEA	New Jersey Wind Energy Area
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
O&M	Operations and Maintenance
OCS	Outer Continental Shelf
OLPD	online partial discharge
OSS	offshore substation
PBR	Potential Biological Removal
PDE	Project Design Envelope
Project	Atlantic Shores Offshore Wind South Project
PVC	polyvinyl chloride
RAL	radar-activated light
ROW	rights-of-way
rpm	revolutions per minute
RSZ	rotor-swept zone
SAP	Site Assessment Plan
SCADA	supervisory control and data acquisition
SCRAM	Stochastic Collision Risk Assessment for Movement
SPS	Significant Peripheral Structures
SWPPP	Stormwater Pollution Prevention Plan
USACE	United States Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UXO	unexploded ordnance
WNS	white-nose syndrome
WTA	Wind Turbine Area
WTG	wind turbine generator

1. INTRODUCTION

Pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, the Bureau of Ocean Energy Management (BOEM) requests informal consultation with the United States Fish and Wildlife Service (USFWS) regarding species that may be affected by the approval of a Construction and Operations Plan (COP) for the Atlantic Shores Offshore Wind South Project (Project). The Project being developed by Atlantic Shores Offshore Wind, LLC (Atlantic Shores) is located within Lease Area OCS-A 0499 (Lease Area) in the New Jersey Wind Energy Area (NJ WEA) on the Outer Continental Shelf (OCS) (Figure 1-1), approximately 8.7 miles (14 kilometers) from the New Jersey shoreline. The Project consists of two projects (Project 1 and Project 2) and would be located in an approximately 102,124-acre (41,328-hectare) Wind Turbine Area (WTA)[1] (Figure 1-1). Project 1 would be in the western 54,175 acres (21,924 hectares) of the WTA, and Project 2 in the eastern 31,847 acres (12,888 hectares). The Project includes a 16,102-acre (6,516-hectare) Overlap Area that could be used by either Project 1 or Project 2.

As detailed in the COP (Atlantic Shores 2023), the Project would include up to 200 wind turbine generators (WTGs) (between 105 and 136 WTGs for Project 1, and between 64 and 95 WTGs for Project 2), up to 10 offshore substations (OSSs) (with up to 5 in each of the two Projects), up to 1 permanent meteorological (met) tower (in Project 1), and up to 4 temporary meteorological and oceanographic (metocean) buoys (up to 3 metocean buoys in Project 1 and up to 1 metocean buoy in Project 2), interarray and interlink cables connecting WTGs and OSSs within the WTA, up to 2 onshore substations or converter stations, one Operations and Maintenance (O&M) facility, and up to 8 transmission cables making landfall at up to two New Jersey locations. The proposed landfall locations are the Atlantic Landfall in Atlantic City (Atlantic County), with an onshore route to the existing Point of Interconnection (POI) at the existing Cardiff Substation, and the Monmouth Landfall in Sea Girt (Monmouth County) with an onshore route to the existing POI at the existing Larrabee Substation. Project 1 would have a capacity of 1,510 megawatts (MWs); the capacity for Project 2 is not yet determined. While Project 1 and Project 2 would be electrically distinct from each other, the Project Design Envelope (PDE)[2] maintains the flexibility to utilize one or both transmission solutions for Project 1 and Project 2 (e.g., co-location of export cables). The spatial extent of these Project components is defined for the purposes of this assessment as the *Project area*.

This Biological Assessment (BA) evaluates the potential effects of the proposed Project (including Project 1 and Project 2 as defined above) on ESA-listed species under the jurisdiction of the USFWS that would occur or potentially occur within the Project area if BOEM were to approve the COP. ESA-listed species under the jurisdiction of the National Marine Fisheries Service (NMFS) are being evaluated in a separate BA. The species under the jurisdiction of the USFWS occur primarily onshore; however, several ESA-listed bird and bat species may occur within the offshore portion of the Project area. This BA describes the proposed Project (Section 2), defines the Action Area (Section 3), describes the potentially affected ESA-listed species

[1] Under the proposed Project, the WTA is where the proposed offshore wind farm will be located. The geographic extent is consistent with the Lease Area boundary.

[2] The PDE concept allows Atlantic Shores to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as WTGs, foundations, submarine cables, and OSSs.

under USFWS jurisdiction (Section 4), and provides an analysis and determination of how the proposed Project may affect ESA-listed species or their habitats and details proposed avoidance, minimization, and mitigation measures (Section 5). Effect determinations are provided in Section 6.

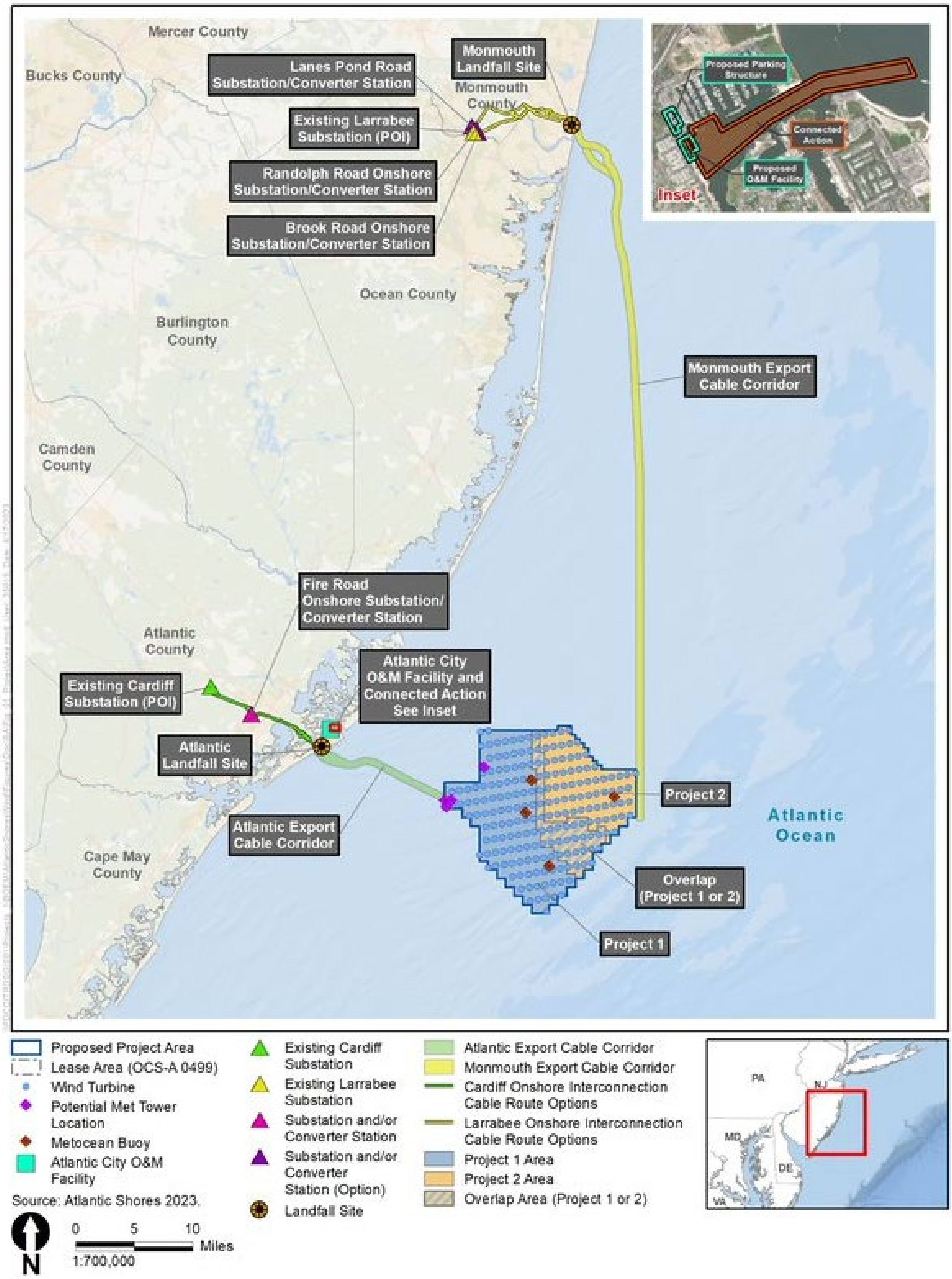


Figure 1-1 Atlantic Shores Offshore Wind South Project Location

1.1. BACKGROUND

In 2009, the U.S. Department of Interior (DOI) announced final regulations for the OCS Renewable Energy Program, which was authorized by the Energy Policy Act of 2005. The Energy Policy Act provisions implemented by BOEM provide a framework for issuing renewable energy leases, easements, and rights-of-way (ROW) for OCS activities. BOEM's renewable energy program comprises four distinct phases: (1) regional planning and analysis, (2) lease issuance, (3) site assessment, and (4) construction and operations. The location of the NJ WEA was identified by BOEM through a multi-year effort by state and federal regulatory agencies to identify OCS areas suitable for offshore renewable energy development in the Mid-Atlantic. The original Area of Interest considered by BOEM for leasing was reduced in size and aliquots were removed to address potential environmental constraints, user group conflicts, navigational safety, public health and safety, and stakeholder concerns (e.g., commercial fishing). The history of BOEM's planning and leasing activities offshore New Jersey is summarized below:

- On April 20, 2011, BOEM published in the *Federal Register* (86 FR 60283) a Call for Information and Nominations for Commercial Leasing for Wind Power on the OCS Offshore New Jersey in the Federal Register (Call). The public comment period for the Call closed on June 6, 2011. In response, BOEM received 11 commercial indications of interest. After analyzing Automatic Identification System (AIS) data and holding discussions with stakeholders, BOEM removed OCS Blocks Wilmington NJ18– 02 Block 6740 and Block 6790 (A through K, M, and N) and Block 6840 (A) to alleviate navigational safety concerns resulting from vessel transits out of New York Harbor.
- On February 3, 2012, BOEM published in the *Federal Register* (77 FR 5560) a Notice of Availability of a final Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia.
- On July 21, 2014, BOEM published in the *Federal Register* (79 FR 42361) a Proposed Sale Notice requesting public comments on the proposal to auction two leases offshore New Jersey for commercial wind energy development.
- On September 25, 2015, BOEM published in the *Federal Register* (80 FR 57862) a Final Sale Notice, which allowed a commercial lease sale to be held.
- On November 9, 2015, a commercial lease sale was held for the WEA offshore New Jersey. The NJ WEA was auctioned as two leases. RES America Developments, Inc. was the winner of Lease Area OCS-A 0498 and US Wind, Inc. was the winner of lease OCS-A 0499.
- On March 17, 2016, BOEM received a request to extend the preliminary term for commercial lease OCS-A 0499, from March 1, 2017, to March 1, 2018. BOEM approved the request on June 10, 2016.
- On January 29, 2018, BOEM received a second request to extend the preliminary term for commercial lease OCS-A 0499, from March 1, 2018, to March 1, 2019. BOEM approved the request on February 14, 2018.

- On November 16, 2018, BOEM received an application from US Wind Inc. to assign 100 percent of commercial lease OCS-A 0499 to EDF Renewables Development, Inc. BOEM approved the assignment on December 4, 2018.
- On April 29, 2019, BOEM received an application from EDF Renewables Development, Inc. to assign 100 percent of commercial lease OCS-A 0499 to Atlantic Shores Offshore Wind, LLC. BOEM approved the assignment on August 13, 2019.
- On March 25, 2021, Atlantic Shores submitted its COP for the construction and installation, operations and maintenance, and conceptual decommissioning of the Project within the Lease Area. Updates to the COP, supporting appendices, and geographic information system (GIS) data were submitted on August 25, 2021; September 24, 2021; October 20, 2021; December 17, 20, and 22, 2021; January 17, 18, and 31, 2022; March 9, and 28, 2022; April 29, 2022; August 4, 19, and 26, 2022; September 1, 2022; October 13, and 17, 2022; November 14, and 23, 2022; December 12, 21, and 30, 2022; and January 10, 18, and 20, 2023, February 2, 6, 10, 13, and 25, 2023; and March 7, 10, 14, 16, and 31, 2023; and April 6, 13 and 14, 2023.
- On April 8, 2021, BOEM approved the Site Assessment Plan (SAP) for Lease OCS-A 0499 (Atlantic Shores Offshore Wind, LLC). The SAP approval allowed for the installation of two floating light and detection ranging buoys (FLiDARs).
- On September 28, 2021, BOEM received an application from Atlantic Shores Offshore Wind, LLC to assign 100 percent interest in the southern portion of OCS-A 0499 (which contains the Project 1 and Project 2 areas) to Atlantic Shores Offshore Wind Project 1, LLC and Atlantic Shores Offshore Wind Project 2, LLC, respectively, with each entity having a 50 percent interest.
- On September 30, 2021, BOEM published a Notice of Intent (NOI) to Prepare an Environmental Impact Statement (EIS) for the Atlantic Shores Offshore Wind South Project offshore New Jersey.
- On April 19, 2022, the northern portion of OCS-A 0499 was retained by Atlantic Shores Offshore Wind, LLC and given a new lease number (OCS-A 0549) by BOEM, while the southern portion retains the original lease number assigned by BOEM: OCS-A 0499.

1.2. CONSULTATION HISTORY

This informal consultation for the Project builds upon BOEM's experience with similar offshore wind development projects in the Atlantic Ocean.

- BOEM was also involved in consultation with USFWS regarding the construction, O&M, and decommissioning of offshore wind turbines for the Cape Wind Energy Project in federal waters of Nantucket Sound, Massachusetts. The USFWS Biological Opinion (dated November 21, 2008) concluded that the proposed Cape Wind Energy Project was not likely to jeopardize the continued existence of the piping plover (*Charadrius melodus*) and roseate tern (*Sterna dougallii dougallii*) and that, in all cases except collisions, the effects were insignificant or discountable and would not result in take (mortality) of roseate terns and piping plovers (USFWS 2008).
- On March 24, 2011, BOEM requested informal ESA Section 7 consultation with USFWS for lease issuance and site assessment activities off New Jersey, Delaware, Maryland, and

Virginia. On June 20, 2011, USFWS concurred with BOEM's determinations that the risk to the endangered roseate , threatened piping plover , endangered Bermuda petrel (*Pterodroma cahow*), and candidate *rufa* red knot (*Calidris canutus rufa*) regarding lease issuance, associated site characterization (survey work), and site assessment activities (construction, O&M, and decommission of buoys and meteorological towers) was "small and insignificant" and therefore not likely to adversely affect the three ESA-listed species and one candidate species.

- On October 19, 2012, BOEM requested informal ESA Section 7 consultation with USFWS for lease issuance and site assessment activities off Rhode Island and Massachusetts. On November 1, 2012, USFWS concurred with BOEM's determination that the proposed action is not likely to adversely affect the roseate tern, piping plover, and *rufa* red knot. To evaluate collision risk, USFWS recommended the placement of visibility sensors on the meteorological towers to collect data on the occurrence, frequency, and duration of poor visibility conditions.
- BOEM was a cooperating agency with the United States Army Corps of Engineers (USACE), which informally consulted with USFWS on the Deepwater Wind Block Island Wind Facility and Block Island Transmission System. The Block Island Wind Facility is composed of five 6-MW wind turbines within 3 miles (4.8 kilometers) of Block Island, Rhode Island. On July 31, 2013, USFWS concurred that the proposed Block Island Transmission System and Block Island Wind Facility were not likely to adversely affect the American burying beetle (*Nicrophorus americanus;* formerly endangered, re-classified as threatened in 2020), roseate tern, piping plover, or *rufa* red knot "due to insignificant (should never reach the scale where take occurs) and discountable (extremely unlikely to occur) effects."
- On February 12, 2014, BOEM requested informal ESA Section 7 consultation with USFWS for lease issuance and site assessment activities offshore North Carolina, South Carolina, and Georgia. On March 17, 2014, USFWS concurred with BOEM's determination that commercial wind lease issuance and site assessment activities would not likely adversely affect the Bermuda petrel, Kirtland's warbler (*Setophaga kirtlandii;* formerly endangered and de-listed in 2019), roseate tern, piping lover, and *rufa* red knot.
- BOEM was the lead agency and informally consulted with USFWS on the Virginia Offshore Wind Technology Advancement Project. The project is composed of two 6-MW wind turbines 24 nautical miles (44 kilometers) offshore with a subsea export cable making landfall on Camp Pendleton Beach. On January 29, 2015, USFWS concurred with the determinations of "no effect" on endangered hawksbill (*Eretmochelys imbricata)* and endangered leatherback (*Dermochelys coriacea*) sea turtles and "not likely to adversely affect" the threatened green sea turtle (*Chelonia midas*), endangered Kemp's Ridley sea turtle (*Lepidochelys kempii*), threatened loggerhead sea turtle (*Caretta caretta*), piping plover, red knot, roseate tern, Bermuda petrel, and endangered black-capped petrel (*Pterodroma hasitata*). On March 27, 2019, USFWS completed its review of the revised plan and found that no impacts on federally listed species or designated critical habitat will occur.
- On September 3, 2020, BOEM requested informal consultation from USFWS regarding the approval of the Vineyard Wind Offshore Energy Project COP for the construction, O&M, and decommissioning of a commercial-scale offshore wind energy facility within a BOEM

Renewable Energy Lease Area (OCS-A 0501) 14 miles (23 kilometers) southeast of Martha's Vineyard, Massachusetts. On October 16, 2020, USFWS concurred with BOEM's determination that the project would "not likely adversely affect" the roseate tern, piping plover, and *rufa* red knot.

- On January 28, 2021, BOEM requested informal consultation from USFWS regarding the approval of the South Fork Offshore Wind COP for the construction, O&M, and decommissioning of a commercial-scale offshore wind energy facility within a BOEM Renewable Energy Lease Area (OCS-A 0486) 19 miles (31 kilometers) southeast of Block Island, Rhode Island, and 35 miles (56 kilometers) east of Montauk Point, New York. On March 14, 2021, USFWS concurred with BOEM's determination that the project would "not likely adversely affect" the roseate tern, piping plover, *rufa* red knot, seabeach amaranth (*Amaranthus pumilus*), and northern long-eared bat (*Myotis septentrionalis*).
- On August 10, 2021, BOEM requested informal consultation with USFWS for lease and grant issuance and site assessment activities on the Atlantic OCS of the New York Bight. On March 15, 2021, USFWS concurred with BOEM's determination that commercial wind lease issuance and site assessment activities would "not likely adversely affect" the Bermuda petrel, roseate tern, piping plover, and *rufa* red knot.
- On May 27, 2022, BOEM requested informal consultation from USFWS regarding the approval of the Ocean Wind 1 COP for the construction, O&M, and decommissioning of a commercial-scale offshore wind energy facility within a BOEM Renewable Energy Lease Area (OCS-A 0498). BOEM has determined that the Proposed Action would have no effect on the bog turtle (*Clemmys muhlenbergii*) or American chaffseed (*Schwalbea americana*). BOEM respectfully requests your acknowledgment of the "no effect" determination for these two federally listed species. BOEM has also determined that the Proposed Action may affect, but is not likely to adversely affect. the northern long-eared bat, tri-colored bat (*Perimyotis subflavus*), piping plover, *rufa* red knot, roseate tern, eastern black rail (*Laterallus jamaicensis* ssp. *Jamaicensis*), saltmarsh sparrow (*Ammospiza caudacuta*), monarch butterfly (*Danaus plexippus*), Knieskern's beaked-rush (*Rhynchospora knieskernii*), seabeach amaranth, sensitive joint-vetch (*Aeschynomene virginica*), and swamp pink (*Helonias bullata*).

2. DESCRIPTION OF PROPOSED ACTION

The Proposed Action would include the construction, installation, operations and maintenance, and decommissioning of the offshore and onshore components of two wind energy facilities (Project 1, capacity up to 1,510 MW; Project 2, capacity to be determined). Atlantic Shores has a goal of 1,327 MW for Project 2 due to plans to sign an interconnection service agreement (not an offtake award) with regional transmission organization, PJM. The proposed Project is being developed and permitted using the PDE approach (BOEM 2018a), allowing flexibility in project elements as the offshore wind industry and associated technological solutions evolve, while ensuring a timely and thorough environmental review. The key onshore and offshore components of the PDE are summarized in Table 2-1 (Atlantic Shores 2023. The COP provides a further description of the Proposed Action and discussion of construction methods and schedule, which this document summarizes (Atlantic Shores 2023).

Table 2-1 Project Components of the PDE

Element	PDE	Total	Differentiation Between PDEs	
			Project 1	Project 2
WTGs	Maximum number of WTGs	200 (inclusive of the 31 WTGs in the Overlap Area)[1]	105–136	64–95
	WTG layout	Grid layout with east-northeast/west-southwest rows and approximately north/south columns, consistent with the predominant flow of traffic	--	--
	Maximum rotor diameter	918.6 feet (280.0 meters)	--	--
	Maximum tip height[2]	1,046.6 feet (319 meters)	--	--
OSSs	Maximum number of OSSs	10 small OSSs, or	5	5
		5 medium OSSs, or	2	3
		4 large OSSs	2	2
	OSS layout	Positioned along the same east-northeast/west-southwest rows as WTGs	--	--
	Minimum distance from shore	Small OSS: 12 miles (19.3 kilometers)	--	--
		Medium and large OSS: 13.5 miles (21.7 kilometers)	--	--
WTG and OSS Foundations	Foundation types			
	Piled	Monopiles or piled jackets	--	--
	Suction bucket	Suction bucket jackets	--	--
	Gravity	Gravity-base structures	--	--
	Maximum pile diameter at seabed (for	Monopile: 49.2 feet (15.0 meters)	--	--

	piled foundation types)	Piled jacket: 16.4 feet (5.0 meters)	--	--
Interarray and Interlink Cables	Cable types and voltage	Interarray: 66–150 kV HVAC	--	--
		Interlink: 66–275 kV HVAC	--	--
	Maximum total cable length	Interarray: 547 miles (880 kilometers)	273.5 miles (440 kilometers)	273.5 miles (440 kilometers)
		Interlink: 37 miles (60 kilometers)	18.6 miles (30 kilometers)	18.6 miles (30 kilometers)
	Target burial depth range	5 to 6.6 feet (1.5 to 2 meters)	--	--
Export Cables	Cable types and voltage	230–275 kV HVAC cables and/or 320–525 kV HVDC cables	--	--
	Number of ECCs	2: Atlantic ECC and Monmouth ECC	--	--
	Maximum number of cables	8 total: HVAC and/or HVDC export cables	--	--
	Maximum total cable length	Atlantic Landfall Site to OSSs: 99.4 miles (160.0 kilometers)	--	--
		Monmouth Landfall Site to OSSs: 341.8 miles (550.0 kilometers)	--	--
	Target burial depth range	5 to 6.6 feet (1.5 to 2 meters)	--	--
Met Towers Metocean Buoys	Maximum number of met towers	Total: 1 (permanent)	1	0
	Maximum number of metocean buoys	Total: 4 (temporary, during construction)	3	1
Landfall Sites	Number of landfall sites	2: Atlantic Landfall Site and	--	--
		Monmouth Landfall Site	--	--
	Installation method	HDD	--	--
Onshore Facilities	Number of onshore interconnection cable routes	2: Cardiff Onshore Interconnection Cable Route	--	--
		Larrabee Onshore Interconnection Cable Route	--	--
	Approximate route length	9.8 to 23.0 miles (15.8 to 37.0 kilometers) each	--	--
	Onshore interconnection cable types and voltage	230–275 kV HVAC cables installed in underground duct bank	--	--
		or 320–525 kV HVDC	--	--

		cables installed in underground duct bank		
	Number of onshore substations or converter stations[3]	Total: two (one per POI), Project 1 has one potential sites; Project 2 has up to three potential sites	--	--
	Points of Interconnection (POI)	Cardiff POI	--	--
		Larrabee POI	--	--
O&M Facility	Location	New O&M facility proposed in Atlantic City, New Jersey	--	--

Source: Atlantic Shores 2023
[1] The number of WTGs in Project 1, Project 2, and the associated Overlap Area would not exceed 200 WTG locations. For example, if Project 1 includes 105 WTGs (the minimum) then the Overlap Area would be incorporated into Project 2, which would include the remaining 95 WTGs; and conversely if the Overlap Area is incorporated into Project 1 such that it includes 136 WTGs, then Project 2 would be limited to 64 WTGs. Each Project may also use only part of the Overlap Area.
[2] All elevations are provided relative to Mean Lower Low Water (MLLW).
[3] Converter station would only be required if HVDC transmission is utilized.
ECC = export cable corridor; HDD = horizontal directional drilling; HVAC = high-voltage alternating current; HVDC = high-voltage direct current; kV = kilovolt; O&M = operations and maintenance; OSS = offshore substation; PDE = Project Design Envelope; POI = Point of Interconnection; WTG = wind turbine generator.

2.1. CONSTRUCTION AND INSTALLATION

The Proposed Action would include the construction and installation of both onshore and offshore facilities. Construction and installation are expected to begin in 2024 and be completed by 2027, pending securing all necessary permits. An estimated Project schedule is included in COP Volume I, Chapter 4, Table 4.1-1 (Atlantic Shores 2023) and is provided in Table 2-2.

Table 2-2 Estimated Construction Schedule

Construction Activity	Duration[1]	Expected Time Frame[2]	Project 1 Start Date	Project 2 Start Date
Onshore Interconnection Cable Installation	9–12 months	2024–2025	Q1 – 2024	Q1 – 2024
Onshore Substation and/or Converter Station Construction	18–24 months	2024–2026	Q1 - 2025	Q1 – 2025
Export Cable Installation	6–9 months	2025	Q2 – 2025	Q3 – 2025
OSS Installation and Commissioning	5–7 months	2025–2027	Q2 – 2026	Q2 – 2026
WTG Foundation Installation[3]	10 months	2026–2027	Q1 – 2026	Q1 – 2026[3]
Interarray Cable Installation	14 months	2026–2027	Q2 – 2026	Q3 – 2026[4]
WTG Installation and Commissioning	17 months	2026–2027	Q2 – 2026	Q1 – 2027[4]

Source: Atlantic Shores 2023
[1] These durations assume continuous foundation installation without consideration for seasonal pauses or weather delays; anticipated seasonal pauses are reflected in the expected timeframe.
[2] The expected timeframe is indicative of the most probable duration for each activity; the timeframe could shift and/or extend depending on the start of fabrication, and the selected fabrication and installation methods.
[3] The expected timeframe depends on the foundation type. If piled foundations are utilized, pile driving would follow a proposed schedule from May to December to minimize risk to North Atlantic right whale. No simultaneous pile driving is proposed.
[4] The expected timeframe is dependent on the completion of the preceding Project 1 activities (i.e., Project 1 interarray cable installation and WTG installation) and the Project 2 foundation installation schedule.

OSS = offshore substation; WTG = wind turbine generator

2.1.1 ONSHORE ACTIVITIES AND FACILITIES

Proposed onshore elements of the Proposed Action include the landfall sites for the submarine export cables, underground onshore export cable route(s), onshore substations/converter stations, interconnection cables linking the onshore substations/converter stations to the POIs to the existing grid, and an O&M facility. Draft EIS, Appendix C, *Project Design Envelope and Maximum-Case Scenario*, describes the PDE (BOEM 2023) for onshore activities and facilities, and COP Volume 1, Section 4.0 provides details on construction and installation methods (Atlantic Shores 2023).

The Atlantic Landfall Site for the submarine Atlantic Export Cable Corridor (ECC), would be located in Atlantic City, New Jersey, on a site currently consisting of a paved public parking lot (Figure 2-1). The proposed landfall site is located at the eastern terminus of South California Avenue adjacent to the Atlantic City Boardwalk. The site is bounded by Pacific, South Belmont, and South California Avenues and is owned by Atlantic Shores. The landfall site would include underground transition vaults associated with the Atlantic export cables (one vault per cable export). An offset would be instituted around an existing outfall pipe at the proposed location. This landfall crosses beneath the Absecon Island Coastal Storm Risk Management Federal Civil Works Project. Atlantic Shores would coordinate all planned activities with USACE and the New Jersey Department of Environmental Protection (NJDEP), Office of Coastal Engineering.

The landfall would be connected to the approximate 12- to 14-mile (19.3- to 22.5-kilometer) Cardiff Onshore Interconnection Cable Route that would continue northwest under inland waterways and urban residential, commercial, and industrial areas to the location for the onshore substation and/or converter station and terminate at the Cardiff Substation POI, owned by Atlantic City Electric (ACE) (Figures 2-2, 2-3, 2-4, and 2-5). The onshore substation and/or converter station site, shown on Figure 2-2, is a vacant lot located in Egg Harbor Township. It is approximately 20 acres (8 hectares) in size and bordered by Fire Road (County Road 651) to the north and Hingston Avenue to the south (Fire Road Onshore Substation/Converter Station).

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

For the purposes of this BA, the proposed siting of the Atlantic City Landfall and the associated Cardiff Onshore Interconnection Cable Route to the Cardiff Substation POI is referred as "Atlantic City Landfall to Cardiff POI."

The Monmouth Landfall Site for the submarine Monmouth ECC would be located in Sea Girt, New Jersey, at the U.S. Army National Guard Training Center (NGTC), as seen on Figure 2-6. The underground transition vaults (one per export cable) would be located in the southeast corner of the NGTC property in a previously disturbed area. This area currently serves as a staging and access location for a federal beach nourishment project, and, as such, Atlantic Shores would coordinate all planned activities at this location with USACE and NJDEP, Office of Coastal Engineering. The landfall would be connected to the approximately 12-mile (19.3-kilometer) Larrabee Onshore Interconnection Cable Route, which would continue west to one of three potential sites for the Larrabee Substation and/or Converter Station (Lanes Pond Road, Brook Road or Randolph Road) and terminate at the Larrabee Substation POI owned by Jersey Central Power & Light (JCP&L) (Figure 2-6).

As shown on Figure 2-6, from the Monmouth Landfall Site, the Larrabee Onshore Interconnection Cable Route exits the northeastern corner of the NGTC property and extends west, utilizing Sea Girt Avenue, Camp Drive, Crescent Place, and/or 8th Avenue to the intersection of Sea Girt Avenue and North Main Street. The route then continues west either along Sea Girt Avenue, recreational bike paths, Bailey's Corner Road, Tilton's Corner Road, Atlantic Avenue, Lakewood-Allenwood Road, and/or Hospital Road. Route options then continue west along Easy Street, Lakewood-Farmingdale Road, Lakewood-Allenwood Road, and Randolph Road. Routing options for the three onshore substation and/or converter station sites under consideration include Miller Road, Lanes Pond Road from Randolph Road, and Lakewood Farmingdale Road, The PDE includes all proposed onshore substation and/or converter station and cable route options, which will be analyzed collectively as part of the Proposed Action.

For the purposes of this BA, the proposed siting of the Monmouth County Landfall and the associated Larrabee Onshore Interconnection Cable Route to the Larrabee Substation POI is referred as "Monmouth County Landfall to Larrabee POI."

Figure 2-1 Atlantic City Landfall to Cardiff POI

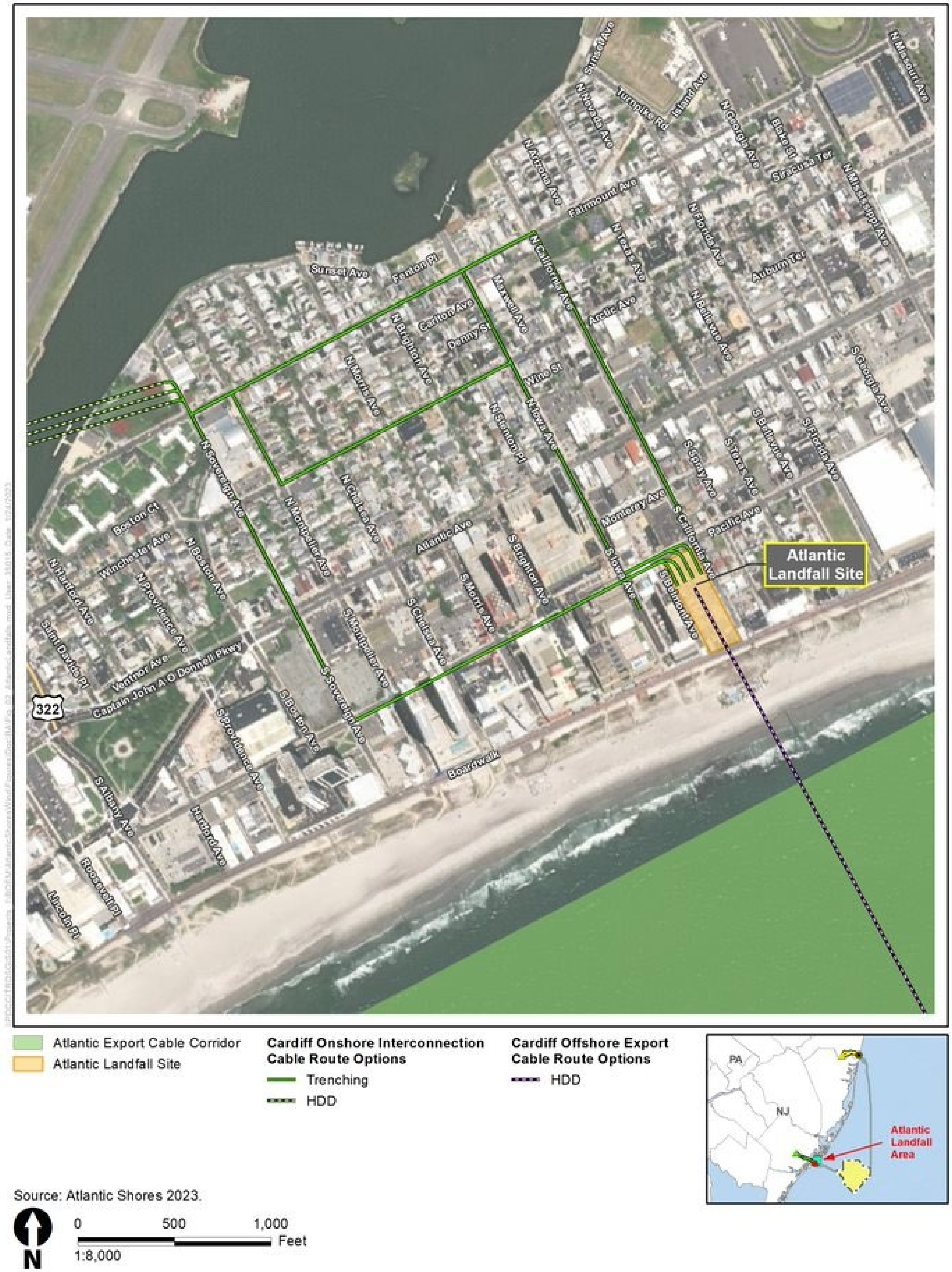


Figure 2-2 Atlantic City Landfall

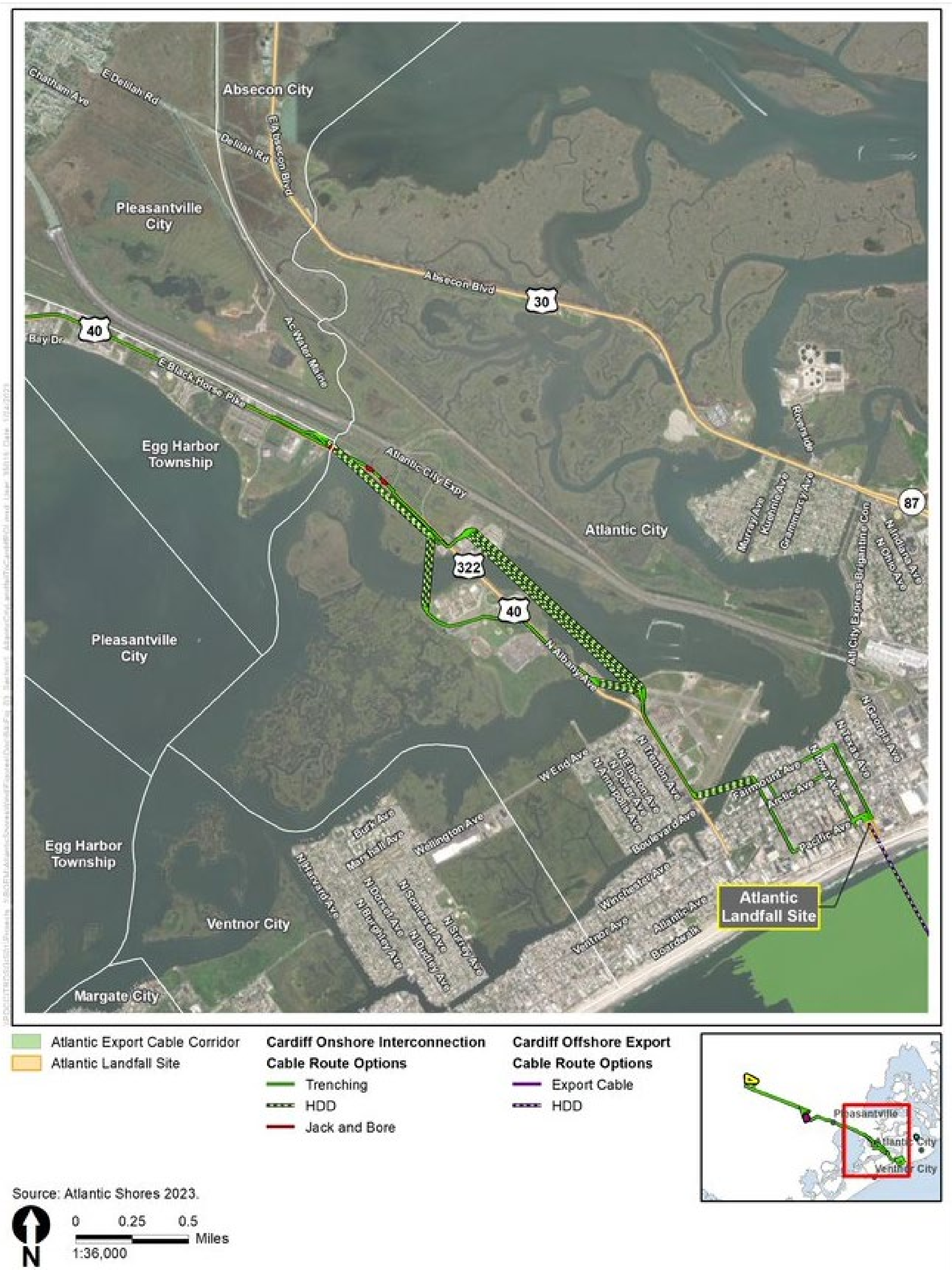


Figure 2-3 Section 1 of Atlantic City Landfall to Cardiff POI

Figure 2-4 Section 2 of the Atlantic City Landfall to Cardiff POI

Figure 2-5 Section 3 Atlantic City Landfall to Cardiff POI

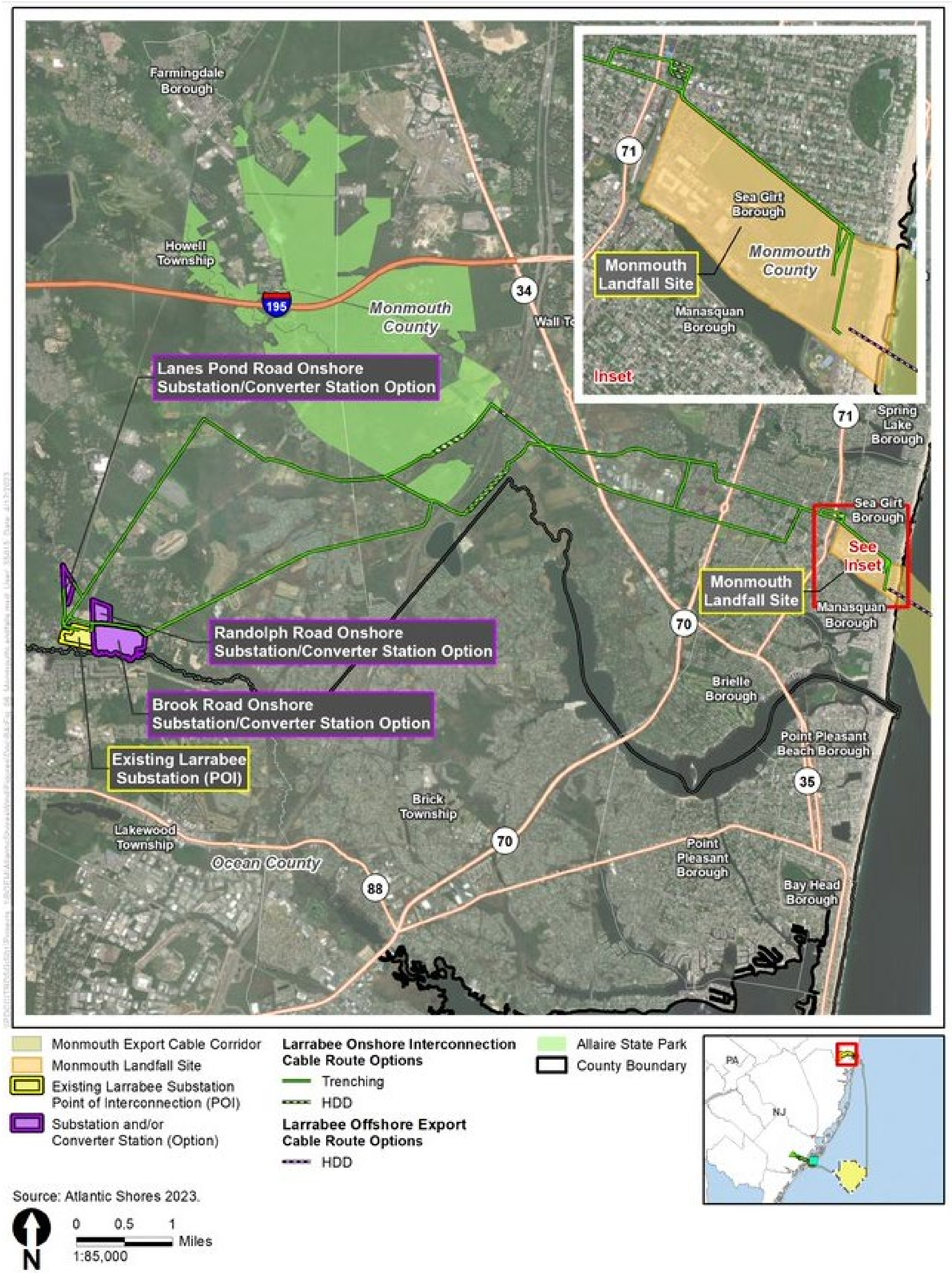


Figure 2-6 Monmouth County Landfall to Larrabee POI

The onshore interconnection cables would be contained within buried concrete duct banks. Onshore interconnection cables typically require splices every 1,640 to 3,280 feet (500 to 1,000 meters). At each splice location, a concrete splice vault is installed. Typical dimensions of a splice vault are up to 8 feet (2.5 meters) wide, 26 feet (8 meters) long, and 5 feet (1.5 meters) deep. The installation of the duct banks and encased cables within the cable routes would be completed via open trenching except in areas where resources are present and need to be avoided. During typical installation of the onshore interconnection cable duct banks or splice vaults, the associated trench is up to 15 feet (4.5 meters) wide and 12 feet (3.5 meters) deep. These dimensions are required to meet minimum standards for safe installation of the duct bank while maintaining a required 3- to 6-foot (0.9- to 1.8-meter) depth of cover over the top of the duct bank. Where dual duct banks are used, there needs to be a minimum separation of 5 feet (1.5 meters) between the duct banks. Both the Cardiff and Larrabee onshore interconnection cable routes include several wetland and waterway crossings. Atlantic Shores has indicated techniques such as horizontal directional drilling (HDD), pipe jacking, and/or jack-and-bore methodologies would be utilized to avoid direct surface disturbance at these locations. These following describes these specialty techniques:

- **Horizontal directional drilling:** HDD is typically used to cross beneath relatively wide features such as interstate highways and waterbodies. In the context of the offshore-to-onshore transition, HDD commonly involves drilling a hole in an arc under the surface feature, then enlarging that hole and pulling either a large polyvinyl chloride (PVC) or high-density polyethylene (HDPE) casing or several smaller PVC or HDPE conduits (in a bundle) back through the bore hole. Onshore, each HDD alignment would originate or terminate in an excavated pit that is approximately 10 by 13 feet (3 by 4 meters), located landward of the beach and dune at the landfall site's onshore staging area. At the offshore HDD entrance/exit location, a shallow area of up to approximately 66 by 33 feet (20 by 10 meters) would be excavated. All HDD activities would be managed by an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid to ensure the protection of marine and inland surface waters from an accidental release of drilling fluid. Additionally, all drilling fluids would be collected and recycled upon HDD completion.
- **Pipe jacking:** In this method, a casing pipe originating in a jacking shaft is driven through the soil by powerful hydraulic jacks to excavate a tunnel that leads to a receiving shaft on the opposite side of the obstacle being avoided on the surface. This method results in a flexible, structural, watertight, and finished conduit for the installation of cables.
- **Jack-and-bore:** This trenchless crossing technique is used to install a casing beneath the surface feature being avoided. Relative to HDD, jack-and-bore is typically used for shorter crossings (less than approximately 200 feet [61 meters]), such as those under streams or highways. A jack-and-bore is performed by excavating a bore pit and a receiving pit, located on opposite sides of the obstacle. Drilling and jacking activities are initiated from the bore pit, while the steel or concrete casing is driven into the receiving pit. As a borehole is drilled, the casing is pushed into the borehole. After the casing is in place, it is cleaned, and then smaller HDPE or PVC conduits are installed inside the casing.

HDD will be used for the crossings of Chelsea Harbor, Great Thorofare, and Beach Thorofare to avoid impacts to any submerged aquatic vegetation (SAV) that may be present. For the Cardiff POI, the onshore substation and/or converter station site is located at a vacant commercial center situated on a wooded lot along U.S. Route 40 in Egg Harbor Township (see Figure 2-7). This site is referred to as the "Fire Road Substation or Converter Station" (Figure 2-8). For the Larrabee POI, the following onshore substation and/or converter station sites are within the PDE:

- Brook Road Site: A vacant wooded site located directly east of the Larrabee POI.;
- Randolph Road Site: A developed site located north and across Randolph Road from the Larrabee POI[2];
- Lanes Bond Road Site: A partially cleared and forested site located northwest of the Larrabee POI.

None of the potential onshore substation and/or converter station sites for interconnection at either Cardiff or Larrabee are within a designated floodplain or other flood hazard area or contain wetland resources. The sites are all zoned for commercial and/or industrial uses. Modifications to the Cardiff and Larrabee POIs would be required to accommodate the interconnection of the Atlantic Shores South Project. The modifications at the Cardiff POI may range from expanding the existing substation by adding additional breaker bay(s) to upgrading the existing high voltage section of the substation to a breaker and a half configuration. ACE would be responsible for the design and construction of the required upgrades on the existing electrical grid, including the upgrades at Cardiff Substation POI. The modifications at the Larrabee POI are expected to include upgrading the existing substation by adding an additional breaker bay(s). JCP&L would be responsible for the design and construction of the required upgrades on the existing electrical grid, including the upgrades to the Larrabee Substation POI.

[2] The Brook Road Site is expected to be prepared and developed as part of the State of New Jersey's State Agreement Approach (SAA) to support multiple offshore wind generation projects that the State will procure in the future. New Jersey's "Third Offshore Wind Solicitation" (https://www.nj.gov/bpu/pdf/boardorders/2023/20230306/8D%20ORDER%20OSW%20Third%20Solicitation.pdf) requires bidders to utilize the State's transmission provider and their infrastructure (to be developed by Mid-Atlantic Offshore Development [MAOD]) in their bids. If Atlantic Shores receives the award on behalf of the Atlantic Shores South Project, Atlantic Shores will route to MAOD's prepared site (the Brook Road Site). All siting, environmental review, permitting, and other preparation activities at the Brook Road Site are to be completed by MAOD (or then designated lead state or federal agency as appropriate) and are thereby not included in the environmental analysis of this Draft EIS. If Atlantic Shores does not receive the award to utilize the Brook Road Site, Atlantic Shores will utilize either the Lanes Pond Road Site or the Randolph Road Site. Additional details regarding this action can be found in Appendix D Planned Activities Scenario of the DEIS and is analyzed as a project in the cumulative impacts.

Figure 2-7 Proposed Location of Onshore Substation and/or Converter Station for Atlantic City Landfall to Cardiff POI

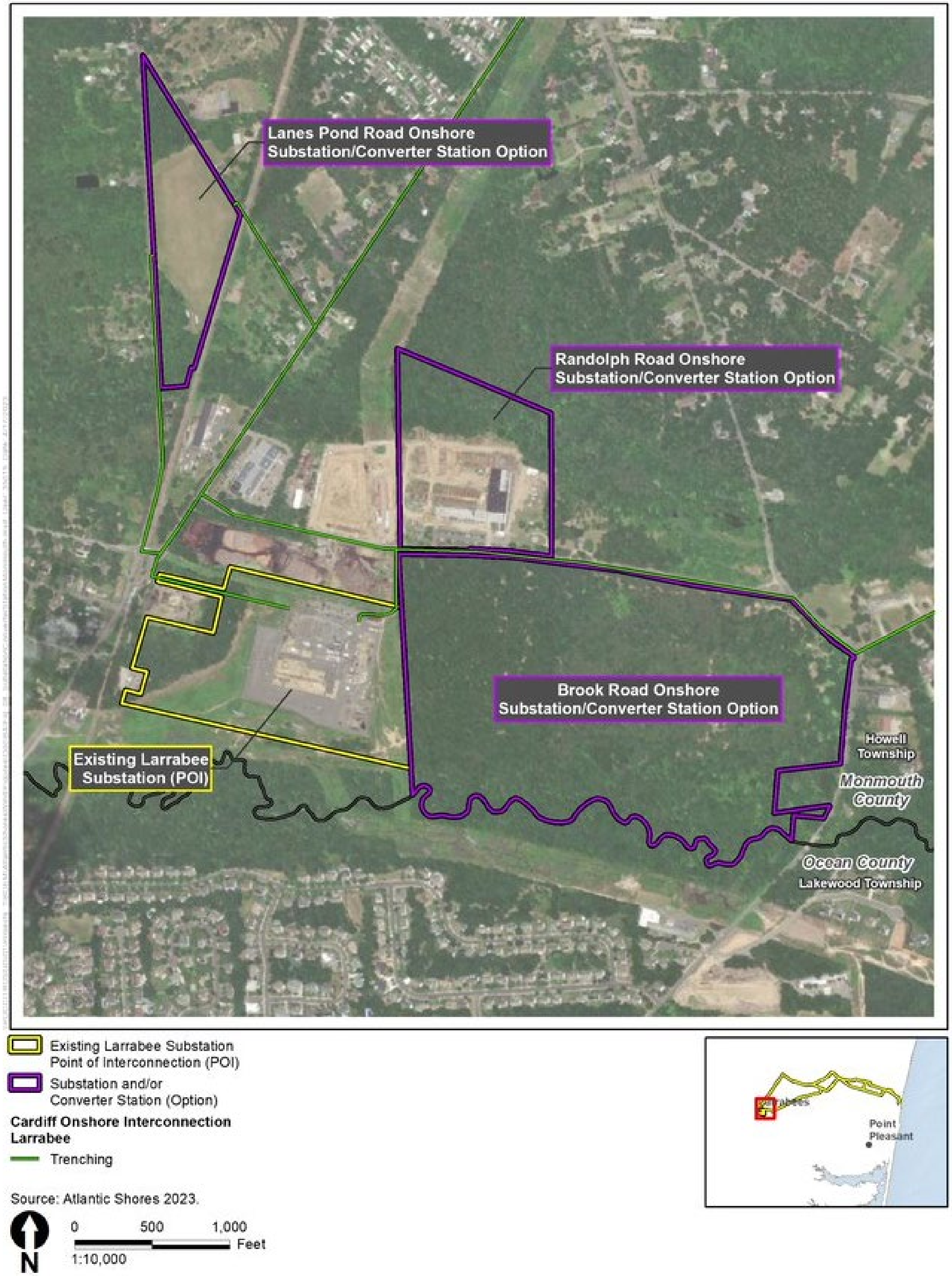


Figure 2-8 Proposed Location of Onshore Substation and/or Converter Station for Monmouth

County Landfall to Larrabee POI

Atlantic Shores proposes to construct a new O&M facility on a shoreside parcel in Atlantic City, New Jersey, that was formerly used for vessel docking and other port activities (Figure 2-9). This facility would be used solely by Atlantic Shores as the primary location for O&M operations including the management of routine inspection and maintenance activities, marine coordination, dispatching of technicians, material storage, vehicle parking, and vessel docking. The O&M facility would include office space with a server/IT room, harbor area and quayside, warehouse space, a communication antenna with a height of up to 120 feet (36.6 meters), and an outdoor parking area with storage space. Construction of the O&M facility is expected to involve a new building and associated parking structure, and installation of new dock facilities, requiring coordination with Atlantic City's proposed bulkhead repair and maintenance dredging within Clam Creek and adjacent basins (Connected Action).

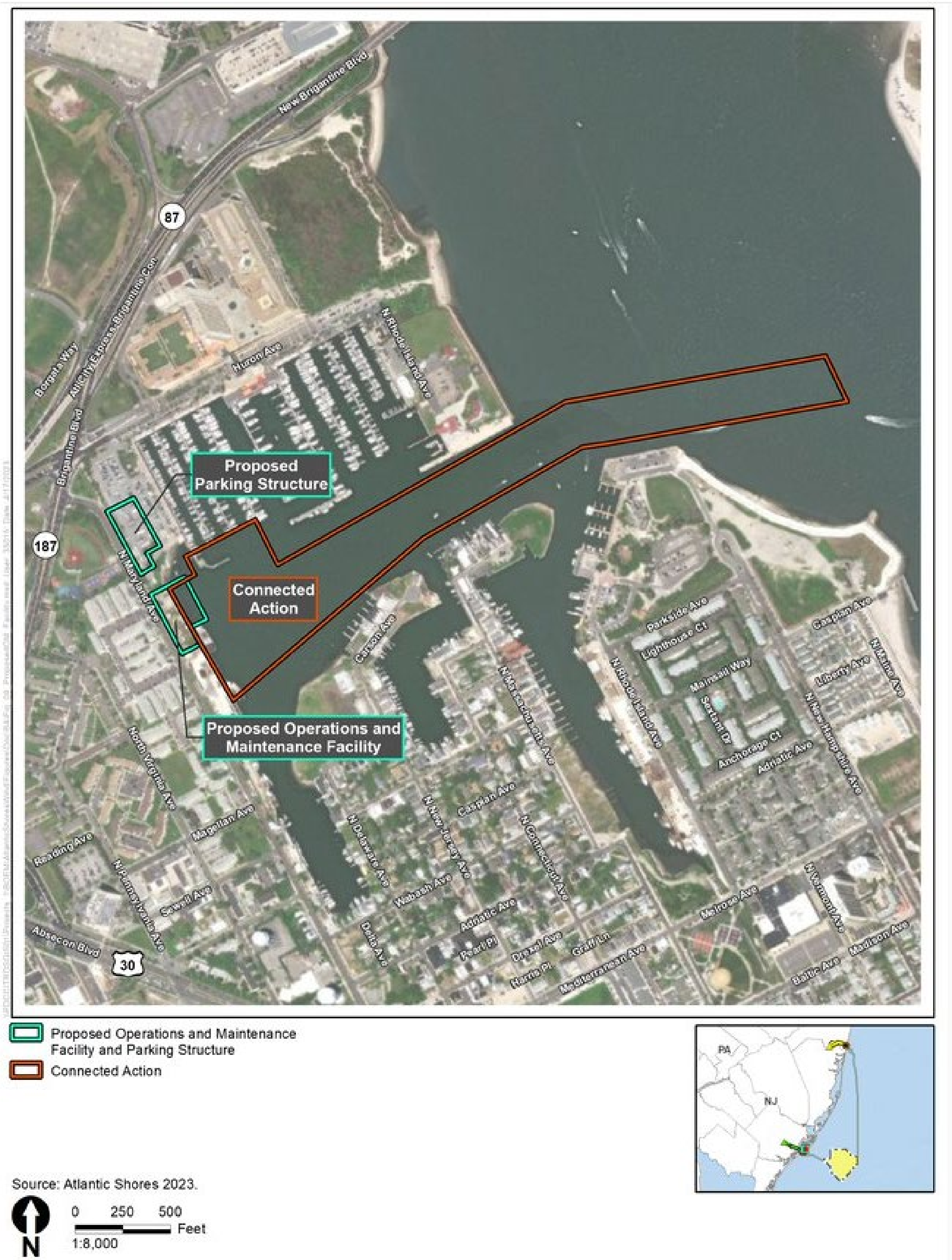


Figure 2-9 Proposed Location of O&M Facility

2.1.2 OFFSHORE ACTIVITIES AND FACILITIES

Proposed offshore components include WTGs and their foundations, OSSs and their foundations, scour protection for foundations and cables, interarray cables, and offshore export cables, a permanent met tower, and temporary metocean buoys. The proposed Offshore Project elements would be located on the OCS, except that a portion of the offshore export cables would be within state waters. COP Volume I, Section 4.0 provides additional details on construction and installation methods (Atlantic Shores 2023).

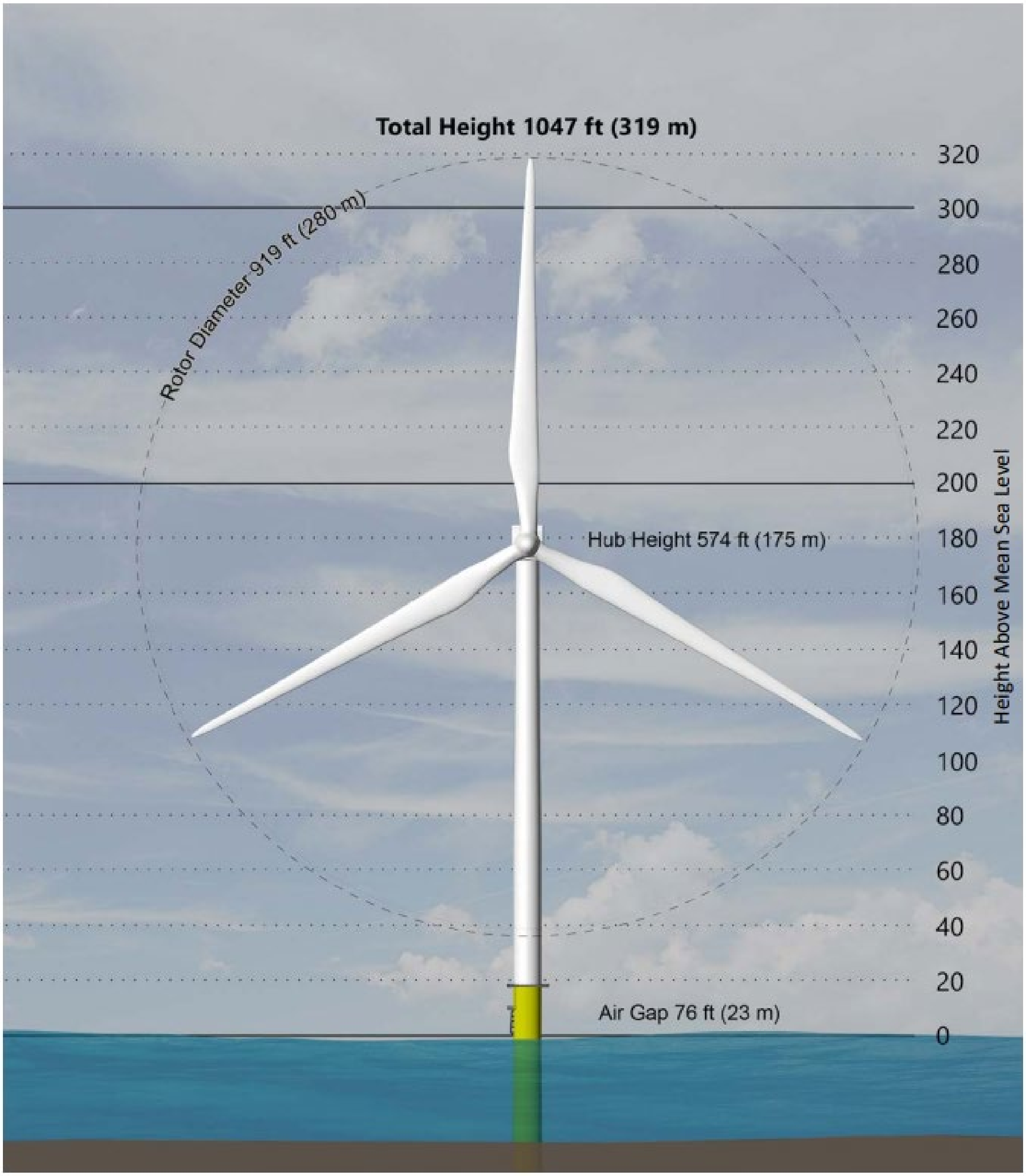
2.1.2.1. WTG and OSS Foundations

Atlantic Shores proposes the installation of a maximum of 200 WTGs (inclusive of the 31 WTGs in the Overlap Area); this would include a minimum of 105 WTGs to a maximum of 136 WTGs for Project 1 and a minimum of 64 WTGs to a maximum of 95 WTGs for Project 2, within the approximately 102,124-acre (41,328-hectare) WTA. The WTGs would extend to a height of up to approximately 1,046.6 feet (319.0 meters) above mean sea level (AMSL) with 0.6- by 1.0-nautical mile (1,100- by 1,852-meter) spacing. The WTG dimensions on Figure 2-10 are indicative of the maximum dimensions of WTGs anticipated to be commercially available within the Atlantic Shores South Project's expected development schedule. See COP Volume I, Section 4 (Atlantic Shores 2023) for a discussion of WTG design. Atlantic Shores would mount the WTGs on piled, suction-bucket, or gravity-based foundations. See COP Volume I, Section 4.2 (Atlantic Shores 2023) for more detailed descriptions and schematics of the foundation types and associated installation/construction methods. The WTG foundations would have a maximum seabed penetration of 262 feet (80 meters). Where required, scour protection would be placed around foundations to stabilize the seabed near the foundations, as well as the foundations themselves. The scour protection would be a maximum of 8.2 feet (2.5 meters) in height and would extend away from the foundation as far as 174 feet (53 meters). Each WTG would contain approximately 3,031 gallons (11,473 liters) of oils and lubricants and 400 gallons (1,514 liters) of diesel fuel. Other chemicals used would include coolants/refrigerants, grease, paints and varnishes, lead-acid batteries, solvents, and adhesives. COP Volume I, Section 7.0 provides additional details related to proposed chemicals and their anticipated volumes (Atlantic Shores 2023)

Offshore installation of WTGs would likely involve a jack-up WTG installation vessel assisted by feeder barges or jack-up feeder vessels., as well as other necessary support vessels (see COP Volume I, Section 4.10.1, Table 4.10-1; Atlantic Shores 2023). For monopile and piled-jacket foundations, once the installation vessel is in place, Atlantic Shores would begin pile driving until the target embedment depth is met. Should the pile reach a point of refusal, drilling out some of the sediment inside the pile may be required to reduce piling resistance and achieve the desired penetration depth. Installation of monopile or piled jacket foundations is similar, although piled jacket foundations would require more seabed preparation for each of the jacket feet. Scour protection, consisting of rock, rock bags, grout- or sand-filled bags, concrete mattresses, ballast-filled mattresses, or frond mattresses, would be placed around all types of foundations, where required.

Atlantic Shores would include one or more OSSs that serve as common collection points for power from the WTGs as well as the origin for the export cables that deliver power to shore. OSSs help stabilize and maximize the voltage of power generated offshore, reduce potential electrical losses, and transmit energy to shore. Power generated by the WTGs would be transmitted to the OSSs via 66 kilovolt (kV) to 150 kV interarray cables, which would connect to circuit breakers and transformers located within the OSS topsides. These transformers would increase the voltage level to the export cable voltage (230 kV to 525 kV). From the OSSs, the export cables would transmit electricity to shore. Atlantic Shores is considering three sizes of OSSs. Depending on the final OSS design, there would be up to 10 small OSSs, up to 5 medium OSSs, or up to 4 large OSSs combined for Project 1 and Project 2. OSSs would be located along the same east-northeast to west-southwest rows as the WTGs; small OSSs would be located at least 12 miles (19.3 kilometers) from shore, whereas medium and large OSSs would be located at least 13.5 miles (21.7 kilometers) from shore. Atlantic Shores is considering one of three categories of OSS foundations: piled, suction-buckets, or gravity-based foundations. The type of foundation would depend on the size of the OSS itself. Each OSS would consist of a topside structure with one or more decks on a foundation.

An OSS is generally installed in two phases: first, the foundation substructure would be installed as described above, and then the topside structure would be installed on the foundation structure. Pre-fabricated OSS topsides would be loaded onto a vessel to be transported to the WTA for installation. Once at the WTA, the OSS topsides are expected to be lifted from the transport vessel onto the OSS foundation using a crane on a jack-up vessel or heavy lift vessel (HLV) using either dynamic positioning (DP) or anchors. Alternatively, the OSS topsides may be pulled by tugboats and floated to the WTA, after which the topsides would be ballasted down over an installed OSS foundation, or jack-up legs integrated into the topside would lower to the seabed and raise the topside to its target elevation. More detailed information of OSS topside design and construction and OSS foundation design and installation can be found in COP Volume I, Section 4.4 (Atlantic Shores 2023).



Source: Draft EIS Chapter 2, Figure 2.1-5, BOEM 2023.

Figure 2-10 Maximum Wind Turbine Generator Dimensions

2.1.2.2. Lighting of Structures

The WTGs and OSSs would be lit and marked in accordance with Federal Aviation Administration (FAA) and U.S. Coast Guard (USCG) lighting standards and consistent with BOEM lighting guidelines (BOEM 2021a). Atlantic Shores would paint WTGs no lighter than radar-activated light (RAL) 9010 Pure White and no darker than RAL 7035 Light Grey. In addition, the lower sections of each structure would be marked with high-visibility yellow paint from the water line to an approximate height of at least 50 feet (15.2 meters), consistent with International Association of Marine Aids to Navigation and Lighthouse Authorities guidance. Each WTG and OSS foundation would have yellow flashing marine navigation lights that are visible in all directions. Each WTG would also contain aviation obstruction lights in accordance with FAA and BOEM guidance. The aviation obstruction lighting system on the WTGs would include red flashing lights on the nacelle and, if the WTG exceeds 699 feet (213.36 meters) in height, an additional level of flashing red lights located lower on the tower. These flashing red lights would be positioned so that they are visible by a pilot approaching from any direction. Atlantic Shores proposes to implement an Aircraft Detection Lighting System (ADLS) to automatically activate aviation obstruction lights when aircraft approach, which would greatly reduce the amount of time that the aviation obstruction lights are illuminated. If the height of the OSSs exceeds 200 feet (61 meters) AMSL or any obstruction standard contained in 14 CFR Part 77, the OSSs would include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements. Some outdoor OSS lighting (in addition to any required aviation or marine navigation lighting) would be necessary for maintenance that may occur at night. Atlantic Shores anticipates using controls to ensure that general outdoor OSS lighting would be illuminated only when the OSS is manned and will be downshielded to the extent practical.

2.1.2.3. Transmission Cables

Up to eight export cables would be installed to convey electricity from the OSSs to the landfall sites. The export cables from each Project have the potential to utilize either the Atlantic ECC or Monmouth ECC or be co-located in the same ECC. The Projects would each include high-voltage alternating current (HVAC) or high-voltage direct current (HVDC) export cables. If HVAC cables are used, the voltage would be between 230 kV and 275 kV; if HVDC cables are used, the voltage would be between 320 kV and 525 kV. Atlantic Shores proposes to construct separate submarine export cables for Project 1 and Project 2 within the submarine ECCs identified in the COP; however, they may be co-located. The approximately 12-mile (19-kilometer) Atlantic ECC would travel from the western tip of the WTA westward to the Atlantic Landfall site. The approximately 61-mile (98-kilometer) Monmouth ECC would travel from the eastern corner of the WTA along the eastern edge of the Lease Area to the Monmouth Landfall site. The width of each ECC would correspond to the width of the marine survey corridors and would range from approximately 3,300 to 4,200 feet (1,000 to 1,280 meters) for all of the Monmouth ECC and most of the Atlantic ECC, though the Atlantic ECC widens to approximately 5,900 feet (1,800 meters) near the Atlantic Landfall Site. The proposed width of each ECC accommodates the planned export cable options as well as the associated cable installation vessel activities and would allow for avoidance of resources such as shipwrecks, artificial reefs, and sensitive habitats. Variations in width at the landfall sites are needed to accommodate the construction vessel activities necessary to support the landfall of each export cable via HDD.

Both Project 1 and Project 2 would also include electrically distinct interarray cables to connect strings of WTGs to an OSS and may include interlink cables to connect OSSs to each other.

Most of the export, interarray, and interlink cables would be installed using jet trenching (either simultaneous lay and burial or post-lay burial or pre-lay trenching) or jet plowing, with limited areas of mechanical trenching. Atlantic Shores is carefully evaluating available cable installation tools to select techniques that are appropriate for the site and that would maximize the likelihood of achieving the target cable burial depth of 5 to 6.6 feet (1.5 to 2.0 meters). It is estimated that 80 to 90 percent of the offshore cables would be installed with a single pass of the cable installation tool. However, in limited areas expected to be more challenging for cable burial (along up to 10 to 20 percent of the export, interarray, and interlink cable routes), an additional one to three passes of the cable installation tool may be required to further lower the cable to its target burial depth.

Atlantic Shores is carefully evaluating available cable installation tools to select techniques that are appropriate for the site and that would maximize the likelihood of achieving the target cable burial depth of 5 to 6.6 feet (1.5 to 2.0 meters).

Cable protection may be necessary if sufficient burial depth cannot be achieved (e.g., due to sediment properties or a cable joint). Cable protection may also be required to support the crossing of existing marine infrastructure such as submarine cables or pipelines. While Atlantic Shores would work to minimize the amount of cable protection required, it is conservatively assumed that up to 10 percent of the export cables, interarray cables, and interlink cables may require cable protection where sufficient burial depth is not achieved. Atlantic Shores is considering the use of five types of cable protection: rock placement, concrete mattresses, rock bags, grout-filled bags, and half-shell pipes.

Prior to cable installation, survey campaigns would be completed including debris and boulder clearance, unexploded ordnance (UXO) clearance, pre-lay grapnel run, and pre-installation surveys to ensure the submarine export cable and burial equipment would not be affected by debris or other hazards during the burial process. Portions of the submarine export cable routes would be surveyed for UXO. In the event UXO are located during the surveys or construction, Atlantic Shores would implement a mitigation strategy to avoid UXO and the cable would be re-routed slightly within the surveyed corridor to avoid these features; therefore, detonation is not expected. A pre-grapnel run may be completed to remove seabed debris, such as abandoned fishing gear or wires, from the siting corridor. Additionally, pre-sweeping may be required in areas of the submarine export cable corridor with megaripples and sand waves. Dredged material generated from pre-sweeping activities may either be sidecast near the installation site or removed for reuse or proper disposal.

2.1.2.4. Construction Vessels

The construction and installation phase of the proposed Project would make use of both construction and support vessels to complete tasks in the Offshore Project area. Construction vessels would travel between the Offshore Project area and port facilities where equipment and materials would be staged. Atlantic Shores has identified 23 port facilities in New Jersey, New York, the Mid-Atlantic, and New England, and one on the U.S. Gulf Coast that may be used for major construction staging activities for the Project. Additionally, some components, materials, and vessels could originate from additional U.S. Gulf Coast ports or international ports.

2.1.2.5. Ports

Construction ports would be utilized for the following functions: crew transfers; component fabrication and assembly, receiving, and offloading of Project components; storing Project components; preparing Project components for installation; loading Project components onto installation vessels or other suitable vessels for delivery to the Offshore Project area for installation; and/or preparing vessels to tow floating components to the WTA. A list of U.S. ports considered for temporary use during major construction staging activities is provided in COP Volume I, Section 4.10.3, Table 4.10-2, Figure 4.10-1 (Atlantic Shores 2023); however, it is likely that only some of the ports identified would be utilized for the Project's construction. All port facilities being considered to support Project construction are located within industrial waterfront areas with existing marine industrial infrastructure or where such infrastructure is proposed for development within the required Project timeframe. Atlantic Shores would not implement any port improvements for the ports utilized for Project construction but may contribute financial support to a port's redevelopment as part of a multi-developer economic incentive package. Any port development would occur independent of the Project, including any permitting or approvals that the port facility owner/lessor may need to obtain.

Construction of the O&M facility would require localized dredging and bulkhead repair. A floating dock system is anticipated to be used to facilitate mooring of the O&M vessels. These upgrades would be the responsibility of Atlantic Shores and are outlined in greater detail in the application filing to USACE and NJDEP.

2.2. OPERATIONS AND MAINTENANCE

Once installed and commissioned, both Project 1 and Project 2 are designed to operate for up to 30 years. O&M activities would ensure that the Projects function safely and efficiently. To minimize equipment downtime and maximize energy generation, the Project would conduct O&M activities through scheduled, predictive, and remotely controlled activities.

The Project's facilities would operate autonomously without onsite attendance by technicians. The Project would be equipped with a supervisory control and data acquisition (SCADA) system, which would provide an interface between each Project's facilities and all environmental and condition monitoring sensors and would provide detailed performance and system information. The operator would monitor the status, production, and health of the Projects 24 hours a day from the proposed O&M facility in Atlantic City, New Jersey. Scheduled maintenance activities would be performed on a fixed, predetermined schedule (e.g., quarterly or annually) and may consist of preventative maintenance, remote monitoring, inspections, testing, and replacement of consumables. Unscheduled maintenance activities could occur at any time of the year and would be performed in response to an event that causes accidental damage or in response to a sensor alarm or fault indicating malfunction. These activities may include troubleshooting, inspections, and corrective maintenance.

2.2.1 ONSHORE ACTIVITIES AND FACILITIES

Regular maintenance activities at the onshore substations and/or converter stations would involve inspection of electrical systems such as transformers, switchgear, harmonic filters, reactive power equipment, revenue meters, protection and control systems, and auxiliary services would be inspected regularly, with preventative and corrective maintenance performed as required. Scheduled maintenance of the onshore interconnection cables would also be performed; any necessary maintenance would involve access through manholes and would be completed within the installed transmission infrastructure. Manlifts and small cranes may be used to work on elevated equipment. For larger pieces of equipment that require in-shop service or replacement, heavy duty construction equipment, such as cranes similar in size to those used during construction, may be used to aid in removal and replacement. Although unlikely, if a section of onshore interconnection cable fails where access is not feasible at manholes, cable pulling equipment would be needed. No tree clearing or work in wetlands, beaches, or dunes during O&M is anticipated, only the routine mowing of manicured areas and snow clearing as required. Atlantic Shores and BOEM would coordinate with USFWS should any non-routine clearing of trees (greater than 3 inches diameter at breast height) or work in wetlands, beaches, or dunes be required during O&M.

2.2.2 OFFSHORE ACTIVITIES AND FACILITIES

Scheduled maintenance of WTGs would include regularly scheduled inspections and routine maintenance of mechanical and electrical components. Annual maintenance activities would involve general upkeep (e.g., bolt tensioning, crack and coating inspection, safety equipment inspection, cleaning, high-voltage component service, and blade inspection) and replacement of consumable components (e.g., lubrication, oil changes). Annual maintenance activities at OSSs would be performed on both medium-voltage and high-voltage systems, auxiliary systems, and safety systems as well as topside structural inspections. Portions of the topsides may require the reapplication of corrosion-resistant coating. Routine maintenance and refueling would also be performed on diesel generators located on the OSSs. At regular intervals, WTG, OSS, and met tower foundations would be inspected both above and underwater to assess their condition, including checking for corrosion, cracking, and marine growth. Scheduled maintenance of foundations would also include safety inspections and testing; coating touch up; preventative maintenance of cranes, electrical equipment, and auxiliary equipment; and removal of marine growth. The offshore cables would be continuously monitored using a distributed temperature system (DTS), a distributed acoustic sensing (DAS) system, and/or online partial discharge (OLPD) monitoring. In addition, cable surveys would be performed at regular intervals to identify any issues associated with potential scour and depth of burial. Annual surveys would be performed for the first few years of operation, and provided no abnormal conditions are detected during those initial surveys, less frequent surveys would continue for the life of the Project. Cable terminations and hang-offs would be inspected and maintained during scheduled maintenance of foundations, OSSs, or WTGs.

2.3. DECOMMISSIONING

Under 30 CFR Part 585 and conditions for the Lease Area, Atlantic Shores would be required to remove or decommission all facilities, projects, cables, and pipelines, and clear the seafloor of all obstructions created by the proposed Project (see COP Volume I, Section 6.2; Atlantic Shores 2023). All foundations would need to be removed 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)). Absent permission from BOEM, Atlantic Shores would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed. Atlantic Shores has submitted a conceptual decommissioning plan as part of the COP, and the final decommissioning application would outline Atlantic Shores' process for managing waste and recycling proposed Project components

(COP Volume I, Section 6.0; Atlantic Shores 2023). Although the proposed Atlantic Shores South Project is anticipated to have an operational life of 30 years, it is possible that some installations and components may remain fit for continued service after this time. Atlantic Shores would have to apply for and be granted an extension if it wanted to operate the proposed Atlantic Shores South Project for more than the 25-year operations term stated in its lease.

BOEM would require Atlantic Shores to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease, 90 days after completion of the commercial activities on the commercial lease, or 90 days after cancellation, relinquishment, or other termination of the lease (see 30 CFR 585.905). Upon completion of the technical and environmental reviews, BOEM may approve, approve with conditions, or disapprove the lessee's decommissioning application. This process would include an opportunity for public comment and consultation with municipal, state, and federal management agencies. Atlantic Shores would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the proposed Project. Approval of such activities would require compliance under the National Environmental Policy Act (NEPA) and other federal statutes and implementing regulations.

If the COP is approved or approved with modifications, Atlantic Shores would have to submit a bond (or another form of financial assurance) prior to installation that would be held by the U.S. government to cover the cost of decommissioning the entire facility in the event that Atlantic Shores would not be able to decommission the facility.

2.3.1 Decommissioning Activities at Onshore Facilities

At the time of decommissioning, some components of the onshore electrical infrastructure may still have substantial life expectancies. If components of the onshore substation are not suitable for future use, they would be demolished, and materials recycled. The onshore export and interconnection cables and their duct banks would be likely be retired in place. Removing buried concrete duct banks would require excavations similar to those involved with installation; therefore, leaving these conduits in place for other infrastructure could be less disruptive and beneficial. Even if duct banks are left in place for future use, the onshore cables would likely be removed from the conduits and recycled accordingly.

2.3.2 Decommissioning Activities at Offshore Facilities

Decommissioning of the WTGs and OSSs would be performed using a "reverse installation" process, with turbine components or the OSS topside structure removed prior to foundation (and scour) removal. Procedures used for decommissioning the WTG and OSS foundations would depend on the type of foundation. Piled foundations would be severed below the mudline in accordance with standard practices and would be completely removed above that point. Suction bucket foundations would be injected with water, essentially reversing the installation process and enabling the complete removal of the foundation. For gravity foundations, the ballasts within the foundations would be removed and the foundations would be floated away. If it is not possible to re-float the gravity foundation, it would be disassembled onsite, and all components removed. The scour protection around the base of each foundation, if used, would be left in place as the default option to preserve the marine life that may have established itself on the substrate.

Export cables, interarray cables, and interlink cables (if present) would either be retired in place or removed from the seabed. If it is determined that offshore cables should be removed from the seabed, any overlying cable protection would need to be removed first, then the cables would be extracted from the seabed. Where these cables are buried in dense sediments, it may be necessary to fluidize overlying sediments before extracting the cables. Cables freed from the seabed would be coiled onto reels or cut into manageable lengths and transported to a port for recycling.

2.4. RELEVANT ALTERNATIVES TO THE PROPOSED ACTION

BOEM considered four relevant alternatives to the Proposed Action (Alternatives C through G in the Draft EIS) (Table 2-3). Additional information on these alternatives (including figures, where applicable) can be found in Draft EIS Chapter 2, Sections 2.1.3 through 2.1.7 (BOEM 2023).

Table 2-3 Alternatives to the Proposed Action Considered for Analysis

Alternative	Description
Alternative C – Habitat Impact Minimization/ Fisheries Habitat Impact Minimization	Under Alternative C, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, the layout and maximum number of WTGs and OSSs would be adjusted to avoid and minimize potential impacts on important habitats. NMFS identified two AOCs within the Lease Area that have pronounced bottom features and produce habitat value. AOC 1 is part of a designated recreational fishing area called "Lobster Hole." AOC 2 is part of a sand ridge (ridge and trough) complex. • **Alternative C1: Lobster Hole** Avoidance**.** Up to 16 WTGs, 1 OSS, and associated interarray cables within the Lobster Hole designated area as identified by NMFS would be removed. • **Alternative C2: NMFS- Proposed Sand Ridge Complex Avoidance.** Up to 13 WTGs and associated interarray cables within the NMFS-identified sand ridge complex would be removed. • **Alternative C3: Demarcated Sand Ridge Complex Avoidance.** Up to 6 WTGs and associated interarray cables within 1,000 feet (305 meters) of the sand ridge complex area identified by NMFS, but further demarcated through the use of NOAA's Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores, would be removed. • **Alternative C4: Micrositing.** This alternative consists of micrositing 29 WTGs, 1 OSS, and associated interarray cables outside of 1,000-foot (305-meter) buffers of ridges and swales within AOC 1 and AOC 2.
Alternative D – No Surface Occupancy at Select Locations to Reduce Visual Impacts	Under Alternative D, the construction and installation, O&M, and eventual decommissioning of two wind energy facilities (Project 1 and Project 2) on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, no surface occupancy would occur at select WTG positions to reduce the visual impacts of the proposed Project. • **Alternative D1: No Surface Occupancy of Up to 12 Miles (19.3 Kilometers) from Shore: Removal of Up to 21 Turbines.** This alternative would exclude placement of WTGs up to 12 miles (19.3 kilometers) from shore, resulting in the removal of up to 21 WTGs from Project 1 and associated interarray cables. The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL. • **Alternative D2: No Surface Occupancy of up to 12.75 Miles (20.5 Kilometers) from Shore: Removal of Up to 31 Turbines.** The 31 WTGs sited closest to shore would be removed, as well as the associated interarray cables. The remaining WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284

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

Source: Draft EIS Chapter 2, Table 2-1; BOEM 2023.
AMSL = above mean sea level; AOC = area of concern; COP = Construction and Operations Plan; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; O&M = operations and maintenance; OCS = Outer Continental Shelf; OSS = offshore substation; WTG = wind turbine generator

2.5. MITIGATION MEASURES THAT ARE PART OF THE PROPOSED ACTION

This section outlines the environmental protection measures included in the Proposed Action to avoid and minimize potential impacts on ESA-listed species under jurisdiction of the USFWS. Atlantic Shores' mitigation measures for specific resources are provided in Table 2-4 (Atlantic Shores 2023). Additional conditions, including mitigation, monitoring, or reporting measures, may be included in any BOEM-issued lease or other authorization, including those resulting from the ESA Section 7 consultation process.

BOEM considered additional avoidance and minimization measures that could further reduce potential effects of the Proposed Action on ESA-listed animals and plants during the development of this BA. These potential measures are listed in Table 2-5. Some or all of these measures may be required as a result of ESA Section 7 consultation with the USFWS. Any measures imposed through consultations will be included in the Final BA. The additional measures presented in Table 2-5 may not all be within BOEM's statutory and regulatory authority to require; however, other jurisdictional governmental agencies may potentially require them. BOEM may choose to incorporate one or more additional measures in the record of decision on the Final EIS and adopt those measures as conditions of COP approval.

Table 2-4 Applicant-Proposed Environmental Protection Measures

APM Number	Measure	Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
BAT-01	Two years of preconstruction vessel-based acoustic surveys for bats has been implemented to build upon and fill knowledge gaps from previous survey efforts.	X				
BAT-02	Limit lighting during offshore O&M to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of bats and their insect prey and therefore reducing the effects of light on potential collisions of bats at night.	X				
BAT-03	Red flashing FAA lights and yellow flashing marine navigation lights will be used on the WTGs instead of constant white light. Furthermore, ADLS is being considered to significantly reduce the number hours FAA lighting will be illuminated.	X				
BAT-04	Use down-lighting and down-shielding to the maximum extent practicable.	X				
BAT-05	Develop and implement a post-construction bat monitoring plan.	X				
BAT-06	Site onshore facilities to avoid bat habitat to the maximum extent practicable.	X				
BAT-07	Minimize tree clearing to the maximum extent practicable.	X				
BAT-08	No known northern long-eared bat maternity or roost trees are present in the Onshore Project area; however, to avoid potential conflicts, any tree removal activities will take place outside of the "active season" for northern long-eared bats, which is defined as April 1 to September 30.	X				
BAT-09	Onshore construction lighting will be temporary and localized to the work area.	X				
BAT-10	Limit lighting during onshore O&M to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of bats or their insect prey and therefore reducing the effects of light on potential collisions of bats at night.	X				
BAT-11	BMPs will be implemented to minimize onshore construction noise.	X				
BAT-12	Minimize work at night to the maximum extent	X				

APM Number	Measure	Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
	practicable.					
BIR-01	Implement an Avian and Bat Survey Plan in conjunction with BOEM and USFWS that includes digital aerial surveys and a satellite telemetry study of the federally protected red knot to further characterize the WTA and support consultations.	X	X			
BIR-02	Use the Motus Wildlife Telemetry System to track the offshore movement of the nanotagged bird species within the WTA, following forthcoming USFWS guidance on how to integrate automated radio telemetry into pre- and post-construction monitoring plans for offshore wind farms.		X			
BIR-03	Limit lighting during offshore operations to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of birds.		X			
BIR-04	Reduce attraction to structures by using perch deterrents to the maximum extent practicable.		X			
BIR-05	Use red flashing FAA lights and yellow flashing marine navigation lights on the WTGs, instead of constant white light, to reduce further bird attraction, and consider Aircraft Detection Lighting System (ADLS) to significantly reduce the number of hours FAA lighting will be illuminated.		X			
BIR-06	Use down-lighting and down-shielding to the maximum extent practicable.		X			
BIR-07	Marine debris caught on Offshore Project structures will be removed, when safe and practicable, to reduce the risk of bird entanglement.		X			
BIR-08	Develop and implement an avian post-construction monitoring plan.		X			
BIR-09	Report any dead or injured birds to BOEM on an annual basis. Birds with USFWS bands will be reported to the USGS Bird Banding Lab.		X			
BIR-10	Bury onshore cables, avoiding collision risk to birds associated with overhead structures and conductors.		X			
BIR-11	HDD at the landfall site and trenchless cable installation techniques for wetland crossings will be used to avoid impacts on wetlands and shoreline habitats, including any potential shoreline nesting areas, such as those for the federally listed threatened piping plover and red knot. .		X			
BIR-12	Minimize brush/tree clearing to the maximum extent practicable. This limited brush/tree clearing will be the minimum required to install facility components, will not include mature trees, and will be conducted in the winter months.		X			
BIR-13	Onshore construction lighting will be temporary and localized to the work area.		X			

APM Number	Measure	Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
BIR-14	Limit lighting during onshore operations to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of birds.		X			
BIR-15	The communication antenna will be designed in accordance with USFWS guidelines, to the extent practicable, including lighting and support system characteristics.		X			
COA-01	Site Project facilities and work areas/construction in previously disturbed areas and along existing ROWs to avoid sensitive habitats (e.g., wetlands, waterbodies, forest) to the maximum extent practicable.	X	X	X	X	X
COA-02	Avoid removing mature trees, remove only the minimum necessary, and do so during the winter months to minimize potential impacts on wildlife species.	X	X		X	X
COA-03	Install onshore interconnection cables and use trenchless installation methods such as jack-and-bore, jack piping, and HDD, where there are wetlands, waterbodies, and other sensitive habitats, particularly threatened and endangered species habitats, such as the dune and beach habitat east of the Monmouth Landfall Site.	X	X	X	X	X
COA-04	Implement lower dB construction equipment when feasible.	X	X	X	X	
COA-05	Conduct construction during permitted hours, to the maximum extent practicable, when ambient noise levels are highest.	X	X	X	X	
COA-06	Time of year restrictions for construction will be followed, as required, through permitting and resource agency consultation (USFWS and NJDEP).	X	X	X	X	X
COA-07	IA- certified Soil Erosion and Sediment Control Plan from the appropriate County Conservation District and approved New Jersey Division of Land Resource Protection NJPDES permit will be implemented that includes a SWPPP to avoid and minimize Project-related water quality impacts on nearby aquatic habitats.			X		X
COA-08	Restore temporarily disturbed areas by seeding and/or repaving to preconstruction conditions, where required and as feasible.		X	X	X	X
COA-09	Assign Environmental/Construction Monitor(s) to ensure compliance with applicable permit conditions and that BMPs are functional.	X	X	X	X	X
GEO-12	Site cable routes to travel primarily along previously disturbed areas such as existing roadways, utility ROWs, and/or bike paths.	X	X	X	X	X
GEO-15	Use trenchless techniques to minimize soil disturbance in select locations such as wetlands,		X	X	X	X

APM Number	Measure	Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
	waterbodies, or busy roadways.					
GEO-17	Employ BMPs to properly contain excavated soils and sediments and stabilize disturbed land areas, to avoid erosion and sediment runoff into nearby resource areas.		X	X	X	X
GEO-18	Implement BMPs, including preconstruction installation of appropriate erosion and siltation control measures, such as siltation fencing, near water bodies, around catch basins, and around temporary stockpiles.			X		X
GEO-19	Implement BMPs that include regular monitoring of disturbed areas and existing drainage areas, and monitoring of these areas immediately after precipitation events and adjustment of measures as needed.	X	X	X	X	X
GEO-20	Implement BMPs that include stabilization, through seeding or repaving of disturbed areas as appropriate, as soon as possible following installation activities.				X	X
GEO-27	Maintain and update the Environmental Protection Plan and Fisheries Protection Plan at key Project milestones, including commencement of construction, completion of construction, and every two years thereafter, through decommissioning, or at other times as requested by NJDEP.	X	X	X	X	X
GEO-28	Update the Environmental Protection Plan and Fisheries Protection Plan to ensure New Jersey's natural resources, including finfish and shellfish, sea turtles, marine mammals, avian species, bats and benthic populations are protected throughout the life of the Project from pre-construction through decommissioning and to ensure that any impacts are being actively monitored and mitigated as required by law.	X	X	X	X	X
GEO-29	Provide payment to the State of New Jersey for research initiatives and the regional monitoring of wildlife and fisheries related to the introduction of offshore wind projects in the amount of $15,096,000. The funding will be administered by the NJDEP and BPU, with stakeholder input to aid in the identification and prioritization of regional research and monitoring needs.	X	X	X	X	
GEO-30	Report annually in writing to BPU and NJDEP beginning June 30, 2022, on actions taken to ensure environmental protection, fisheries protection, mitigation of environmental and/or fishing impacts. This report will specifically address how Atlantic Shores is enacting its plans for environmental and fisheries protection and mitigation of impacts as articulated in its Application to BPU. An appendix to the report will indicate the data collected in the reporting period, and will include an accessibly-written, narrative description(s) of the dataset(s), the	X	X	X	X	

APM Number	Measure	Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
	associated findings made based upon these data, and reference(s) to the data portal(s) where these data can be publicly accessed. This appendix will be made public.					
GEO-31	Report annually in writing to BPU and NJDEP beginning June 30, 2022, on the policies and programs that may be adopted by BPU or NJDEP to help reduce future environmental or fisheries impacts or enhance the protection of natural resources. This report will detail any proposed future mitigation or protection measures that could be adopted, providing a description, proposed timeline, and expected outcomes of the recommended action.	X	X	X	X	
GEO-32	Make public through appropriate data portals, all data collected in the development of the Project from pre-construction activities through decommissioning activities. All collected information and scientific data not deemed confidential by statute or regulation will be made publicly available. Specifically, data with particular emphasis on natural resources including, but not limited to, finfish and shellfish, sea turtles, marine mammals, avian species, bat and benthic populations, as well as data regarding vessel strikes, avoidance, observations on habitat, and routine data collection on ocean conditions will be shared in a manner that is in keeping with best practices for the reporting of these types of data. Atlantic Shores will report annually to BPU and NJDEP beginning June 30, 2022, describing the type of data shared, and where the data is shared. Should a common database for New Jersey-related, scientific data generated in association with offshore wind development be created, Atlantic Shores will archive all data collected with the development of the Project in that data repositor.	X	X	X	X	
WAT-03	Manage accidental spill or release of oils or other hazardous materials through the OSRP that meets USCG and the BSEE requirements (COP Volume I, Appendix I-D; Atlantic Shores 2022).		X	X	X	X
WAT-06	Site/route Project facilities in previously disturbed areas and along existing ROWs.	X	X	X	X	X
WAT-08	Use trenchless cable installation methods to avoid impacts on wetlands and waterbodies. HDD will be used to install the export cable to the landfall sites. All HDD activities will be managed by an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid to minimize the potential effects from an accidental release of drilling fluid on marine and inland surface waters. All drilling fluids will be collected and recycled upon HDD completion.		X	X	X	X
WET-01	Site/route Project facilities in previously disturbed areas and along existing ROWs.	X	X	X	X	X

APM Number	Measure	Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
WET-02	Install onshore interconnection cables underground and use trenchless installation such as jack-and-bore, pipe jacking, and/or HDD, where feasible, to avoid direct impacts on wetlands and waterbodies.		X	X	X	X
WET-03	Implement BMPs such as silt fence, filter socks, inlet protection, dust abatement, and other approved BMPs in accordance with the approved Soil Erosion and Sediment Control Plan to properly contain excavated soils and sediments and stabilize disturbed land areas, to avoid erosion and sediment runoff into wetlands and waterbodies. Additionally, the Project will be constructed according to an approved New Jersey Division of Land Resource Protection Stormwater Management Control Plan (NJPDES and SWPPP) and County Soil Conservation District BMPs to avoid and minimize Project-related effects on nearby aquatic habitats.			X		X
WET-04	Return temporarily disturbed areas to preconstruction conditions and ensure that all onshore substation areas are graded, grassed, graveled, or paved to prevent future erosion.				X	X

Acronyms: ADLS = Aircraft Detection Lighting System; APM = Applicant-Proposed Measure; BMP = best management practices; BOEM = Bureau of Ocean Energy Management; dB = decibels; ESA = Endangered Species Act; FAA = Federal Aviation Administration; HDD = horizontal directional drilling; NJDEP = New Jersey Department of Environmental Protection; NJDES = New Jersey Pollutant Discharge Elimination System; O&M = operations and maintenance; OSS = offshore substation; ROW = right-of-way; USCG = U.S. Coast Guard; USFWS = U.S. Fish and Wildlife Service; USGS = U.S. Geological Survey; WTA = wind turbine area; WTG = wind turbine generator
APM Codes: BAT = Bat (northern long-eared bat and tricolored bat); BIR = Bird (piping plover, *rufa* red knot, roseate tern, eastern black rail, and saltmarsh sparrow); COA = Coastal Habitat and Fauna; GEN = General; GEO = Geological Resources; WAT = Water Quality; WET = Wetlands and Waterbodies

Table 2-5 Additional Measures Proposed to Avoid and Minimize Potential Effects of the Proposed Action

No.	Description		Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
1.a.	To minimize attracting birds to operating turbines, Atlantic Shores must install bird perching-deterrent devices on WTGs and OSSs. The location of bird-deterrent devices must be proposed by Atlantic Shores based on BMPs applicable to the appropriate operation and safe installation of the devices. The Lessee must confirm the locations of bird-deterrent devices with a monitoring plan to track the efficacy of the deterrents as part of the documentation it must submit with the FDR.			X			
1.b.	Atlantic Shores must use an FAA-approved vendor for the ADLS, which will activate the FAA hazard lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night. Atlantic Shores must confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the FDR.		X	X			

No.	Description		Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
1.c.	Atlantic Shores must light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc around the WTG and OSS. To minimize the potential of attracting migratory birds, the top of each light must be shielded to minimize upward illumination (conditional on U.S. Coast Guard approval).		X	X			
2	Atlantic Shores must develop and implement a BBMP in coordination with USFWS and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring. Prior to commencing offshore construction activities, Atlantic Shores must submit the BBMP for BOEM and USFWS review. BOEM and USFWS will review the BBMP and provide any comments on the plan within 30 calendar days of its submittal. Atlantic Shores must resolve all comments on the BBMP to BOEM and USFWS's satisfaction before implementing the plan. a. **Monitoring**. Atlantic Shores must conduct monitoring as outlined in the Bird and Bat Monitoring Plan b. **Annual Monitoring Reports**. Atlantic Shores must submit to BOEM (at renewable_reporting@boem.gov), USFWS, and BSEE (at OSWSubmittals@bsee.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 6 months of completion of the last avian survey. The report must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. BOEM, USFWS, and BSEE will use the annual monitoring reports to assess the need for reasonable revisions (based on subject matter expert analysis) to the BBMP. BOEM, BSEE, and USFWS reserve the right to require reasonable revisions to the BBMP and may require new technologies as they become available for use in offshore environments. c. **Post-Construction Quarterly Progress Reports**. Atlantic Shores must submit quarterly progress reports during the implementation of the BBMP to BOEM (at renewable_reporting@boem.gov) and the USFWS by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The progress reports must include a summary of all work performed, an explanation of overall progress, and any technical problems encountered. d. **Monitoring Plan Revisions.** Within 15 calendar		X	X			

No.	Description		Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
	days of submitting the annual monitoring report, Atlantic Shores must meet with BOEM and USFWS to discuss the following: the monitoring results; the potential need for revisions to the BBMP, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If BOEM or USFWS determines after this discussion that revisions to the BBMP are necessary, BOEM may require Atlantic Shores to modify the BBMP. If the reported monitoring results deviate substantially from the impact analysis included in the Final BA, Atlantic Shores must transmit to BOEM recommendations for new mitigation measures and/or monitoring methods. e. **Operational Reporting (Operations).** Atlantic Shores must submit to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) an annual report summarizing monthly operational data calculated from 10-minute supervisory control and data acquisition data for all turbines together in tabular format: the proportion of time the turbines were operational (spinning at >x revolutions per minute) each month, the average rotor speed (monthly revolutions per minute) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the impact analysis included in the Final BA. f. **Raw Data.** The Lessee must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to BOEM, BSEE, and USFWS, upon request for the duration of the Lease. The Lessee must work with BOEM to ensure the data are publicly available. The USFWS may specify third-party data repositories that must be used, such as the Motus Wildlife Tracking System or MoveBank, and such parties and associated data standards may change over the duration of the monitoring plan.						

No.	Description		Bats	Birds	Bog Turtle	Monarch Butterfly	Plants
3	Atlantic Shores must provide an annual report to BOEM and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with federal or research bands must be reported to the United States Geological Survey Bird Band Laboratory, available at https://www.pwrc.usgs.gov/bbl/.		X	X			
3.5	Any occurrence of a dead ESA-listed bird or bat must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state.		X	X			
4	Because many wildlife species overwinter in cavities and nests, any mature trees slated for removal should be checked (including for vacant raptor nests) and avoided if possible. If the tree must be taken down, this should occur between October 1 and February 28 or 29.		X	X			

ADLS = Aircraft Detection Lighting System; BA = Biological Assessment; BBMP = Bird and Bat Monitoring Plan; BMP = best management practices; BOEM = Bureau of Ocean Energy Management; BSEE = Bureau of Safety and Environmental Enforcement; ESA = Endangered Species Act; FAA = Federal Aviation Administration; FDR = Facility Design Report; OSS = offshore substation; USFWS = U.S. Fish and Wildlife Service; WTG = Wind Turbine Generator

3. ACTION AREA

The Action Area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). The Project area includes upland and coastal habitats in New Jersey and adjacent New Jersey State waters and ocean habitats on the NJ WEA on the OCS offshore of New Jersey. As such, the Action Area includes separate onshore and offshore components, as well as a 1-mile buffer around these elements to account for potential impacts associated with constructing, operating, and decommissioning the proposed Project (Figure 3-1). The Onshore Action Area includes the area affected by the construction, operation, and decommissioning of the onshore elements of the Proposed Action including landfall sites for the submarine export cables, onshore export cable route(s), onshore substations and/or converter stations, interconnection cables linking the onshore substations to the POIs to the existing grid, and the O&M facility. The Offshore Action Area includes areas of the water column, sediments, and above the water surface affected by construction, operations, and decommissioning of the offshore elements of the Proposed Action including WTGs and their foundations; OSSs and their foundations; scour protection for foundations, interarray cables, and offshore export cables; permanent met tower; and temporary metocean buoys.

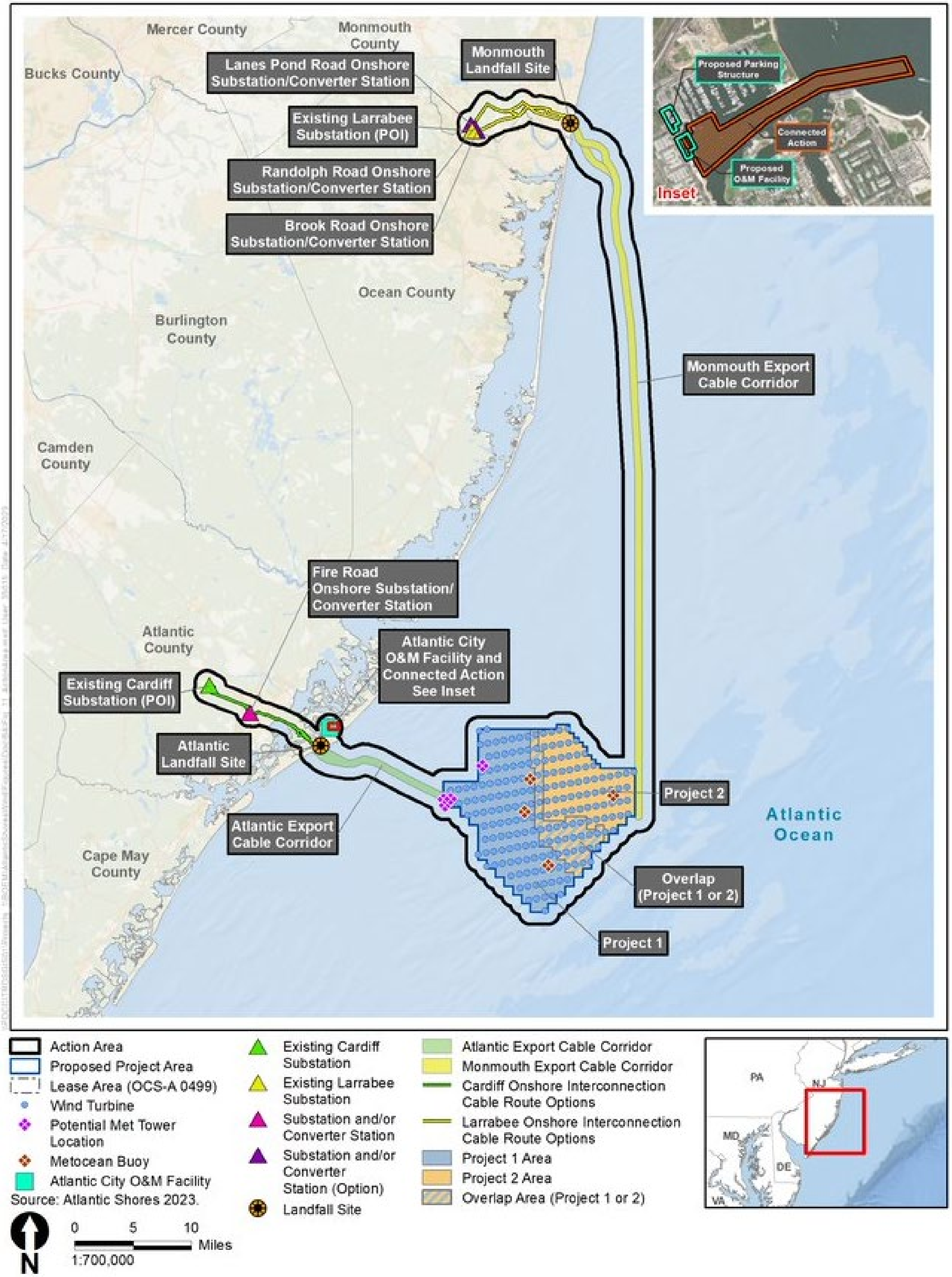


Figure 3-1 Proposed Action Area

3.1. DESCRIPTION OF ONSHORE ACTION AREA

The Onshore Action Area encompasses portions of coastal New Jersey within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area and includes tidal and non-tidal waters (including wetlands), maritime dune and beach areas, forested areas, and developed areas (e.g., residential, commercial, industrial, and linear development). The onshore export and interconnection cables, onshore substations, and O&M facility are located primarily along or within existing roadway corridors and railroad ROWs.

Invasive plant species commonly associated with disturbed and urban areas occur, often at high densities, throughout the Onshore Project area. Due to the high level of development, impervious surfaces, and other such areas that are devoid of vegetation within the onshore export and interconnection cable construction corridors, onshore substations, and O&M facility, invasive plant species are concentrated within and adjacent to disturbed wetlands and streams as well as along vegetated edges of public roadways.

3.1.1 ATLANTIC CITY LANDFALL TO CARDIFF POI

Portions of the Onshore Action Area associated with the Atlantic City Landfall to Cardiff POI interconnection cable route overlap with mapped New Jersey Pinelands. The Pinelands ecosystem covers a large area of southern New Jersey characterized by unconsolidated sand and gravel with a shallow aquifer that is characteristically acidic and nutrient poor, and specialized plant and animal species adapted to these conditions and to wildfires. The Pinelands area is protected under the Pinelands Protection Act (New Jersey Statutes Annotated 13:18-1 et seq.), managed by the Pinelands Commission and is defined by three separate zones: protected areas, managed use areas, and zones of cooperation. The portion of Atlantic City Landfall and Cardiff POI overlaps with the Pinelands Area of Egg Harbor Township that is designated as a "Regional Growth Area" (i.e., a managed use area). It does not intersect with any Pinelands designated protected area (State of New Jersey 2021).

The Onshore Action Area for the Atlantic City Landfall to Cardiff POI consists of approximately 59.4 percent developed or disturbed area. The remaining area consists of mixed forest, scrub-shrub, old fields, herbaceous fields, herbaceous tidal and non-tidal wetlands, coniferous wooded wetlands, deciduous wooded wetlands, mixed wooded wetlands, coniferous scrub/shrub wetlands, deciduous scrub/shrub wetlands, mixed shrub/scrub wetlands, vegetated dune communities, and coastal beach (COP Volume II, Appendix II-E1; Atlantic Shores 2023). Apart from tidal herbaceous wetlands and coastal beaches, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat. The Cardiff Substation is in a developed and disturbed area with an existing vacant commercial building. Due to existing levels of development and habitat degradation in the area, the wildlife community is expected to be dominated by urban-adapted, disturbance-tolerant generalist species, such as gulls (*Laridae* family), corvids (*Corvidae* family), pigeons (*Columbidae* family), starlings (*Sturnidae* family), squirrels (*Sciuridae* family), and racoons (*Procyon lotor*). Wildlife surveys conducted in the Onshore Project area for the Atlantic City Landfall to Cardiff POI found only urban-adapted birds, such as house sparrow, and no reptiles, amphibians, or mammals (COP Volume II, Section 4.2.1.1; Atlantic Shores 2023). The coastal beach habitat and intertidal herbaceous wetlands are associated with the barrier island of Atlantic City. Intertidal wetlands were characterized as being dominated by typical of this type of habitat in the northeastern United States, including species such as: smooth cordgrass (*Spartina alterniflora*), glasswort (*Salicornia depressa*), seaside goldenrod (*Solidago sempervirens*), and common reed (*Phragmites australis*). Coastal birds likely forage and/or nest on these beaches and within tidal wetlands adjacent to cable landfall locations. Beaches that have the potential to support ESA-listed species would not be affected by landfall or cable installation for the Atlantic Landfall to Cardiff POI portion of the Project, as Atlantic Shores has committed to trenchless solutions (e.g., HDD) for sensitive habitat crossings.

3.1.2 MONMOUTH COUNTY LANDFALL TO LARRABEE POI

The Onshore Action Area associated with the Monmouth County Landfall to Larrabee POI interconnect cable route is outside of the mapped New Jersey Pinelands and consists of approximately 57.2 percent developed or disturbed areas (COP Volume II, Appendix II-E2, Section 4.1; Atlantic Shores 2023). The remainder of the Onshore Action Area associated with this portion of the Project consists of edges of mixed forest, deciduous forest, evergreen forest, evergreen shrub, scrub-shrub old fields, herbaceous fields, agricultural pastures, beach with vegetation, and forested, scrub-shrub, herbaceous non-tidal wetlands and vegetated beaches. Apart from wetlands and stream crossings, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat (COP Volume II, Appendix II-E1; Atlantic Shores 2023).

Due to existing levels of development and habitat degradation in the area, the wildlife community is expected to be dominated by urban-adapted, disturbance-tolerant generalist species. Wildlife surveys conducted for the Monmouth Landfall to Larrabee Substation portion of the Project found only common, urban-adapted birds, such as herring gull, house sparrow, and mourning dove, and no reptiles, amphibians, or mammals (COP Volume II, Section 4.2.1.2; Atlantic Shores 2023). During habitat assessment surveys conducted in June and December of 2020 and in September of 2021, Atlantic Shores did not identify any suitable or critical habitat to support federal- or state-listed species occurring in the Monmouth Landfall to Larrabee Substation portion of the Project, although some species may occur in adjacent areas where more suitable habitat is present (COP Volume II, Appendix II-E2; Atlantic Shores 2023).

3.1.3 O&M FACILITY

The Onshore Action Area also includes the proposed O&M facility, located in an urbanized area and consisting of approximately 80 percent developed or disturbed land uses, with the remaining 20 percent consisting of the surface waters of Clam Creek (COP Volume II, Appendix II-E1; Atlantic Shores 2023). Clam Creek is associated with the larger Atlantic City Harbor tidal waterbody, where approximately 0.8-acre (0.3-hectare) of open water is included within the Project area.

Due to high levels of urban development within the vicinity of the Onshore Action Area associated with the proposed O&M facility, the wildlife community is dominated by urban-adapted, disturbance-tolerant generalist species, such as gulls, pigeons, house sparrows, squirrels, and raccoons (COP Volume II, Appendix II-E1; Atlantic Shores 2023). No federally or state-listed species were observed in the vicinity of the Onshore Action Area during natural resources surveys conducted in 2020 and 2021 (COP Volume II, Appendices II-E1 and II-E2; Atlantic Shores 2023).

3.2. DESCRIPTION OF OFFSHORE ACTION AREA

The Offshore Action Area consists of the WTA and the ECCs to landfall. The WTA is located a minimum of 8.7 miles (14 kilometers) east of the New Jersey coast, on the submerged shallow portion of the OCS of the Western Atlantic continental margin. The continental shelf extends eastward from the New Jersey coast for about 87 miles (140 kilometers) to the continental slope break (COP Volume II, Section 2.1.1.1; Atlantic Shores 2023). The offshore setting of the WTA is known as the Mid-Atlantic Bight (also the New York Bight or NY/NJ Bight), due to its position within the open arc of the New Jersey-New York coastline. The ECC routes extend from the WTA to landfall. The WTA and ECC routes are relatively flat and composed mainly of soft sediments, with low-degree seaward slopes and depth contours generally paralleling the shoreline.

4. COVERED SPECIES

Four federally listed birds, one federally listed bat, one federally listed reptile, four federally listed plants, and one candidate insect occur or potentially occur in all or portions of the Action Area, depending on species and Project element (Table 4-1). The saltmarsh sparrow, which is currently under consideration for ESA listing, and the tricolored bat, which was officially proposed for ESA listing in September of 2022, also have potential to occur in the Action Area. Although the saltmarsh sparrow and roseate tern were not listed as potentially occurring in the Action Area on USFWS' January 2023 Information for Planning and Conservation (IPaC) report, the species are included in this BA. The saltmarsh sparrow is included, due to the presence of marsh habitat in the Action Area. The roseate tern is included due to its migratory activities and potential presence in the Action Areas of the Empire Wind and Ocean Wind projects. There is no critical habitat designated for any of these species or any other federally listed species designated within the Action Area. Data sources used for the analysis are discussed in Section 4.1, and a description of each species and the potential occurrence in the Action Area is provided in Sections 4.2 through 4.14 of this BA.

Table 4-1 ESA-Listed, Candidate, and Proposed Species that Occur, Could Occur, or May Be Impacted by Project Activities in the Action Area as Determined by USFWS IPaC System

Species	Lease Area (WTAs for Project 1 and Project 2)	Atlantic Export Cable (Onshore and Offshore)	Monmouth Export Cable (Onshore and Offshore)	Larrabee Onshore Substations/Converter Station Location	Cardiff Onshore Substation/Converter Station Location	O&M Facility	Habitat(s)
Mammals							
Northern Long-eared Bat (E)[1] (*Myotis septentrionalis*)	No	Yes	Yes	Yes	Yes	No	Summer: roost underneath bark, in cavities or in crevices of both live and dead trees. May also roost in caves and mines. Winter: hibernate in caves and mines with large passages, large entrances, constant temperature, and high humidity. Feeding: understory of forested hillsides and ridges. (USFWS 2020a)
Tricolored Bat (PE) (*Perimyotis subflavus)*	No	Yes	Yes	Yes	Yes	Yes	Spring, summer, and fall: forested habitats; roost primarily in trees, especially among leaves of live or recently dead deciduous hardwood trees. Occasionally roosts in artificial structures. Winter: caves and abandoned mines. (USFWS 2022b)
Birds							

Species	Lease Area (WTAs for Project 1 and Project 2)	Atlantic Export Cable (Onshore and Offshore)	Monmouth Export Cable (Onshore and Offshore)	Larrabee Onshore Substations/Converter Station Location	Cardiff Onshore Substation/Converter Station Location	O&M Facility	Habitat(s)
Eastern Black Rail (T) (*Laterallus jamaicensis jamaicensis*)	No	Yes	No	No	No	Yes	Breeding: tidal or non-tidal marsh that can range in salinity from salt to brackish to fresh water. Typically found in salt and brackish marshes with dense vegetation. Can also be found in upland areas directly adjacent to marshes. Migratory: wet prairies, wet meadows, and hay fields. (USFWS 2020b)
Piping Plover (T) (*Charadrius melodus*)	Yes	Yes	Yes	No	No	Yes	Breeding and Nesting: beach nest sites are simple depressions or scrapes in the sand about 2 to 3 inches (6 to 8 centimeters) in diameter. Arrive from March-May and migrate as late as mid-August to southern wintering habitat. (NatureServe 2020a)
Roseate Tern (E)[2] (*Sterna dougallii dougallii*)	No	No	No	No	No	No	Coastal beaches; protected bays and estuaries; offshore ocean.
Rufa Red Knot (T) (*Calidris canutus rufa*)	Yes	Yes	Yes	No	No	Yes	Migratory: stopover areas, generally along the coast, that have an abundance of food such

Species	Lease Area (WTAs for Project 1 and Project 2)	Atlantic Export Cable (Onshore and Offshore)	Monmouth Export Cable (Onshore and Offshore)	Larrabee Onshore Substations/Converter Station Location	Cardiff Onshore Substation/Converter Station Location	O&M Facility	Habitat(s)
							as small crabs, crustaceans, mussels, snails, marine worms, and horseshoe crab eggs. Migration is tied to coincide with the spawning season of horseshoe crabs. (USFWS 2014))
Saltmarsh Sparrow *(Ammospiza caudacuta)* (not listed[2,3])	No	Yes	No	No	No	No	Tidal marsh obligate; prefers high marsh habitat dominated by saltmeadow cordgrass, as well as saltgrass and saltmarsh rush (*Juncus gerardii*). (Greenlaw et al. 2020)
Reptiles							
Bog Turtle (T) (*Clemmys muhlenbergii*)	No	No	Yes	No	No	No	Wet grassy areas, mossy bogs, and herbaceous meadows that have unpolluted, clear spring-fed streams that flow throughout the year. Open areas are required for basking and nesting. (CWF 2020)
Insects							
Monarch Butterfly(C)[4] (*Danaus plexippus*)	No	Yes	Yes	Yes	Yes	No	Fields, open areas, wet areas, urban areas, or other areas where milkweed and flowering plants are

Species	Lease Area (WTAs for Project 1 and Project 2)	Atlantic Export Cable (Onshore and Offshore)	Monmouth Export Cable (Onshore and Offshore)	Larrabee Onshore Substations/Converter Station Location	Cardiff Onshore Substation/Converter Station Location	O&M Facility	Habitat(s)
							present. Can feed on many different flowering plants but can only lay eggs on milkweed. (USFWS 2020c)
Flowering Plants							
American Chaffseed (E) (*Schwalbea americana*)	No	Yes	Yes	Yes	Yes	No	Sandy (sandy peat or sandy loam), acidic, seasonally moist to dry soils. It is generally found in habitats described as open, moist pine flatwoods, fire-maintained savannas, ecotonal areas between peaty wetlands and xeric sandy soils, and other open grass-sedge systems. (Buchanan and Finnegan 2010)
Knieskern's Beaked-rush (T) (*Rhynchospora knieskernii*)	No	Yes	No	No	Yes	No	Endemic to five counties in the New Jersey Pine Barrens. Restricted to early successional habitats in pitch pine lowland forests within pine barrens. Prefers a substrate that is nutrient poor, highly acidic, fine-grained mineral soils and can frequently be found

Species	Lease Area (WTAs for Project 1 and Project 2)	Atlantic Export Cable (Onshore and Offshore)	Monmouth Export Cable (Onshore and Offshore)	Larrabee Onshore Substations/Converter Station Location	Cardiff Onshore Substation/Converter Station Location	O&M Facility	Habitat(s)
							over clay deposits and sometimes found on bog iron deposits. Prefers areas with a fluctuating water level, bare or sparsely vegetated areas that remain open due to disturbances either natural or human-caused. (NatureServe 2020b)
Seabeach Amaranth (T) *(Amaranthus pumilus*)	No	Yes	Yes	No	No	Yes	Occurs on barrier islands, usually on coastal over-wash flats at the accreting ends of the islands and lower foredunes and on ocean beaches above mean high tide. Prefers areas that are not well vegetated (NatureServe 2020c).
Swamp Pink (T) (*Helonias bullata*)	No	Yes	Yes	Yes	Yes	No	Swampy forested wetlands bordering meandering streams; headwater wetlands; sphagnous hummocky, dense, Atlantic white cedar swamps; blue ridge swamps; meadows; bogs and spring seepage areas. In conjunction with these areas the species also

Species	Lease Area (WTAs for Project 1 and Project 2)	Atlantic Export Cable (Onshore and Offshore)	Monmouth Export Cable (Onshore and Offshore)	Larrabee Onshore Substations/Converter Station Location	Cardiff Onshore Substation/Converter Station Location	O&M Facility	Habitat(s)
							requires habitat that is permanently saturated, but not inundated, by floodwaters. There must be a water table near the surface that fluctuates slightly during spring and summer months. Prefers areas with 20–100% canopy cover. (USFWS 2016a)

Source: USFWS IPaC Review January and March 2023 (USFWS 2023).
[1] USFWS reclassified as Endangered, effective March 31, 2023.
[2] Included although not identified in IPaC.
[3] Currently under consideration by USFWS for ESA listing, but not a Candidate or Proposed species.
[4] Candidate species are provided no statutory protection under the ESA.
E = Endangered, T = Threatened, PT = Proposed Threatened, PE = Proposed Endangered, C = Candidate

4.1. DATA SOURCES FOR ANALYSIS

Sources of information used in this BA to describe potential occurrences of ESA-listed species in the Project area, and potential impacts from the Proposed Action, included the USFWS IPaC, the Project COP and supporting assessments, recent USFWS Biological Opinions and other environmental review documents from prior mid-Atlantic offshore wind projects, the NJDEP Natural Heritage Database (including Landscape Project), tracking studies and surveys of ESA-listed birds and bats in the offshore environment (e.g., Loring et al. 2019), site-specific studies and surveys conducted for the Proposed Action (Atlantic Shores 2023), peer-reviewed literature, and other sources as cited herein. Desktop assessments were also performed using GIS and aerial photography to characterize land cover types within onshore portions of the Action Area where surface disturbance would occur and assess habitat suitability there for ESA-listed species based on published descriptions of their habitat associations and sensitivity to human disturbance.

Additional sources of information for ESA-listed birds in the Action Area included NJDEP Ocean/Wind Power Ecological Baseline Studies (Geo-Marine, Inc. 2010); Atlantic Shores digital aerial surveys (COP Volume II, Appendix II-F2; Atlantic Shores 2023); Marine-life Data and Analysis Team (MDAT) models (Curtice et al. 2019); National Oceanic and Atmospheric Administration (NOAA) Northwest Atlantic Seabird Catalog data; tracking studies by Loring et al. (2017, 2018, 2019, 2021); and the Atlantic Shores red knot satellite telemetry study (COP Volume II, Appendix II-F3; Atlantic Shores 2023).

Additional northern long-eared bat data sources included NJDEP records of known hibernacula, maternity colonies, and roost trees, and vessel-based acoustic surveys conducted by Atlantic Shores in the Action Area in 2020 and 2021 (COP Volume II, Appendix II-F4; Atlantic Shores 2023). Other mid-Atlantic, offshore bat monitoring studies were used to provide additional information about bat occurrences in the offshore environment (e.g., NJDEP 2010; Hatch et al. 2013; Sjollema et al. 2014; Normandeau 2022). BOEM's *Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities* report (Pelletier et al. 2013) was also referenced for the assessment of bat occurrences in the offshore portion of the Action Area and the likelihood of impacts from offshore activities of the Proposed Action.

4.2. NORTHERN LONG-EARED BAT

4.2.1 SPECIES DESCRIPTION

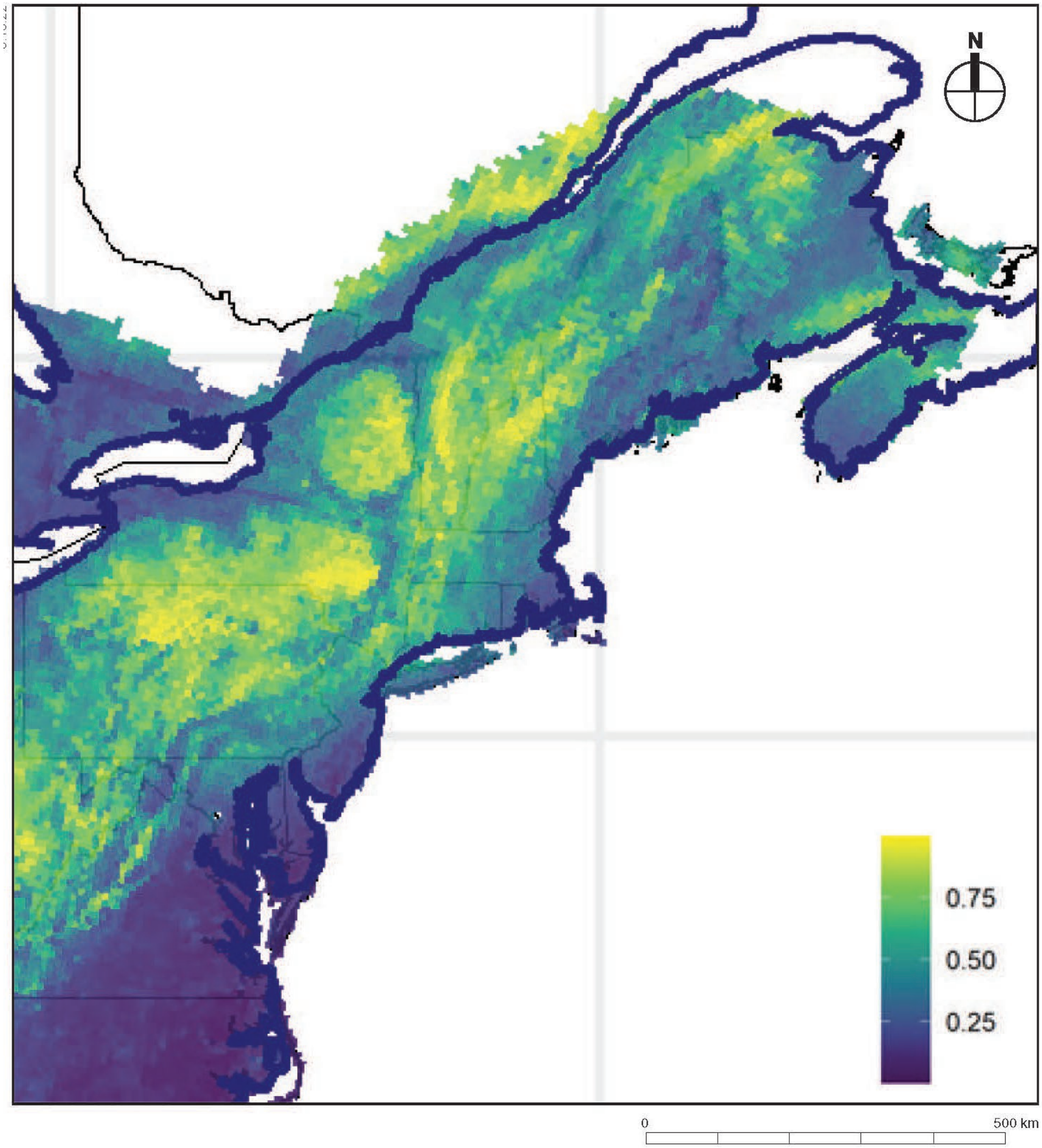
The once common northern long-eared bat is distinguished from other *Myotis* species by its long ears. The species has been devastated by the fungal disease white-nose syndrome (WNS) and was listed under the ESA as Threatened in 2015 (80 FR 17974). Declines are expected to continue as WNS spreads throughout the remainder of the species' range (USFWS 2016b). The USFWS issued an ESA Section 4(d) Rule (81 FR 1900) that specifically defines "take" prohibitions and exempts most incidental take for a variety of commercial and industrial projects within the species' range, subject to known roost trees and hibernacula within areas affected by WNS. Once the northern long-eared bat listing is elevated to Endangered, effective March 31, 2023, the 4(d) Rule may no longer apply at the time of Project construction. To avoid any potential delays that may result from reinitiating consultation as a result of northern long-eared bat status elevation, Project activities that may impact the species will be conducted adhering to prohibitions afforded to endangered species.

The range of the northern long-eared bat includes most of the eastern and midwestern United States and southern Canada. Within the northeastern United States, this species occurs from Maine to Virginia and is more prevalent inshore than along the coast, including in New Jersey (Figure 4-1).

The annual life cycle of the northern long-eared bat includes winter hibernation, spring staging, spring migration, summer birth of young, fall migration, and fall swarming and mating. The northern long-eared bat overwinters in caves and abandoned mines and spends the remainder of the year in forested areas. Individuals congregate in the vicinity of their hibernacula in August or September and enter hibernacula in October and November. An individual will use the same hibernaculum for multiple years. There are eight known hibernacula in New Jersey, all in the northern part of the state (USFWS 2019a).

In spring, the bats leave the hibernacula to roost in the cracks and crevices of trees and forage near the hibernaculum in preparation for migration. Compared to tree bats, northern long-eared bats are short-distance migrants. From approximately mid-May through mid-August, northern long-eared bats occupy summer habitat to roost under bark and in cavities or crevices of both live and dead trees and in anthropogenic structures (Amelon and Burhans 2006; Timpone et al. 2010). Females roost in small maternity colonies and males roost alone (Amelon and Burhans 2006). Northern long-eared bats also switch roosts frequently, typically every 2 to 3 days (Carter and Feldhamer 2005; Foster and Kurta 1999; Owen et al. 2002; Timpone et al. 2010). Northern long-eared bats forage within a few kilometers of their roost sites (Sasse and Perkins 1996; Timpone et al. 2010) on moths, flies, leafhoppers, caddisflies, and beetles approximately 3 to 10 feet (1 to 3 meters) above the ground (Brack and Whitaker 2001) in open forests, edges, and around ponds, streams, and wetlands. There is speculation that northern long-eared bat occurrence in low-lying coastal areas may provide an important refuge from WNS because of their milder winter climate (e.g., Grider et al. 2016; Dowling and O'Dell 2018; Jordan 2020; Gorman et al. 2021).

Offshore records of northern long-eared bats elsewhere are rare (e.g., Dowling et al. 2017; Tetra Tech 2021a). A recent tracking study (n = 8; July–October 2016) conducted on Martha’s Vineyard did not record any offshore movements of northern long-eared bat (Dowling et al. 2017). The BA for the Vineyard Wind 1 project off of Martha’s Vineyard, Massachusetts, and Block Island, Rhode Island, concluded that “it is extremely unlikely that northern long-eared bats would traverse offshore portions” of that project (BOEM 2019). Additionally, stationary acoustic detectors positioned on two WTGs within the operational Block Island Wind Farm in Rhode Island did not detect any northern long-eared bat calls over a 3-year period (Stantec 2020). Similarly, acoustic detectors on WTGs in a Coastal Virginia Offshore Wind (CVOW) pilot project off Virginia did not detect northern long-eared bats during a 1-year survey period (Tetra Tech 2021b, Normadeau 2022), nor did acoustic surveys conducted over an 8-month period in the Empire Wind offshore project area (Tetra Tech 2021a). Overall, any occurrences of the northern long-eared bat in the WTA of the Action Area would be expected to be extremely rare.



Source: U.S. Geological Survey, North American Bat Monitoring Program (USGS 2023).

Figure 4-1 *Myotis septentrionalis* Mean Occupancy Probabilities Predicted in the Modeled Species Range for 2019

4.2.2 Northern Long-eared Bat in the Action Area

Despite the predicted relatively low probably of occurrence (Figure 4-1), northern long-eared bats may be present in wooded areas near these proposed onshore facilities. Records of northern long-eared bat roost trees, including acoustic records and maternity colonies, occur within the Onshore Action Area townships and boroughs (COP Volume II, Section 4.4.1.2; Atlantic Shores 2023). There are no known records of northern long-eared bat hibernacula, roost trees, or maternity colonies in Absecon, Pleasantville City, or Wall; however, records of roost trees, including maternity colonies, exist in Howell Township, but they are all located within the grounds of the Earle Naval Weapon Station or farther north (COP Volume II, Section 4.4.1.2; Atlantic Shores 2023). The nearest maternity colony to onshore Project structures associated with the Atlantic City Landfall to Cardiff POI route is approximately 2.88 miles (4.64 kilometers) from the Cardiff onshore interconnection cable route. The nearest maternity colonies to onshore Project structures associated with the Monmouth Landfall to Larrabee POI route are approximately 6 miles (9.66 kilometers) from the Larrabee interconnection cable route; approximately 8 miles (12.87 kilometers) from the existing Larrabee substation (POI); and approximately 7 miles (11.27 kilometers) from the three substation/converter station options. There are no known hibernacula within the designated buffer of the Onshore Project area and no known maternity roost trees within 150 feet (45 meters) of any planned onshore activities (COP Volume II, Section 4.4.1.2; Atlantic Shores 2023).

There are no records of northern long-eared bats on the OCS off New Jersey. Available survey data and the ecology of the species suggest there is little evidence of use of the offshore environment. Offshore surveys recorded several observations of migratory tree bats in the nearshore portion of the New Jersey Coast and a handful of *Myotis* species were detected, but none were identified as northern long-eared bat (NJDEP 2010). There are records of northern long-eared bat on the coastal islands of Rhode Island and Massachusetts (Dowling et al. 2017; Dowling and O'Dell 2018), indicating that some individuals traveled over open water to the islands, but their occurrence over the ocean is rare. During the offshore construction of the Block Island Wind Farm, bats were monitored with acoustic detectors on boats; no northern long-eared bats were detected among the 1,546 passes of bats (Stantec 2018). In addition, recent data from 3 years of post-construction monitoring around Block Island Wind Farm found relatively low numbers of bats present only during the fall, and no recorded presence of northern long-eared bats (Stantec 2020). Similarly, acoustic detectors on WTGs in Dominion Energy's CVOW pilot project off Virginia did not detect northern long-eared bats (Dominion 2022, Normandeau 2022). There were no detections of this species during offshore acoustic surveys conducted as part of the proposed Project in 2020 and 2021 (COP Volume II, Appendix II-F4; Atlantic Shores 2023). If northern long-eared bats were to migrate over water, movements would likely be closer to the mainland.

Collectively, this information indicates that northern long-eared bat could occur in the terrestrial components of the Action Area during non-hibernation periods (May through October). Project-specific acoustic bat surveys in the Offshore Project area did not detect any northern long-eared bats, indicating probable absence of the species in the Offshore Project area. Any occurrence of northern long-eared bat in the marine component of the Action Area would likely be very rare and in very small numbers and very likely when winds are below cut-in speed for turbines.

4.3. TRICOLORED BAT

4.3.1 SPECIES DESCRIPTION

The tricolored bat is a small bat, measuring about 2 inches (5 centimeters) in body length (up to 3.5 inches [9 centimeters] including the tail) and weighing up to approximately 0.3 ounce (8 grams) (USFWS n.d.). The tricolored bat is distinguished by its fur that appears dark at the base, lighter in the middle and dark at the tip. The tricolored bat's range includes most of the eastern and midwestern United States. The species was once common but has declined by 90 to 100 percent in most locations due to impacts from WNS (USFWS n.d.). On September 13, 2022, the USFWS announced a proposal to list the tricolored bat as Endangered under the ESA.

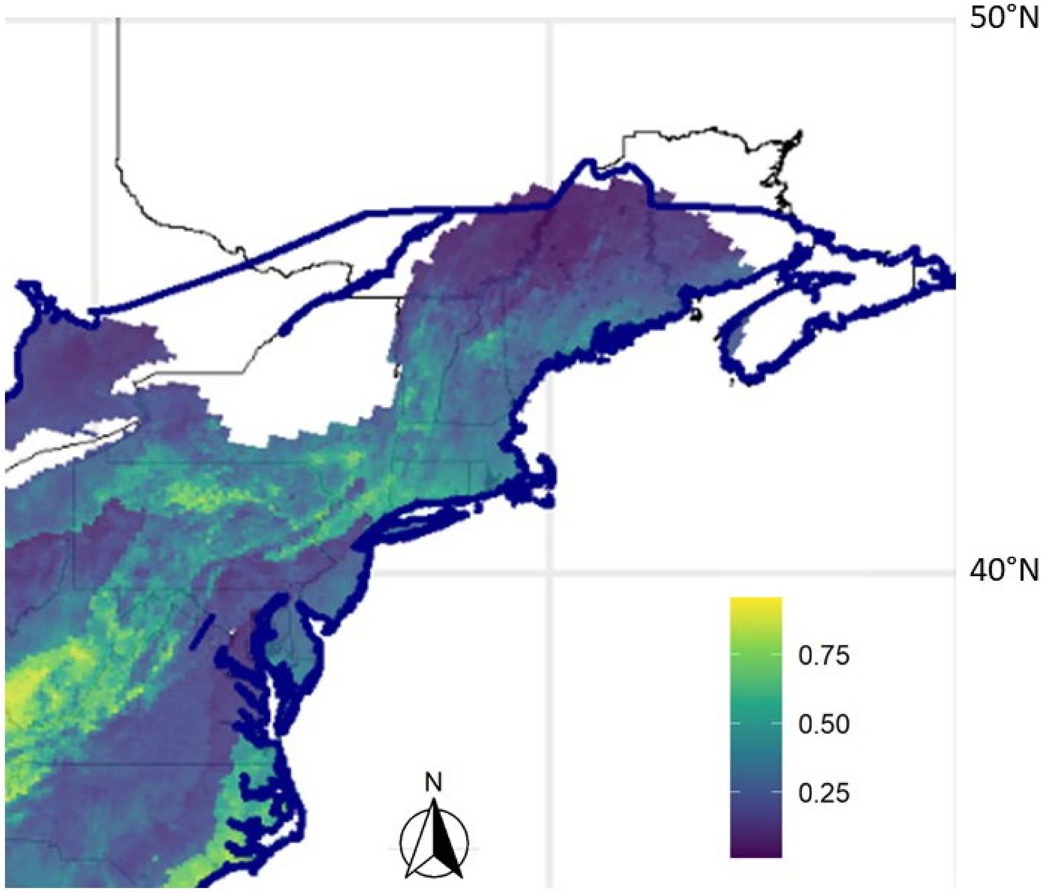
During the spring, summer, and fall—collectively referred to as the non-hibernating seasons—tricolored bats primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees. In the southern and northern portions of their range, they will also roost in Spanish moss (*Tillandsia usneoides*) and lichen *(Usnea trichodea)*, respectively. In addition, tricolored bats have been observed roosting during summer among pine needles and eastern red cedar (*Juniperus virginiana*); within artificial roosts such as barns; beneath porch roofs, bridges, and concrete bunkers, and rarely within caves. Female tricolored bats exhibit high site fidelity, returning year after year to the same summer roosting locations. Females regularly form maternity colonies while males roost singly. During the winter, tricolored bats hibernate in caves and mines; however in the southern United States, where caves are sparse, they often hibernate in road-associated culverts, as well as sometimes in tree cavities and abandoned water wells. Tri-colored bats exhibit high site fidelity with many individuals returning year after year to the same hibernaculum. They mate in the fall, hibernate in the winter, and emerge in the spring. They then migrate to summer habitat where females form maternity colonies, where young are born. Bats disperse once young can fly, and then return to winter habitats to swarm, mate, and hibernate. Tricolored bats emerge early in the evening and forage at treetop level or above, but may forage closer to ground later in the evening. This bat species exhibits slow, erratic, fluttery flight while foraging and are known to forage most commonly over waterways and forest edges.

4.3.2 TRICOLORED BAT IN THE ACTION AREA

Tricolored bat uses habitats that is very similar to habitats used by the northern long-eared bat (see Section 4.2). The occurrence of tricolored bat in the vicinity of the Onshore Action Area is predicted to be relatively low (Figure 4-2). Prior to WNS in the year 2000 there were several occupied hibernacula in northern New Jersey, but the estimated number of current (2020) occupied hibernacula in New Jersey is one (USFWS 2021a); where the occupied and historical hibernacula are located in northern and western New Jersey.

Although there were five detections of this species during offshore acoustic surveys conducted as part of the proposed Project in 2020 and 2021 (COP Volume II, Appendix II-F4; Atlantic Shores 2023) including a recent opportunistic sighting off North Carolina (Thornton et al 2023), other available survey data and the ecology of the species suggest there is little evidence of use of the offshore environment. Offshore surveys recorded several observations of migratory tree bats in the nearshore portion of the New Jersey Coast, but no bats were identified as tricolored bat (NJDEP 2010). There are records of tricolored bat in Nantucket, Massachusetts (Dowling and O'Dell 2018), indicating that some individuals traveled over open water to the islands, but their occurrence over the ocean is rare. During the offshore construction of the Block Island Wind Farm, bats were monitored with acoustic detectors on boats; no tricolored bats were detected among the 1,546 bat passes (Stantec 2018). Preliminary results of the first year of post-construction monitoring at Block Island Wind Farm indicated relatively low numbers of tricolored bat calls (33 out of 1,086 calls) (Stantec 2018). In addition, recent data from 3 years of post-construction monitoring around Block Island Wind Farm found relatively low numbers of bats present only during the fall (Stantec 2020); although 80 passes were labeled as tricolored bats, none had characteristics that were diagnostic of the species, and these were more likely to be eastern red bats (Stantec 2020). Acoustic detectors on WTGs in Dominion Energy's CVOW pilot project off Virginia has not detected tricolored bat (Dominion 2022, Normandeau 2022).

Collectively, this information indicates that tricolored bat could occur in the terrestrial components of the Action Area during non-hibernation periods, although presence would be unlikely and in very small numbers. Any occurrence of tricolored bat in the offshore component of the Action Area would be very rare, in very small numbers, and very likely when winds are below cut-in speed for turbines.



Source: U.S. Geological Survey, North American Bat Monitoring Program (2022).

Figure 4-2 ***Perimyotis subflavus*** **Mean Occupancy Probabilities Predicted in the Modeled Species Range for 2019**

4.4. EASTERN BLACK RAIL

4.4.1 SPECIES DESCRIPTION

The eastern black rail is a small and secretive marsh bird that lives in coastal high marshes and freshwater wetlands throughout eastern North America. The subspecies (of four recognized in North America) was listed under the ESA as Threatened in 2020 with a 4(d) Rule specifying certain prohibitions on, and exceptions to, allowable "take" under the ESA; USFWS further determined that the designation of critical habitat for the eastern black rail was not prudent (85 FR 63764).

Adult eastern black rails are generally blackish-gray and finely barred or spotted with white, with a small black bill and noticeably bright red eyes. Males are generally darker in color than females (USFWS 2019b). Very little is known about the eastern black rail due to its nocturnal habits and preference to stay hidden from view among dense marsh grasses (USFWS 2019b). Habitat for eastern black rail consists of tidal salt marshes, most often on the lee (i.e., sound) side of coastal barrier islands, dominated by saltmeadow cordgrass and saltgrass that attain heights of 18 to 24 inches (46 to 61 centimeters) and are bent over by wind and rain to form dense recumbent mats that are supported by stems below (Watts 2016).

Wintering habitat for eastern black rails is thought to be similar to breeding habitat, with a slight shift south. Eastern black rails in New Jersey are migratory; they winter farther south, from the Carolinas to Florida and also in the Caribbean and Central America (Eddleman et al. 2020). Peak spring migration occurs in mid-March to early May, and peak fall migration occurs from mid-September through the end of October, but observations and communications tower mortality data indicate that there are no apparent concentrated migration routes in either spring or fall (Watts 2016; USFWS 2019b). Nesting extends from mid-May through mid-August (Watts 2021).

The listing rule (85 FR 63764) states that the primary threats to eastern black rail are (1) habitat fragmentation and conversion, resulting in the loss of wetland habitats across the range; (2) sea level rise and tidal flooding; (3) land management practices (i.e., incompatible fire management practices, grazing, and haying/mowing/other mechanical treatment activities); and 4) stochastic events (e.g., extreme flooding, hurricanes). Human disturbance, including birders using excessive playback calls of black rail vocalizations, is also a concern for the species. Additional stressors to the species include oil and chemical spills and other environmental contaminants; disease, specifically West Nile virus; and predation and altered food webs resulting from invasive species (fire ants, feral pigs, nutria, mongoose, and exotic reptiles) introductions (USFWS 2019b). The greatest current threat to black rails in New Jersey is the loss of breeding sites due to ongoing sea level rise (Watts 2016).

Prohibitions under the 4(d) Rule include: purposeful "take" of eastern black rail, to include capture, handling, or other activities; incidental take from prescribed burns (unless utilizing best management practices [BMPs]), mowing, haying, and other mechanical treatment activities in the bird's habitat during the nesting or brooding periods; and grazing on public lands that occur in the bird's habitat and do not support the maintenance of dense overhead cover in at least 50 percent of habitat in any given calendar year.

4.4.2 EASTERN BLACK RAIL IN THE ACTION AREA

If eastern black rail occurs in the Onshore Action Area, it would likely be limited to the salt marsh habitat in the coastal bays. Herbaceous salt marsh habitat is present in the Atlantic Landfall to Cardiff POI portion of the Onshore Action Area; therefore, this species may occur in this area during the spring, summer, and fall months. In contrast, this type of habitat is not present in the Monmouth Landfall to Larrabee Substation POI portion of the Onshore Action Area nor is it present in the portion of the Action Area associated with the proposed O&M facility. There is a low frequency (0–2 percent) of eBird (2022) eastern black rail observations in the past 10 years within the Onshore Action Area, including landfalls.

Migration routes of eastern black rails follow the distribution of available habitat and also include stopover habitat in wet prairies, wet meadows, or hay fields during migration (USFWS 2020b). There is no evidence of the species migrating or otherwise occurring within the Offshore Action Area. Despite estimates of 40 to 60 breeding pairs in New Jersey (Watts 2016), focused surveys conducted since 2015 have failed to record any occurrences of eastern black rail (NJDEP 2018, 2019). Thus, due to the very small number of eastern black rails in New Jersey and the extremely low likelihood of occurrence on the Atlantic OCS 15 miles from land, the likelihood of this species being in the Offshore Action Area is extremely low.

4.5. SALTMARSH SPARROW

4.5.1 SPECIES DESCRIPTION

The saltmarsh sparrow is not federally listed under the ESA. The USFWS initiated the listing decision-making process in 2019 and then postponed the decision until late 2023. At the state level, the saltmarsh sparrow is categorized as a Species of Special Concern in New Jersey and not yet listed as Endangered or Threatened. A recent status review by the State of New Jersey recommended a breeding season status upgrade to Threatened (ACJV 2022). This species is not required to be analyzed for ESA Section 7 consultation but is evaluated here to streamline consultation should this species become listed in the future.

The saltmarsh sparrow is a tidal marsh obligate that prefers high marsh habitat dominated by saltmeadow cordgrass, as well as salt-grass and saltmarsh rush (*Juncus gerardii*). It nests in drier supratidal areas that do not flood as frequently as low marsh. The saltmarsh sparrow breeds along the northeastern U.S. coast, from Maine to the Chesapeake Bay, and winters along the southeastern coast, from Maryland and Virginia south to Florida. North of this range, early winter numbers are variable and a few birds sometimes occur in late December in New Jersey, in Cape May and Cumberland counties (Greenlaw et al. 2020). The breeding season for saltmarsh sparrow in New Jersey begins in early May and lasts until late August (CWF 2022). Timing of spring departure of a few wintering individuals from Virginia north to New Jersey is poorly documented, but one “extreme” date of June 3 was provided in Maryland. In western shore marshes of Chesapeake Bay in Virginia, where the species formerly bred, recent fieldwork indicated that nearly all individuals had departed for breeding grounds in New Jersey by June 10 (Greenlaw et al. 2020).

Available data on population trends for saltmarsh sparrow suggest that loss of coastal marsh habitat over the past century has resulted in population reductions with local extirpations and over 80 percent of the population disappearing in just the last 25 years. At the observed rate of decline of 9 percent per year, the population has presumably shrunk from ~60,000 individuals (in 2011/2012) to fewer than 30,000 currently (Hartley and Weldon 2020). Habitat loss and impacts on habitat quality due to draining, ditching, and pollution of salt marsh habitat have caused some populations of this species to decline. Increased human recreational activities at coastal marshes also threaten this species (CWF 2022). Sea level rise may shrink the available saltmarsh sparrow nesting habitat in New Jersey, and the high marsh saltmeadow cordgrass is increasingly occupied by the taller smooth cordgrass (*Spartina alterniflora*) (Hartley and Weldon 2020). While nest flooding is the primary limiting factor for saltmarsh sparrows across their breeding range, nest depredation was the greatest cause of nest loss in one study in southern New Jersey (Roberts et al. 2017) and is thought to increase from north to south (Hartley and Weldon 2020).

4.5.2 SALTMARSH SPARROW IN THE ACTION AREA

In 2011/2012, New Jersey contained approximately one-third of all breeding saltmarsh sparrows with a breeding population estimate of 19,900 ± 13,600 (Hartley and Weldon 2020). The New Jersey Saltmarsh Habitat and Avian Research Program reported that New Jersey has the highest abundance in the northeast region, at 33 percent of the total northeast regional population (SHARP 2016; ACJV 2022). This proportional population estimate generally agrees with the range-wide population estimate by Wiest et al. (2016) of 53,000 saltmarsh sparrows (95 percent confidence interval[3](CI) = 37,000–69,000). The species is estimated to have been in decline at a steep rate of 9 percent per year since the 1990s (ACJV 2020).

A desktop habitat assessment was conducted to identify suitable habitat for saltmarsh sparrows within all onshore portions of the Project area. Suitable saltmarsh sparrow habitat in the Action Area occurs within the high marsh areas of salt marsh habitat described in Section 4.4 for the eastern black rail. Salt marsh habitat in the Atlantic Landfall to Cardiff POI portion of the Onshore Action Area is present in the marsh complex to the north and south of the Atlantic City Expressway, along the eastern end of the cable installation route. Saltmarsh sparrows have potential to occur in these marshes year-round. There is only one eBird observation of saltmarsh sparrow in this area, from January of 1990, located to the north of the Atlantic City Expressway interchange with Route 40. Farther north, on the north side of Route 30, near the Abescon Boulevard Bridge, there is a more recent eBird record of saltmarsh sparrow, from April of 2019. Limited accessibility to these marshes by the public likely accounts for the lack of additional eBird observations nearby. The Atlantic Coast Joint Venture (ACJV) Saltmarsh Sparrow Habitat Prioritization Tool's regional rankings of the marshes in this complex vary widely from 4,017 (relatively low quality) to 633 (relatively high quality) out of 8,680 total marshes ranked in the species' breeding range.

Saltmarsh habitat is not present in the Monmouth Landfall to Larrabee Substation POI portion of the Onshore Action Area; nor is it present in the portion of the Action Area associated with the proposed O&M facility. The ACJV Saltmarsh Sparrow Habitat Prioritization Tool also does not identify any saltmarsh sparrow habitat in the vicinity of these areas. For these reasons, saltmarsh sparrows are not expected to occur in these portions of the Onshore Action Area.

[3] A 95 percent confidence interval is defined here as the mean plus and minus the margin of error and represents a range of values that the estimate of the mean can be expected to fall between with a 95 percent level of confidence.

4.6. PIPING PLOVER

4.6.1 SPECIES DESCRIPTION

The piping plover is a small, migratory shorebird that breeds along the Atlantic coast, the Great Lakes, and the Great Plains regions of the United States and winters in coastal habitats of the southeastern United States, coastal Gulf of Mexico, and the Caribbean (Elliot-Smith and Haig 2004; USFWS 1996, 2020e). The USFWS listed the Atlantic coast breeding population as Threatened in 1986 (50 FR 50726). Critical habitat for wintering piping plovers has been established along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas (66 FR 36038). Only the Atlantic coast population has the potential to occur within the proposed Action Area during the breeding season, as well as spring and fall migration.

The breeding range of the Atlantic coast population includes the Atlantic coast of North America from Canada to North Carolina. The piping plover breeding season extends from April through August, with piping plovers arriving at breeding locations in mid-March and into April. Piping plovers lay eggs from April to May, with an incubation period that lasts approximately 27 to 30 days. Although piping plovers usually produce only one brood per season, they may re-nest up to several times if early nests are destroyed. Piping plover chicks fledge from late June to mid-August, 25 to 35 days after hatching. Post-breeding staging in preparation for migration extends from late July through September (USFWS 1996). Piping plovers are present along the New Jersey coastline from March to October, and peak in abundance between April and July (COP Appendix II-F2; Atlantic Shores 2023). Piping plover breeding habitat consists of generally undisturbed, sparsely vegetated, flat, sand dune-beach habitats such as coastal beaches, gently sloping foredunes, sandflats, and washover areas to which they are restricted (USFWS 1996, 2020e). Nests sites are shallow, scraped depressions in a variety of substrates situated above the high-tide line (USFWS 1996). Piping plovers forage in the intertidal zone. Foraging habitat includes intertidal portions of ocean beaches, washover areas, wrack lines, mudflats, and sandflats, as well as shorelines of coastal ponds, lagoons, and saltmarshes where they feed on beetles, crustaceans, fly larvae, marine worms, and mollusks (USFWS 1996; BOEM 2012).

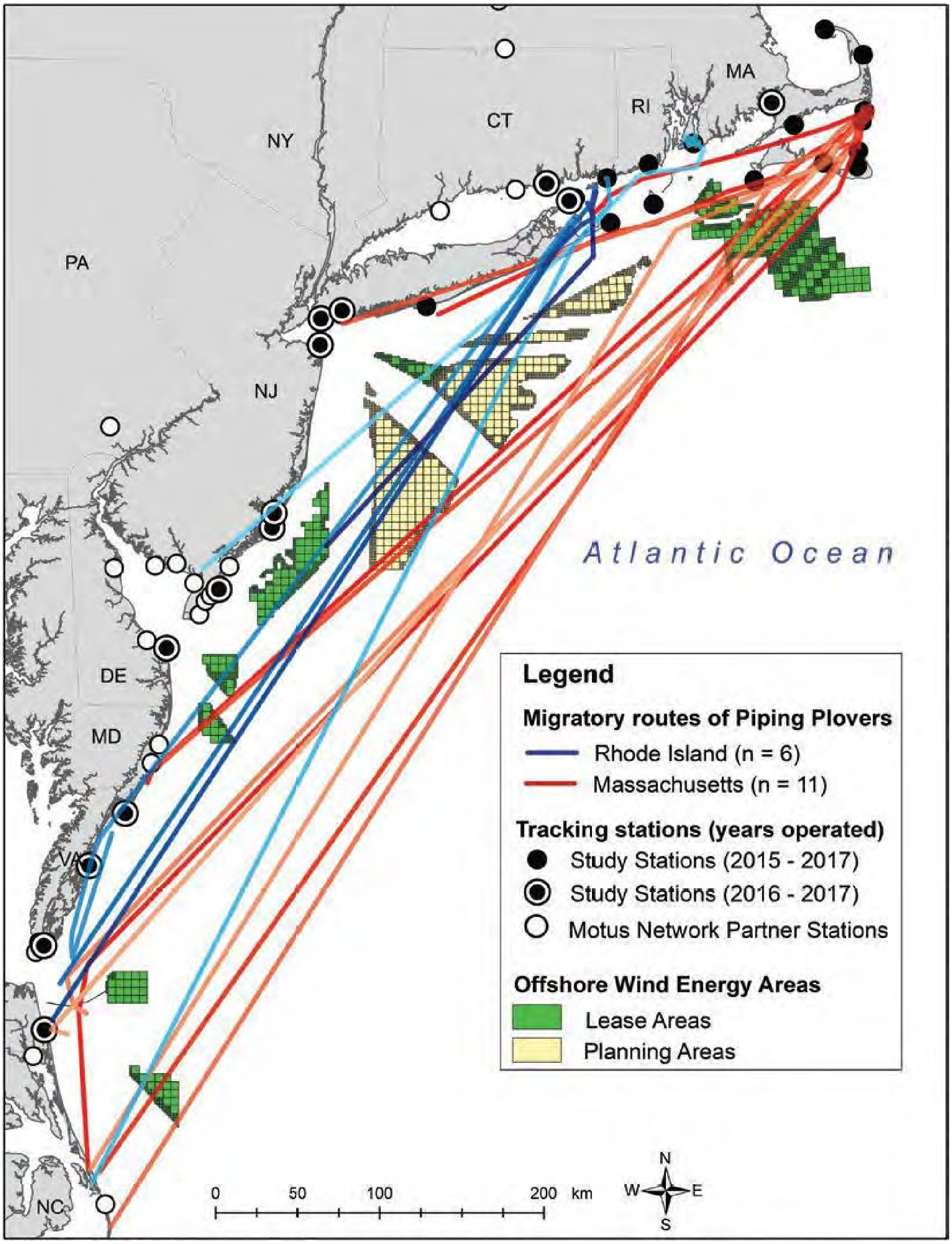
While the precise migratory pathways along the Atlantic coast and to the Bahamas are not well known (USFWS 2009; Normandeau 2011; BOEM 2012), both spring and fall migration routes are believed to follow the Atlantic coast. Similar to other shorebirds, piping plovers either make nonstop long-distance migratory flights (Normandeau 2011), or offshore migratory “hops” between coastal areas (Loring et al. 2021). There are no definitive observations of this species in offshore environments greater than 3 miles (4.8 kilometers) from the Atlantic coast (Normandeau 2011). This is likely due to the difficulty in detecting piping plovers due to their nocturnal and high-altitude migration.

Coastal development is the primary anthropogenic threat to piping plovers. Other threats include disturbance by humans, dogs, and the driving of vehicles on sandy beaches and dune habitats (Elliott-Smith and Haig 2004; USFWS 2009). The piping plover is among 72 avian species (out of 177 species on the Atlantic OCS) that ranked moderate in its relative vulnerability to collision with wind turbines (Robinson Willmott et al. 2013). Watts (2010) identified the piping plover as among the bird species least able to sustain mortality, with a Potential Biological Removal (PBR) value of 61 individuals. However, despite these population pressures, there is little risk of near-term extinction of the Atlantic coast population of piping plovers (Plissner and Haig 2000), and since that prediction in 2000, the Atlantic coast population has been steadily growing from a low of 790 breeding pairs in 1986 to an estimated 2,289 breeding pairs in 2021 (USFWS 2020d, 2022b). The number of nesting piping plovers in the NY-NJ recovery unit in recent years has ranged from approximately 400 to 600 breeding pairs (USFWS 2020d). The number of breeding piping plovers in New Jersey specifically was 103 pairs in 2020 and 137 pairs in 2021 (USFWS 2022b).

4.6.2 Piping Plover in the Action Area

Only the Atlantic coast population of piping plovers has the potential to occur in the Action Area. Suitable habitat for nesting and foraging by piping plover occurs along the beaches of the Onshore Action Area; therefore, this species could be present during migration and/or breeding seasons. The closest recent documentations of nesting activity near the Action Area are within approximately 800 feet (244 meters) from the Monmouth Landfall Site and approximately 8 miles (13 kilometers) from the Atlantic City Landfall Site (COP Appendix II-F2; Atlantic Shores 2023; Walsh pers. comm.). In 2021, the closest nest to the Atlantic City Landfall Site was approximately 7 miles (11 kilometers) away (Walsh pers. comm.). There is a low frequency (0–10 percent) of eBird (2022) piping plover observations in the past 10 years within the Onshore Action Area, including landfalls.

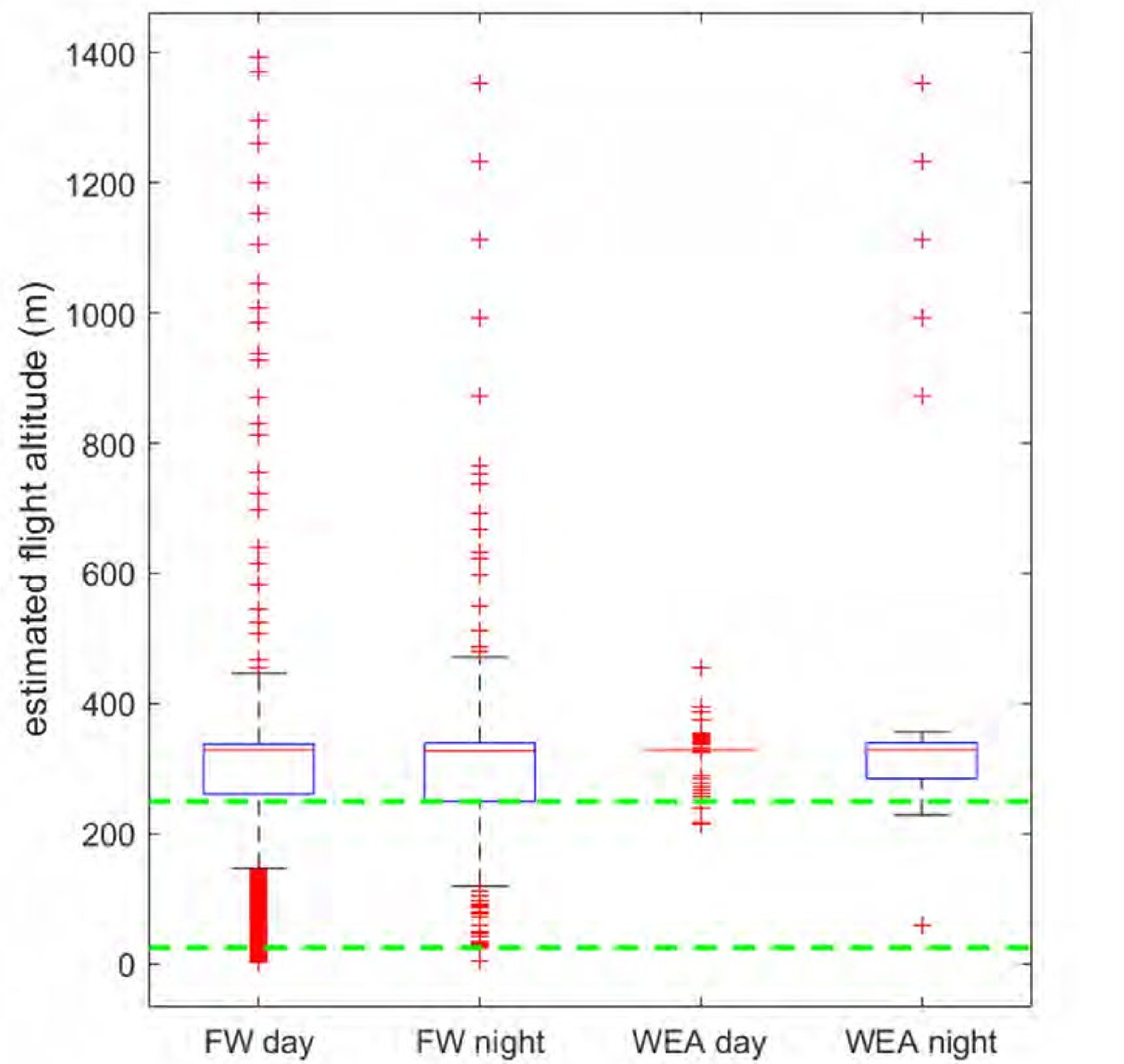
The offshore component of the Action Area lies within the migratory corridor for plovers leaving nesting and staging grounds in New England in the fall, and a small percentage of adult and subadult migrant piping plovers may fly over the offshore component of the Action Area (Figure 4-3). Loring et al. (2020) found that only 12 percent (2 out of 17) of the radio-tagged plovers leaving breeding areas in Massachusetts and Rhode Island during fall migration flew through lease areas off New Jersey, although it is possible that additional plovers flew beyond the range of the land-based receiver network and passed through or near the lease areas without detection. These numbers also represent a course estimation of interpolated flight paths that is based on a subset of individuals (17 of 52; 33 percent) that were detected anywhere south of eastern Long Island (Loring et al. 2020) and may not be representative of plover populations departing from locations outside of Massachusetts and Rhode Island. In spring, 2 of 10 plovers fitted with transmitters in the Bahamas had enough detections to estimate flight paths and traveled north, close to shore and west of the Project (Appendix I in Loring et al. 2019). One of these two birds had a flight speed between detections in the Bahamas and South Carolina that suggested a potential flight trajectory that crossed the OCS, 124 miles (200 kilometers) from shore. Otherwise, the northbound migratory routes of piping plovers from wintering grounds to breeding grounds in the northeastern United States remain largely unknown. Based on the best available information about northbound and southbound migratory routes of piping plovers, however, little piping plover activity is expected to occur within the Action Area. Most migratory flights of the piping plovers in the studies by Loring et al. (2019, 2020) were also estimated to be at an altitude above the studies' hypothetical turbine height, with 15.2 percent of the estimated flight tracks within the hypothetical rotor-swept zone (RSZ) (Figure 4-4). Of 17 piping plovers tracked across the Mid-Atlantic Bight, 7 flights were at an estimated altitude that would overlap with the Proposed Action's RSZ (Loring et al. 2020), although the authors caution that flight altitudes, which are not directly measured by digital radio-tags and thus could only be inferred at a coarse scale but are representative of the conditions that the birds experience during flight.



Source: Loring et al. 2020

Figure shows individual Piping Plovers tracked across a broader portion of the Mid-Atlantic Bight from breeding areas in Rhode Island (n = 6) and Massachusetts (n = 11).

Figure 4-3 Ocean Modeled Migratory Tracks and Composite Probability Density of Piping Plovers with WEA Exposure in the Mid-Atlantic Bight, 2015 to 2017



Source: Loring et al. 2019.

Note: The green-dashed lines represent the lower and upper limits (25-250 meters).

Figure 4-4 Estimated Flight Altitude Ranges (Meters) of Piping Plovers During Exposure to Federal Waters (Altitude When Crossing from State into Federal Waters) and WEAs (Altitude When Flying through WEAs) During Day and Night.

4.7. *RUFA* RED KNOT

4.7.1 SPECIES DESCRIPTION

The *rufa* red knot is a medium-sized member of the sandpiper family with one of the longest migrations in the world between its breeding grounds in the Canadian Arctic and wintering habitat along the northwest coast of the Gulf of Mexico, along the north coast of Brazil, along the U.S. Atlantic coast from Florida to North Carolina, and along the Atlantic coasts of Argentina and Chile (USFWS 2014, 2021b). In 2015, the USFWS listed the species as Threatened under the ESA (79 FR 73706). The USFWS proposed critical habitat for the *rufa* red knot in 2021 (86 FR 37410), but not within the Action Area.

Over the last 20 years, the *rufa* red knot has declined from a population estimated at 100,000 to 150,000 down to 18,000 to 33,000 (Niles et al. 2008), with the most recent USFWS Species Status Assessment estimating the population size to be 64,000 (USFWS 2020e). The *rufa* red knot is composed of four distinct populations defined by their overwintering regions: in Argentina/Chile , Northern Brazil and the northern coast of South America, the western Gulf of Mexico extending from Mississippi through Central America (including Pacific South America), and the Southeast United States/Caribbean. The best available population estimates in the wintering areas are: 15,500 in Southeast United States/Caribbean, 31,000 in Northern Brazil and the northern coast of South America, 5,500 in the western Gulf of Mexico/Central America/Pacific South America, and 11,600 in Argentina/Chile—a total of 63,600 (USFWS 2020e).

Primary threats to the *rufa* red knot population are the loss of breeding and nonbreeding habitat due to climate change, sea level rise, and coastal development; disruption of natural predator cycles on breeding grounds; and the decoupling of the migratory cycle and favorable weather conditions and food availability. Other threats include hunting and predation in nonbreeding areas, harmful algal blooms, and anthropogenic disturbance. Coastal wind energy development is also considered a threat to the *rufa* red knot population. (USFWS 2020e). Watts (2010) identified the *rufa* red knot as among the bird species least able to sustain mortality, with a PBR value of 451 individuals. the *rufa* red knot is one of 72 species populations (out of 177 species on the Atlantic OCS) ranked “medium” in relative vulnerability to collision with offshore wind turbines (Robinson Willmott et al. 2013).

Rufa red knot occurrence on the Atlantic coast is strictly seasonal. Delaware Bay, along the southern border of Cape May County, is a critical stopover area for *rufa* red knots and supports 50 to 80 percent of all *rufa* red knots during spring migration (USFWS 2014). Important spring and/or fall migration stopover sites or winter foraging and roosting habitat are also found along the Atlantic coast of New Jersey at Brigantine and Little Egg Inlets, Seven Mile beach, Hereford Inlet, Two Mile Beach, Cape May Bayshore, Dennis Creek, Heislerville, Egg Island, and Newport Neck (USFWS 2021c). They utilize sandy coastal beaches at or near tidal inlets or the mouths of bays and estuaries, peat banks, salt marshes, brackish lagoons, tidal mudflats, mangroves, and sandy/gravelly beaches where they feed on clams, crustaceans, invertebrates, and the eggs of horseshoe crabs that come ashore to spawn in late May. The spring migration coincides with the spawning season for the horseshoe crab, which is an important food for migrating birds, particularly in Delaware Bay. Mussel beds on the New Jersey coast are also an important food source (USFWS 2021d). After stopping in Delaware Bay, some *rufa* red knots travel up the coast, but the vast majority travel directly overland to breeding areas in Hudson Bay, Canada, and do not fly farther east over federal waters on the OCS .

4.7.2 *RUFA* RED KNOT IN THE ACTION AREA

Rufa red knots are present in New Jersey during spring (northbound) and fall (southbound) migratory periods. They use key staging and stopover areas to rest and feed, especially Delaware Bay (Niles et al. 2010). *Rufa* red knots begin arriving at stopover areas along Delaware Bay and the New Jersey coast during the first week of May, and large flocks occur in these areas from mid-May to early June. Juveniles and non-breeding adults can also be present in New Jersey in June and early July. The fall migration period is from mid-July through November (NJDEP 2020; USFWS 2021b). On some New Jersey beaches, *rufa* red knots can persist into early winter and migrate farther south to winter in the Southeast United States/Caribbean. These birds are considered short-distance migrants, while red knots that winter in South America are designated as long-distance migrants. On their southbound migrations in the fall, the short-distance migrants are expected to fly down the Atlantic coast in a series of short hops to winter on the southeast U.S. coast or the Caribbean, while the long-distance migrants are generally expected to fly directly offshore from coastal New Jersey, across the Atlantic in multi-day offshore flights to their wintering areas in South America. Large concentrations of *rufa* red knots are found along the southern bay beaches of Cape May County and along the Atlantic coast beaches of New Jersey from the Edwin B. Forsythe National Wildlife Refuge in southern Ocean County to the southern tip of Cape May. Other locations known to support concentrations of *rufa* red knots include Avalon, Cape May Refuge, Horseshoe Island, North Brigantine Natural Area, and Stone Harbor Point (Tetra Tech 2017; Davis pers. comm.); however, during migration, transient red knots may be found anywhere along New Jersey's coasts in nearly every month and may move over inland areas during migration (USFWS 2021d). Migration and wintering habitats include both high-energy ocean- or bay-front beaches with large areas of exposed intertidal sediments, as well as tidal flats in more sheltered bays and lagoons (USFWS 2014). The red knot spring stopover population size in Delaware Bay was estimated at 42,271 (95 percent credible interval: 35,948 to 55,210) in 2021(Lyons 2021). Unfortunately, there are no stopover population estimates for the red knot near the onshore portions of the Project area. Therefore, relative numbers were obtained from eBird's Shorebirdvis tool (Red Knot - Calidris canutus - ShorebirdViz).

Suitable stopover and foraging habitat for *rufa* red knot occur along the beaches of the Onshore Action Area; therefore, this species could be present during the migratory season, but would likely be limited to the beaches and tidal wetlands and not farther inshore along the interconnection cable corridors between the landfalls and POIs. There is a low frequency (0–10 percent) of eBird (2022) *rufa* red knot observations in the past 10 years within the Onshore Action Area, including landfalls.

Vessel-based NJDEP (2010) baseline studies did not document any *rufa* red knots in the offshore portion of the Action Area, and the MABS surveys for all shorebirds (which included *rufa* red knots) documented very small numbers of shorebirds during all seasons on the OCS in waters, similar to those within the Project vicinity. However, migrating individuals may traverse the NJ WEA. Based on the radiotelemetry study by Loring et al. (2018), which tracked red knots tagged with digital nanotags in James Bay and the Mingan Islands in Canada, and in Massachusetts and New Jersey, 3 out of 388 tagged *rufa* red knots crossed the NJ WEA; one from Massachusetts (n = 99) and others were from New Jersey (n = 35; from Stone Harbor Point, Brigantine Natural Area, and Avalon Point). It is possible that additional individuals occurred in the area but were not detected due to the limited range of the land-based receiver network. Of the 3 individuals tracked across the NJ WEA, 2 flights were final migratory departure flights, and one was a flight between stopover areas (Loring et al. 2018). Although there are animated flight maps of additional nanotagged red knots on the Motus website, the raw detection data underlying these connect-the-dot flight paths may not have been validated or checked for accuracy (unlike Loring et al. 2018), and the results of the studies have not been published in any peer-reviewed documents to date.

Recently, BRI and Wildlife Restoration Partners (2022), on behalf of Ocean Wind, conducted a study in tracking short-distance migrants in coastal New Jersey using Global Positioning System (GPS) telemetry. The team deployed 32 tags on red knots, and 17 tags provided location and altitudinal information. Of the 17 individuals with tags that provided data, 5 made migratory movements within the life of the tags, including 4 short-distance migrants and 1 long-distance migrant. The tracks of 1 short-distance migrant passed through the lease area at 72 feet (22 meters) above the water on its way to Cuba. Overall, the majority of locations collected by satellite tags were associated with relatively low flight height estimates. A wind analysis indicated that the tagged red knots generally initiated migration with favorable tailwinds, that the one long-distance migrant had favorable wind support throughout its offshore movements, and that the short-distance migrants flew in more variable wind conditions.

Another GPS telemetry study by Feigin et al. (2022) investigated the southward migration of long-distance migrants captured at a key stopover location at Brigantine Natural Area in Atlantic County. Sixty red knots were tagged with GPS satellite transmitters and 40 provided reliable locational data. The migration tracks of tagged birds followed the expected migration routes. Some of the birds headed directly offshore from stopover sites in New Jersey on their way to wintering areas in South America (long-distance migrants), and some took a coastal route in which they hugged the shore on their way south to wintering areas in the southeastern United States and Caribbean islands (short-distance migrants). Nearly 38 percent (15 of the 40 birds that provided tracking data) may have crossed the Atlantic Shores Lease Area. One knot was recorded within the Lease Area flying at 575 meters above the water while it was assumed that the others crossed the Lease Area based on straight lines drawn between locations or animal movement models that estimate paths between locations. For the 15 birds that may have crossed the Atlantic Shores Lease Area, the majority departed during the night, with light winds blowing from the north, little to no precipitation, generally good visibility, and warm temperatures. Across both satellite telemetry studies (BRI and WRP 2022; Feigin et al. 2022), 16 of the 57 total red knots from which tracking data were acquired (28 percent) may have crossed the Atlantic Shores Lease Area.

Information from the nanotag telemetry studies about how *rufa* red knots migrate in spring and information from the satellite telemetry studies about how they migrate in fall, along with what is known about overwintering *rufa* red knots, can be collectively used to characterize red knot passage in the context of the Lease Area. In spring, short-distance migrants overwintering in the Southeast United States are joined by others from the Caribbean to travel northward mostly to Delaware Bay as well as other regional estuaries and coasts. Some birds may take an inland route while others will travel up the coast. After stopping in Delaware Bay or nearby, most will travel inland to breeding areas in Canada while some birds may continue to travel up the coast before turning west to head to breeding areas; these birds are not likely to cross the Lease Area during spring migration. After breeding, these birds fly back and stage on Atlantic coast beaches working their way south down to their overwintering grounds. Birds south of Delaware may continue to fly south near the coast or depart to the Caribbean.

A total of 42,600 red knots from the South American wintering populations follow similar routes as the Southeast United States/Caribbean birds but with some notable exceptions. Birds overwintering in the southern part of South America (Southern) travel northward and are joined by others from Northern Brazil. Birds from both populations then fly offshore heading to North America. Not all birds from these populations fly directly to Delaware Bay, and as many as 27 percent (17,522) could bypass Delaware Bay in spring (USFWS 2021b). More recent data appear to support this assumption (see Pelton et al. 2022), which is also revealed by recent telemetry studies using nanotags. The majority of red knots fitted with nanotags at Bahia Lomas, Chile (66.7 percent, 8 out of 12 fitted with nanotags, Table 4-2) first made landfall south of Delaware Bay. These birds then traveled the shortest route northward either inland or along the coast to Delaware Bay. The next largest group of red knots from Bahia Lomas (16.6 percent, 2 out of 12, Table 4-2) first made landfall east of Delaware Bay at Cape May, New Jersey (south of the Action Area). After stopping in Delaware Bay, most traveled inland to breeding areas in Canada and none traveled farther up the coast. Of course, some birds may bypass Delaware Bay. For example, 1 of the 12 birds tagged in Bahia Lomas flew west into Pennsylvania, and another 1 of the 12 tagged birds made landfall at Long Island, New York, both bypassing a landfall at Delaware Bay. In another study, 27% of *rufa* red knots tagged during spring in Florida and South Carolina (which are a mix of overwintering populations from South America and the southeastern U.S./Caribbean) stopped in Delaware Bay as they continued migrating north, while the majority (73%) bypassed Delaware Bay and either stopped in Chesapeake Bay or New York Bay, or flew directly to their arctic breeding grounds via an overland route through the eastern Great Lake Basin (Smith et al. 2023).

No *rufa* red knots were detected at an active receiver station (RTNJ 4233) near the Lease Area capable of detecting birds 6 miles (10 kilometers) offshore (Mackenzie et al. 2017). However, it is possible for a small percentage of birds (8.3 percent) to make landfall anywhere north of Cape May from the New Jersey shore to Maine, thus creating a 770-mile (1,241-kilometer) migration front. The wind farm occupies 15 miles (24 kilometers) (1.9 percent) of the migration front. Based on this information, the number of birds potentially passing through the wind farm from west to east can be estimated by multiplying the total long-distant migrant population size (42,600 birds) times the proportion that by-pass Delaware Bay (0.083) times the proportion of the migration front that overlaps with the wind farm (0.019). An estimated total of 67 birds could pass through the wind farm in spring (= 42,600 total birds × 0.083 proportion bypass Delaware Bay × 0.019 proportion of migration front by lease).

Table 4-2 Spring Migration Landfall Sites of Nanotagged Red Knots from the Bahia Loma Shorebird Project in South America[1]

Tag ID	Land Fall Date	Location
20914	5/05/19	South Carolina
20908	5/18/19	South Carolina
20866	5/17/19	South Carolina
20878	5/22/19	South Carolina

Tag ID	Land Fall Date	Location
20953	5/18/19	South Carolina
20948	5/19/19	North Carolina
20959	5/23/19	Maryland
15656	5/18/18	Delaware Bay
20883	5/22/19	Cape May, NJ
20912	5/15/19	Cape May, NJ
15651	5/29/18	Pennsylvania
20958	5/23/19	Long Island, NY

Source: Mackenzie et al. 2017.
[1] Tag ID numbers are linked to Motus maps showing all detections and routes between them for each bird.

In fall, red knots leave their breeding grounds in Canada to return to their overwintering grounds. Birds from the Southeast United States/Caribbean population reach the Atlantic coast and work their way south along the coast to the Southeast United States to remain or to fly to and overwinter in the Caribbean. In contrast, birds from the Southern and Northern Brazil populations migrate offshore to their overwintering grounds. The largest staging grounds are along the Mingan Archipelago, Quebec, Canada, where 9,450 birds use the area (Lyons et al. 2018) and in James Bay, Ontario, Canada, where 9,710 and 10,706 birds were estimated to use the area in 2017 and 2018, respectively (MacDonald et al. 2021). A recent telemetry study found that 97 percent (out of 244 tagged birds) departed directly to South America on long-distance migratory routes that would take them beyond U.S. federal waters (Loring et al. 2018). Thus, out of the 63,600 red knots on the Atlantic (see Section 4.7.1, *Species Description*), it can be estimated that approximately 54,150 (= 63,600 – 9,450) depart to overwintering locations in South America from other locations on the Atlantic coast or work their way down the Atlantic coast (e.g., Cape Cod and areas along the New Jersey shore being considered for critical habitat by USFWS) and are among the Southeast United States/Caribbean birds. At maximum, approximately 1 percent of the red knot population stages in fall on the shores across from the proposed Lease Area (Appendix A, Figure A1) or 487 (= 1 percent × 48,650). Recent telemetry work in the area provides estimates of the percentage of birds that may fly offshore and potentially through the Lease Area. For example, 43 percent (15 out of 35) of the birds that were captured and fitted with nanotags in New Jersey were tracked in federal waters (Loring et al. 2018). Similarly, 38 percent (15 out of 40) of the satellite tagged birds crossed the Lease Area (Feigin et al. 2022). None of the short distance migrants passed through the Lease Area (BRI and Wildlife Restoration Partners 2022). Based on the GPS telemetry results, approximately 185 (38 percent) of these birds could fly through the Lease Area. More importantly, none of the GPS tracked birds near the Lease Area flew within the RSZ; in fact, one bird flew above the RSZ (1,887 feet [575 meters]), and the rest flew below the RSZ (Feigin et al. 2022; BRI and Wildlife Restoration Partners 2022). Therefore, based on red knot behavior, it is unlikely that migrating red knots will collide with turbines.

4.8. ROSEATE TERN

4.8.1 SPECIES DESCRIPTION

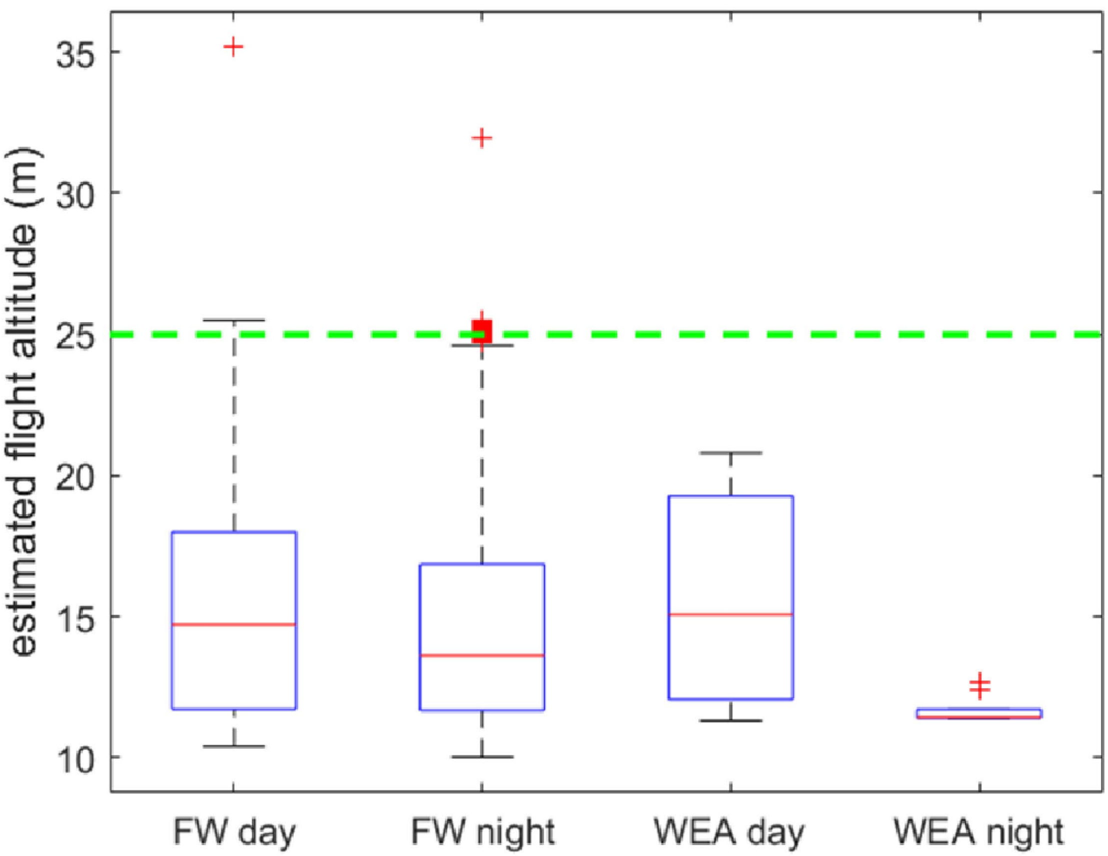
The roseate tern is a small, colonial tern and is one of several similar-appearing terns found throughout most of the world. The subspecies of roseate tern found in North America (*Sterna* *dougallii dougallii*) includes several widely separated breeding populations that breed on the northeastern coast of North America, several islands in the Caribbean Sea, and in northwestern Europe. The northeastern roseate tern population (also known as the Northwest Atlantic population) was listed under the ESA as Endangered in 1987, while terns in the Caribbean population are listed as Threatened (52 Federal Register 42064). The northeastern roseate tern population includes birds along the U.S. Atlantic coast south to North Carolina, the Canadian Atlantic coast north to Quebec, and Bermuda.

The northeastern population of roseate tern breeds on small islands or on sand dunes at the ends of barrier beaches along the Atlantic coast, occurring in mixed colonies with common terns (*Sterna hirundo*). The population is currently restricted to a small number of colonies on predator-limited islands from Nova Scotia to Long Island, New York, with over 90 percent of remaining individuals breeding at just three colony locations in Massachusetts (Bird Island, Ram Island, and Penikese Island in Buzzards Bay), and one colony in New York (Great Gull Island, near the entrance to Long Island Sound) (Nisbet et al. 2014; Loring et al. 2017). Historically, the northeastern roseate tern population was known to breed as far south as Virginia, but the species currently does not breed south of Long Island, New York (USFWS 1998). Declines have been largely attributed to low productivity, partially related to predators and habitat loss and degradation, although adult survival is also unusually low for a tern species (USFWS 2010). The historical population size in northeastern North America was estimated at 8,500 pairs in the 1930s, to around 3,500 pairs in 1995, and the most current estimate of 4,274 pairs in 2019 in Canada and the United States (USFWS 2020f; Nisbet et al. 2014).

Roseate tern foraging behavior and ecology are well described. Roseate terns forage by diving less than 1.6 feet (0.5 meter) into the water for sand lance (*Ammodytes americanus*) in shallow, warmer waters near shoals, inlets, and rip currents close to shore (e.g., Safina 1990; Heinemann 1992; Rock et al. 2007). The sand lance does occur off the shore of New Jersey. Roseate tern foraging flights are slow and range from 10 to 39 feet (3 to 12 meters) above the ocean surface. In sharp contrast to common terns, roseate terns are dietary specialists and exhibit strong fidelity to foraging sites and avoidance of clusters of other feeding tern species (Goyert 2015).

The northeastern roseate tern population generally migrates through the mid-Atlantic to and from its wintering grounds on the northeastern coast of Brazil and arrive at their northwest Atlantic breeding colonies in late April to late May, with nesting occurring between roughly mid-May and late July. Following the breeding season, adult and hatch-year roseate terns move to post-breeding coastal staging areas from approximately late July to mid-September (USFWS 2010). Foraging activity during the staging period is known to occur up to 10 miles (16 kilometers) from the coast, although most foraging activity occurs much closer to shore (Burger et al. 2011).

Migrating roseate terns can occur more than 62 miles (100 kilometers) from shore (Goyert et al. 2014; Loring et al. 2019), typically at flight heights of less than 82 feet (25 meters) (Figure 4-5). When departing breeding areas north of the Action Area (Great Gull Island, New York; Buzzards Bay, Massachusetts) on fall migration, some individuals appear to make long, non-stop, overwater flights towards the Caribbean and north and east coasts of South America while others stay closer to the shoreline and stage in the southeastern United States (Nisbet et al. 2011; Nisbet and Mostello 2015).



Source: Loring et al. 2019.

Note: During exposure to federal waters and Atlantic OCS WEAs during day and night. The green-dashed line represents the lower limit of an idealized RSZ used in the study (82 feet [25 meters]).

Figure 4-5 Model-Estimated Flight Altitude Ranges (Meters) of Roseate Terns

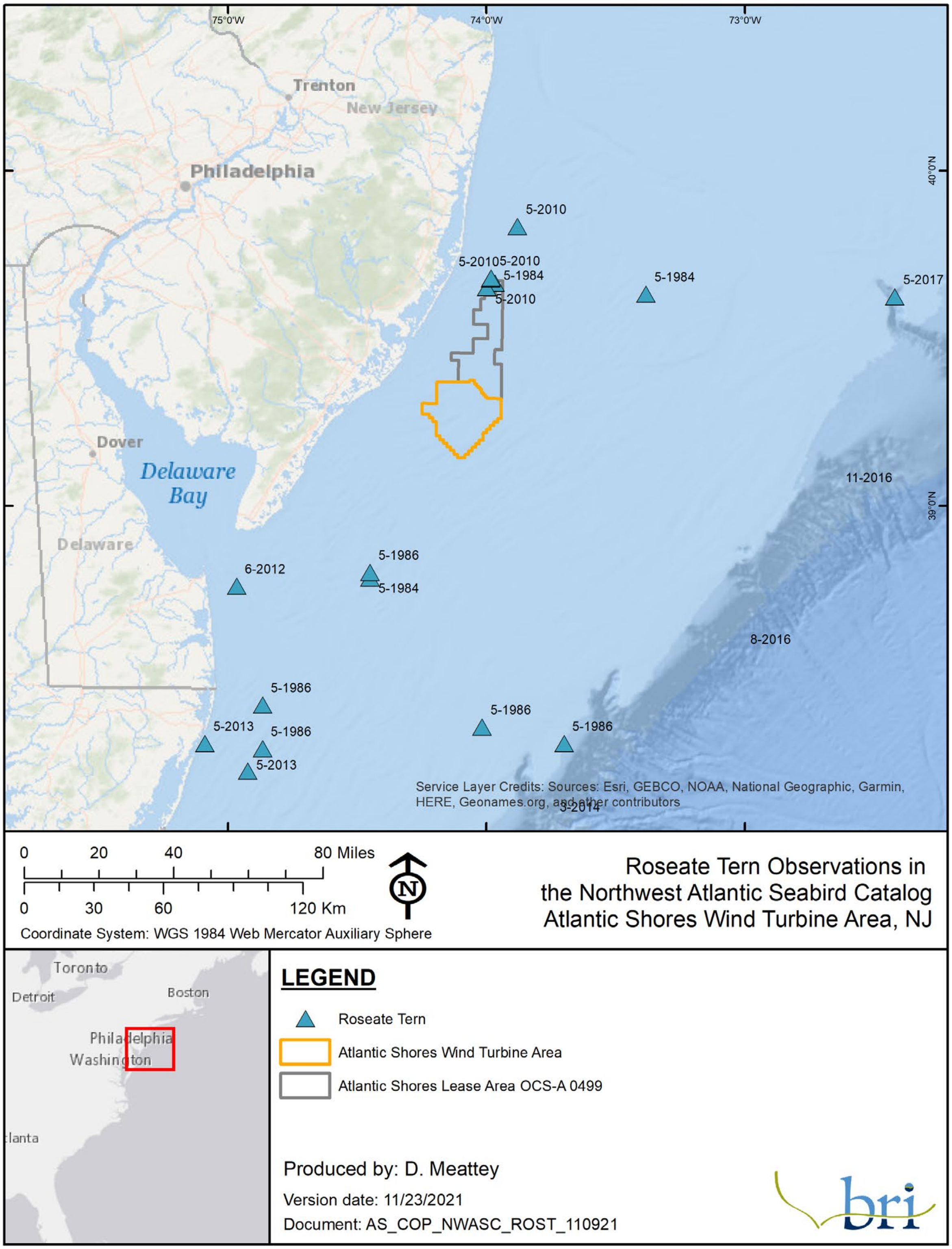
4.8.2 Roseate Terns in the Action Area

There are no known roseate tern breeding colonies in New Jersey (Boyle 2011; Gochfeld and Burger 2020); therefore, no breeding roseate terns are expected to occur in the Onshore Action Area. Coastal beaches within the Onshore Action Area provide suitable stopover and resting areas for some birds during migration, limited to the spring and fall months (late-April to September). Occurrences of roseate terns off the New Jersey coast, and therefore the Offshore Action Area, are also limited to these times (Boyle 2011) with peak activity in federal waters occurring in mid-July and August (COP, Appendix II-F2; Atlantic Shores 2023). There is a low frequency (0–2 percent) of eBird (2022) roseate tern observations in the past 10 years within the Onshore Action Area, including landfalls.

Despite extensive survey efforts, relatively few roseate terns have been detected of New Jersey. Vessel-based NJDEP Baseline Studies (Geo-Marine Inc. 2010) and Atlantic Shores digital aerial surveys (COP, Appendix II-F2; Atlantic Shores 2023) did not detect any roseate terns in the WTA, suggesting migratory flight paths over this area of ocean are uncommon. In the Northwest Atlantic Seabird Catalog, there are no records of roseate terns in WTA, but there are two observations of roseate terms in the northern tip of the overall Lease Area (OCS-A 0499). The majority of observed roseate terns were recorded in offshore areas over 40 miles (64 kilometers) south of the WTA (see Figure 4-6). Offshore eBird records of roseate terns in the vicinity of the Lease Area are limited to only three total observations: two individuals observed on June 2, 2021, well north of the Lease Area, approximately 20 miles (32 kilometers) offshore of Barnegat Light, New Jersey (coordinates not provided with records), and one individual approximately 20 miles (32 kilometers) offshore from Long Beach, New Jersey (39.563, -73.83) on July 2, 2020. These incidental eBird sighting validate the predicted relatively very low density of roseate terns in the Lease Area in spring, summer, and fall by the MDAT models (NOD 2022) (Figures 4-6 through 4-9).

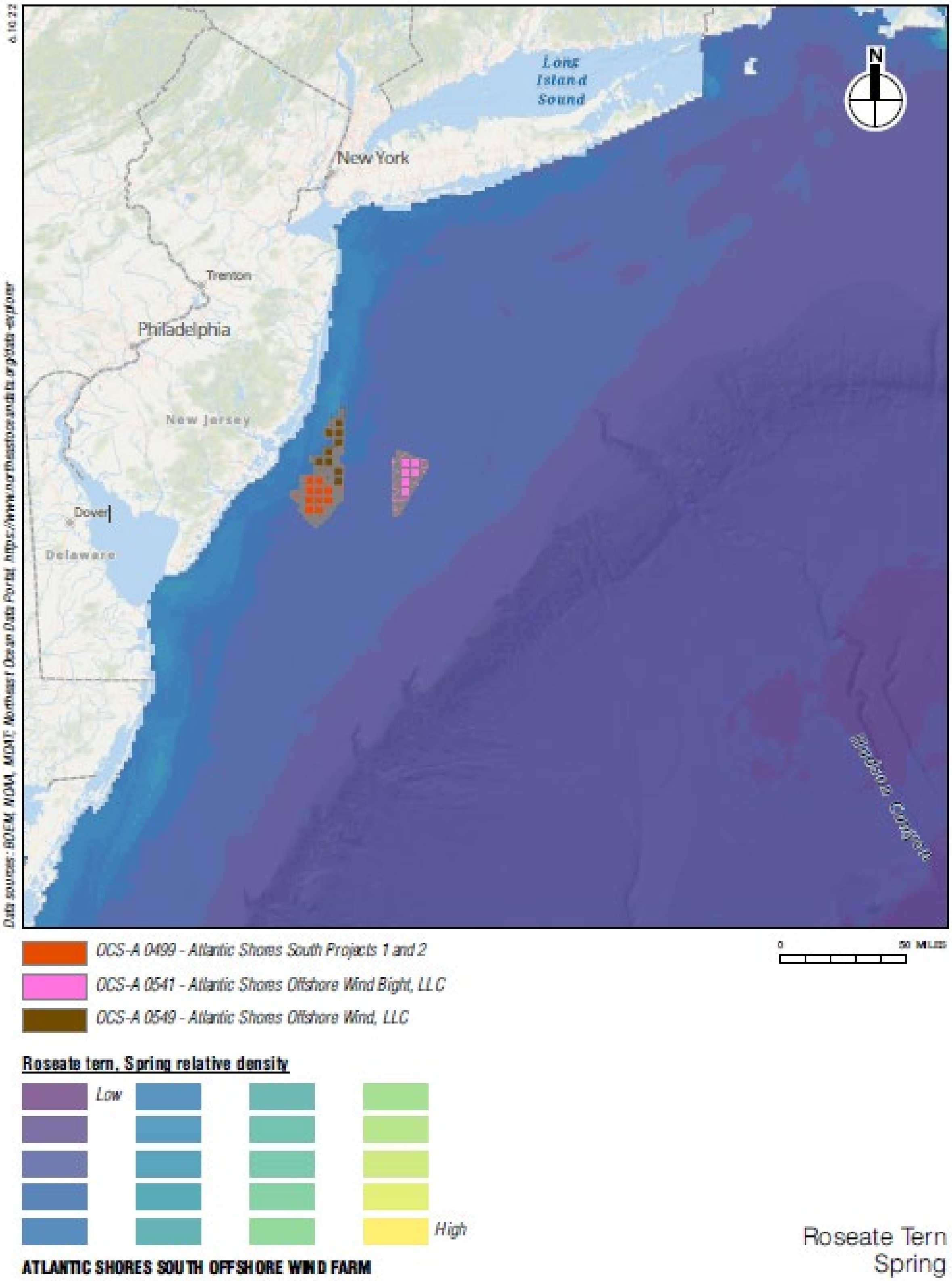
Roseate terns can occur more than 62 miles (100 kilometers) from shore (Goyert et al. 2014; Loring et al. 2019). When departing breeding areas north of the Action Area (Great Gull Island, New York; Buzzards Bay, Massachusetts) on fall migration, some individuals appear to make long, non-stop, overwater flights towards the Caribbean and north and east coasts of South America while others stay closer to the shoreline and stage in the southeastern United States (Nisbet et al. 2011; Nisbet and Mostello 2015). No flight paths of roseate terns that were tracked with automated radiotelemetry from breeding colonies in Buzzards Bay, Massachusetts, and Great Gull Island, New York, were estimated to cross the WTA (Loring et al. 2019), although the detection range of the receiver network was limited to within 15 miles (9.2 kilometers) from shore and most birds went undetected far south of their tagging location (Figure 4-10). Although migrants likely just pass straight through, some do stop, and small numbers of juveniles and non-breeding adults may also occur along the New Jersey coast during the breeding season (Walsh pers. comm.).

In conclusion, based on the behavioral and foraging ecology, telemetry data, and survey data, very little, if any, roseate tern activity is expected within marine waters in and around the Lease Area and should birds pass through the area, they will be flying relatively close to the ocean surface during good weather conditions.



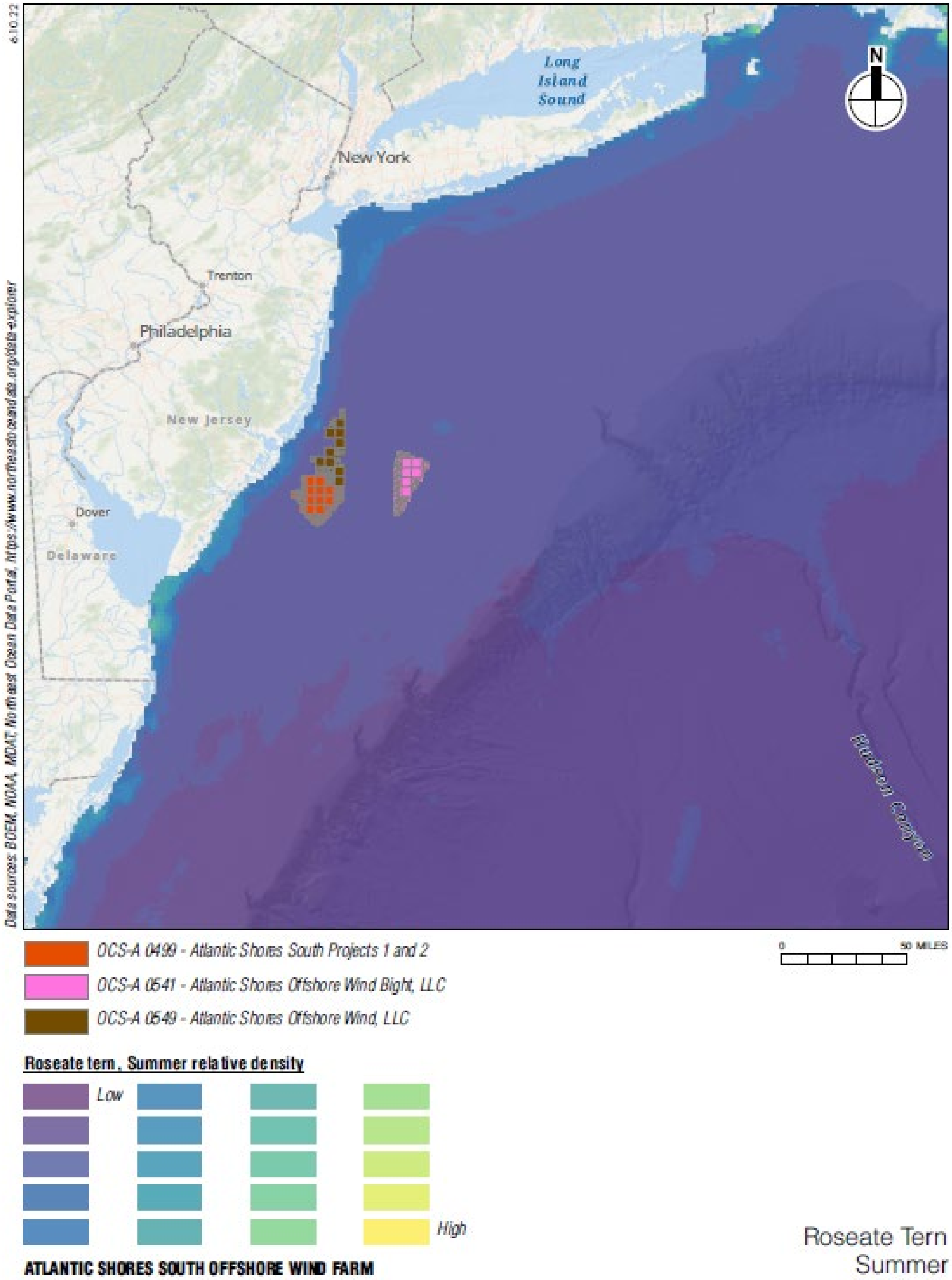
Data provided by NOAA and used with permission.

Figure 4-6 Roseate Tern Observations from the Northwest Atlantic Seabird Catalog



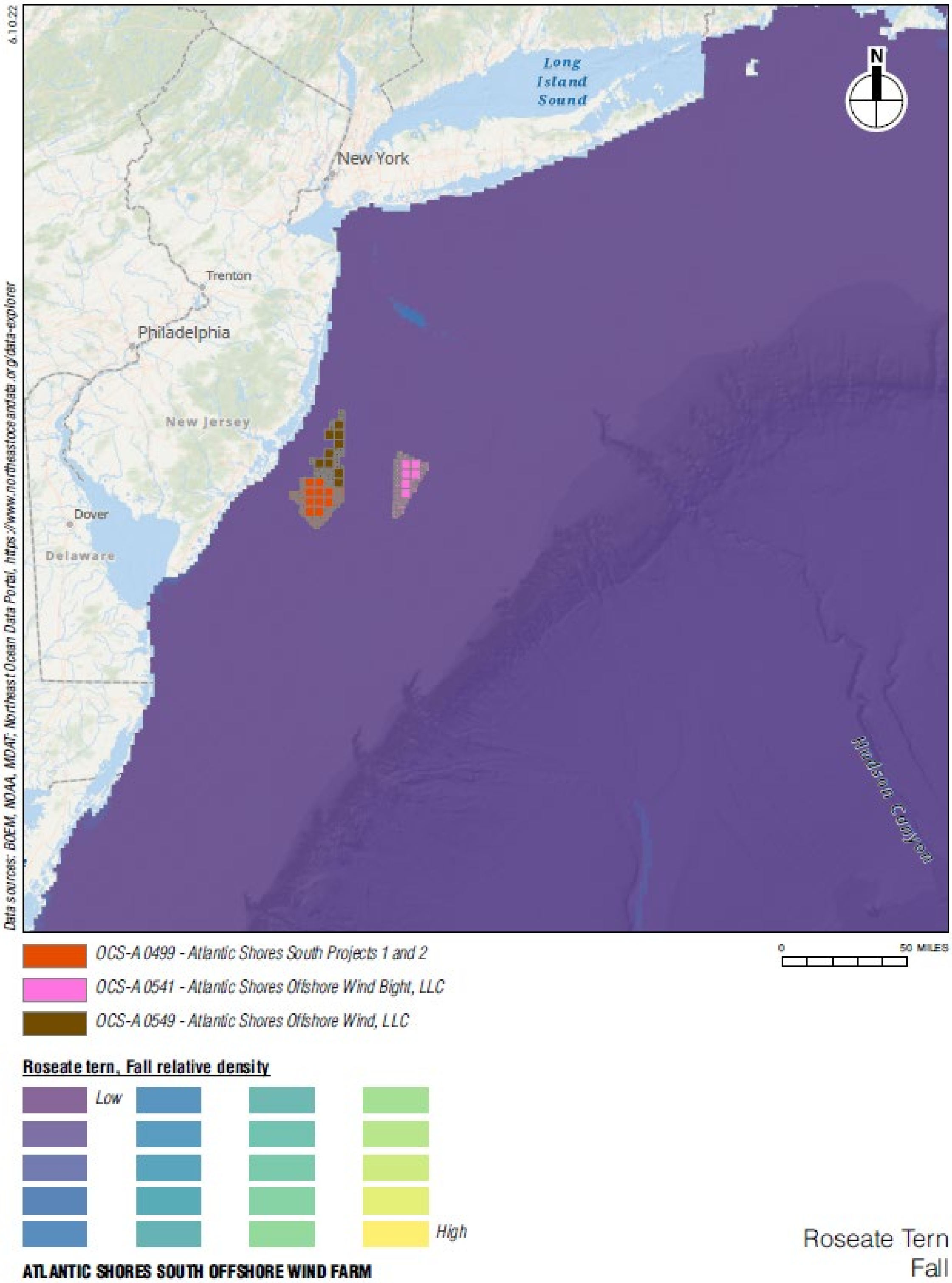
Source: NOD 2022.

Figure 4-7 Relative Density of Roseate Terns in the Action Area (Spring)



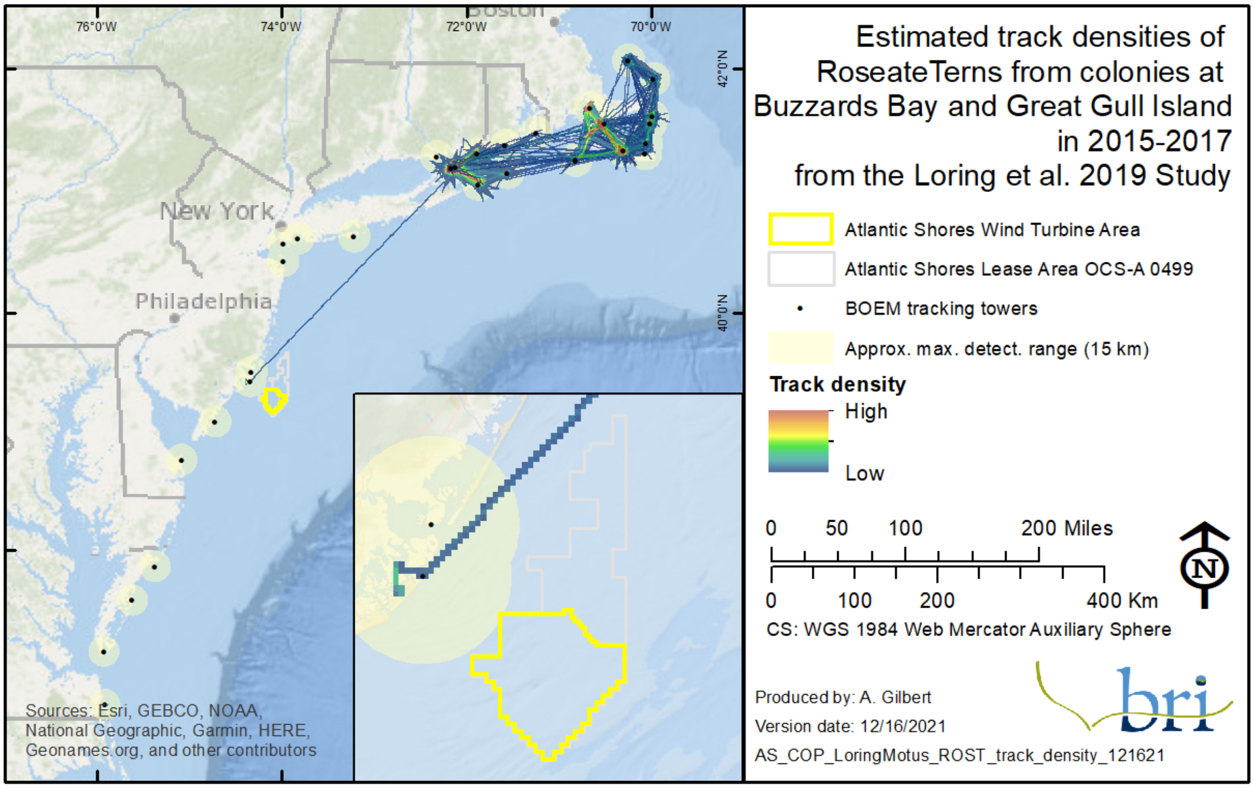
Source: NOD 2022.

Figure 4-8 Relative Density of Roseate Terns in the Action Area (Summer)



Source: NOD 2022.

Figure 4-9 Relative Density of Roseate Terns in the Action Area (Fall)



Note: All data are not actual flight paths but interpolated (model generated) flight paths. Flight paths were modeled by detections of movements between land-based towers. Towers had a typical detection range <9 miles(15 kilometers), so birds were only detected when flying within approximately 9 miles (15 kilometers) of one of the towers. (See Figure 5 [tower locations] in Loring et al. [2019] and Appendix K [detection probability] for details. Appendices are found at: https://espis.boem.gov/final%20reports/BOEM_2019-017a.pdf.) Data provided by USFWS and used with permission.

Figure 4-10 Modeled Flight Paths of Migratory Roseate Terns Equipped with Nanotags (n = 150)

4.9. BOG TURTLE

4.9.1 SPECIES DESCRIPTION

The bog turtle is one of smallest turtles in North America and was listed under the ESA as Threatened in 1997 (62 FR 59605). The northern population ranges from Maryland and Massachusetts. The bog turtle occupies wetland habitat that is generally spring- or groundwater-fed, open-canopy, herbaceous meadows between drier upland areas and more thickly vegetated, wetter, wooded swamp or marsh. This includes well-drained calcareous fens, sphagnum bogs, and wet grassy pastures with soft, thick, mucky substrates and tussock-forming herbaceous vegetation. Open areas are required for basking and nesting. Emergent wetland areas recently or currently used as pastures are common places to find bog turtles as grazing maintains open areas and keeps the ground soft. Unlike other turtle species, bog turtle home ranges are small, and the turtles rarely leave the marsh to forage in upland areas. The bog turtle is highly susceptible to habitat loss, degradation, and fragmentation, as well as collection for the wildlife trade (62 FR 59605). Bog turtles were formerly known to occur in 18 counties in New Jersey, but now are found in 13. Most are found within the Delaware and Susquehanna River watersheds (USFWS 2001).

4.9.2 Bog Turtle in the Action Area

Wetlands near the landfall routes are tidal and brackish, and, therefore, unsuitable for bog turtles. NJDEP makes available a list of known locations of bog turtles in New Jersey by county and municipality (NJDEP 2008a). Within the Onshore Action Area, NJDEP has identified Egg Harbor Township (Atlantic County), and Howell Township and Wall Township (Monmouth County) as locations of known occurrences of bog turtle. There are several areas that provide suitable habitat for bog turtles located along the proposed Monmouth Landfall to Larrabee POI export cable routes, as well as three areas of historical observation. A targeted habitat suitability survey was conducted in February 2023 within the Allaire State Park portion of this route in an area mapped as potential bog turtle habitat by the USFWS (EDR 2023a). Marginally suitable bog turtle habitat was considered present at a location within Allaire State Park that is proximate to the open cut trenching proposed along Hospital Road; however, this wetland is unlikely to support bog turtles because it is located within the Manasquan River floodplain, which floods on a regular basis, and because the wetland lacks standing or slow-flowing surface waters supported by groundwater. No potential bog turtle habitat was identified along the portion of the Manasquan River where proposed HDD activities would occur (EDR 2023a). Wetlands delineated within the Atlantic Landfall to Cardiff Substation portion of the Project were not identified as suitable habitat for bog turtles, nor was suitable habitat identified in the Habitat Assessment Report (Atlantic Shores 203). No wetlands were identified in proximity to the O&M facility (Atlantic Shores 2023). As a strictly freshwater wetland species of turtle, bog turtles do not have the potential to occur in the Offshore Action Area. Based on the presence of suitable habitat and historical observations onshore, bog turtles are considered to have the potential to occur within the Onshore Action Area.

4.10. MONARCH BUTTERFLY

4.10.1 Species Description

The monarch butterfly occurs throughout the United States during the summer months and is a candidate species for federal listing. Monarch butterfly populations east of the Rocky Mountains, the largest of all populations, have declined by over 90 percent in the last three decades (CBD et al. 2014; Xerces 2020). USFWS (2020c) estimated the eastern North American population’s probability of extinction in 60 years under current conditions ranges from 48 to 69 percent. In 2020, the USFWS determined that listing the monarch butterfly as an Endangered or Threatened species is warranted but this was precluded by higher priority actions (85 FR 81813). Although candidate species are not required to be analyzed for Section 7 consultation, the monarch butterfly is evaluated here to streamline consultation should this species become listed in the future. As the monarch butterfly is not listed under the ESA, no critical habitat is designated for the species.

Monarchs are milkweed (*Asclepias spp.*) specialists. Adults lay eggs, and larva feed almost exclusively on milkweed, while the butterflies feed on nectar from various flowers. East of the Rocky Mountains, most monarch butterflies migrate north in successive generations from overwintering areas in central Mexico to as far north as southern Canada. As they migrate north, monarch butterflies mate and deposit their eggs and die. The offspring typically survive 2 to 5 weeks in the adult stage, moving north generation by generation as temperatures warm and plants flower. After three to four generations, the population reaches the northern United States and southern Canada; the final generation makes the return migration in the fall to overwintering sites. Unlike previous generations, the last generation of each year lives for 6 to 8 months over winter and begins the multi-generational migration the following spring (NJDEP 2017).

Threats identified in the petition to list monarch butterflies include loss and degradation of habitat and loss of milkweed resulting from herbicide application, conversion of grasslands to cropland, loss to development and aggressive roadside management, loss of winter habitats from logging, forest disease, and climate change (CBD et al. 2014). The reduced availability, spatial distribution, and quality of milkweed and nectar plants associated with breeding and use of insecticides are most responsible for their decline (85 FR 81813).

4.10.2 Monarch Butterfly in the Action Area

Monarch butterflies are widespread in New Jersey during the spring, summer, and fall, and can be found anywhere in the onshore portions of the Action Area where milkweed and nectar plants occur, including roadside margins and other small, degraded habitat patches. During their southward migration in fall, monarch butterflies rest and refuel at stopover sites like Cape May, New Jersey (Walton and Brower 1996; NJDEP 2017). Daily census counts at Cape May from 1992 to 2019 show that the average number of monarch butterflies counted per hour during 9 census weeks fluctuates from year to year, from a high of 360 in 1999 to a low of 9 in 2004 (New Jersey Audubon 2019). Due to the presence of suitable habitat, monarch butterflies are considered to have the potential to occur within the Action Area during spring, summer, and fall.

4.11. AMERICAN CHAFFSEED

4.11.1 Species Description

American chaffseed is a hemi-parasitic plant that conducts photosynthesis and parasitizes other plants. It was listed under the ESA as Endangered in 1992 (57 FR 44703). It is mainly found in early successional habitats described as open, moist pine flatwoods, fire-maintained savannas, ecotonal areas between peaty wetlands and dry sandy soils, bog borders, and other open grass-sedge systems. This species is dependent on disturbance like fire, mowing, or fluctuating water tables to maintain the open to partly open conditions. No critical habitat has been designated for American chaffseed.

There are historic records of American chaffseed across the Atlantic and Gulf Coastal Plains from Massachusetts to Louisiana, and inland states of Tennessee and Kentucky. When American chaffseed was listed in 1992, it was believed to have been extirpated from New York, Massachusetts, Delaware, Connecticut, Maryland, Virginia, Tennessee, Kentucky, Texas, and Mississippi. The current distribution is believed to be limited to 43 populations in Alabama, Florida, Georgia, Louisiana, Massachusetts, New Jersey, North Carolina, and South Carolina (USFWS 2018). The greatest threats to American chaffseed are fire suppression and competition from other plant species in the absence of fire or other disturbance. Across its range, a fire-return interval of 1 to 3 years is needed to support viable populations; the largest, healthiest populations are in areas that are burned annually. Additional threats include habitat destruction due to land development (USFWS 2018).

4.11.2 American Chaffseed in the Action Area

The Natural Heritage Grid Map indicates that there are no known American chaffseed occurrences within the Project area (NJDEP 2021). Habitat studies within the vicinity of the

Atlantic City Landfall to Cardiff POI and the O&M facility portions occurred on June 22 and 24, 2020, and September 14, 2021 (Atlantic Shores 2023) where habitat is described as 55 percent developed/disturbed. The remainder consists of mixed forest, scrub-shrub, old fields, herbaceous fields, and herbaceous tidal and non-tidal wetlands. Apart from tidal herbaceous wetlands, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat. Habitat assessment studies were conducted between June 24 and June 26, 2020, December 7, 8, and 10, 2020, and September 15, 2021, in the vicinity of Monmouth Landfall to Larrabee POI, where habitat is described as 69 percent developed/disturbed. The remainder consists of edges of mixed forest, scrub-shrub old fields, herbaceous fields, agricultural pastures, and forested, scrub-shrub, and herbaceous non-tidal wetlands. Apart from wetlands and stream crossings, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat.

American chaffseed was not observed during the aforementioned habitat surveys. Potential suitable habitat was observed east and west of the Cardiff substation within a high-voltage transmission line right-of-way operated by Atlantic City Electric. Due to the lack of periodic controlled or natural fires in the eastern and western locations, and current and ongoing mowing in the eastern location, it is unlikely that these locations would support American chaffseed seed germination (EDR 2023b). The USFWS ECOS species profile currently lists that within New Jersey, American chaffseed populations are only found in Burlington County, which is outside of the study area (USFWS 2019c). For these reasons, American chaffseed does not have the potential to occur within the Action Area and thus the Proposed Action would have no effect (refer to Section 5 for definition) on American chaffseed; therefore, this BA does not discuss this species any further.

4.12. KNIESKERN'S BEAKED-RUSH

4.12.1 Species Description

Knieskern's beaked-rush is an obligate wetland sedge that is endemic to the Pinelands region of New Jersey. The species was listed under the ESA as Threatened in 1991 (56 FR 32978). Knieskern's beaked-rush occurs in early successional wetland habitats, often on bog-iron substrates adjacent to slow-moving streams in the Pinelands region (NJDFW 2018). This species is also found in abandoned borrow pits, clay pits, ditches, ROWs, and unimproved roads that exhibit similar early successional stages due to water fluctuation or periodic disturbance from vehicles, mowing, or fire. It is intolerant of shade and competition, especially from woody species, and is sometimes found on relatively bare substrates. When listed, there were 34 known extant populations of Knieskern's beaked-rush in five counties in New Jersey; 14 historical populations were presumed extirpated (USFWS 1993).

Originally, the primary threat to the species was the loss of wetlands to urban and agricultural development. However, state and federal wetland protection laws have reduced the loss of wetlands over time such that, currently, vegetative succession is a major factor threatening Knieskern's beaked-rush (USFWS 1993).

4.12.2 Knieskern's Beaked-Rush in the Action Area

The Natural Heritage Grid Map indicates that there are no known Knieskern's beaked-rush occurrences within the Action Area (NJDEP 2021). Habitat studies within the vicinity of the Atlantic City Landfall to Cardiff POI and the O&M facility were conducted on June 22 and 24, 2020, and September 14, 2021 (Atlantic Shores 2023). In this study, habitat is described as 55 percent developed/disturbed. The remainder consists of mixed forest, scrub-shrub, old fields, herbaceous fields, and herbaceous tidal and non-tidal wetlands. Apart from tidal herbaceous wetlands, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat. In the vicinity of the Monmouth Landfall to Larrabee POI, habitat assessment studies were conducted between June 24 and June 26, 2020, December 7, 8, and 10, 2020, and September 15, 2021, where habitat is described as 69 percent developed/disturbed. The remainder consists of edges of mixed forest, scrub-shrub old fields, herbaceous fields, agricultural pastures, and forested, scrub-shrub, and herbaceous non-tidal wetlands. Apart from wetlands and stream crossings, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat. Knieskern's beaked-rush was not observed during the aforementioned habitat surveys. However, this species' range is exclusive to the Pinelands region of New Jersey, which overlaps with the Action Area (Atlantic Shores 2023). For this reason, Knieskern's beaked-rush does have the potential to occur within the Action Area along the Atlantic export cable route from the Atlantic City landfall to the Cardiff POI.

4.13. SEABEACH AMARANTH

4.13.1 SPECIES DESCRIPTION

Seabeach amaranth is an annual plant found along Atlantic coast barrier beaches and barrier islands. It was listed under the ESA as Threatened in 1993 (58 FR 18035). Seabeach amaranth has stems that are fleshy and pinkish-red or red, with small, rounded leaves. Flowers and fruits are relatively inconspicuous, borne in clusters along the stems. Germination occurs generally from April to July (May 15 through July 31 in New Jersey). A typical plant in New Jersey is approximately 1.6 to 4 inches (4 to 10 centimeters) wide; however, larger plants (4 to 12 inches [10 to 30 centimeters] wide) occur every year, and the New Jersey record holder was 51 inches (130 centimeters) wide. Flowering begins when plants reach a minimum size of 0.8 inch (2 centimeters), usually in early to mid-June and continues through late August.

Seabeach amaranth habitat consists of overwash flats at the accreting ends of islands that accumulate more sand, and lower developing dunes and upper strands of non-eroding beaches. The plant grows on a nearly pure sand substrate, occasionally mixed with shell fragments, above the high-tide line and is intolerant of even occasional flooding during its growing season. It occasionally establishes small temporary populations in other habitats, including sound-side beaches, overwash areas in developing dunes, and sand and shell material placed as beach replenishment or dredge spoil. Seabeach amaranth appears to be intolerant of competition and does not occur on well-vegetated sites (USFWS 2019d).

Historically, seabeach amaranth occurred in nine states along the northeast and mid-Atlantic coast from Massachusetts to South Carolina (excluding Connecticut). Natural populations of seabeach amaranth currently occur in New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, and South Carolina. Populations have also been introduced in most of these states, as well as Massachusetts (Walsh pers. comm.). Threats to the species include coastal development, sea level rise, beach stabilization structures, and recreation such as beach driving and pedestrian traffic. Herbivory by webworms, deer, and feral horses may harm seabeach amaranth plants. Natural disasters such as tropical storms and Nor'easters can inundate or wash away plants before they set seeds (USFWS 2019d).

4.13.2 Seabeach Amaranth in the Action Area

The Natural Heritage Grid Map indicates that there are no known seabeach amaranth occurrences within the Action Area (NJDEP 2021). Seabeach amaranth was not observed during habitat surveys conducted in 2020 and 2021 along the onshore portions of the Atlantic and Monmouth export cable routes, including landfalls. Suitable habitat for seabeach amaranth, including overwash flats at the accreting ends of islands that accumulate more sand, and lower developing dunes and upper strands of non-eroding beaches (USFWS 2019d), is not present in the Action Area (Atlantic Shores 2023). For this reason, seabeach amaranth is not likely to occur there and the Proposed Action would have no effect (refer to Section 5 for definition) on seabeach amaranth. Therefore, this BA does not discuss this species any further.

4.14. SWAMP PINK

4.14.1 Species Description

Swamp pink is a perennial, shade-tolerant, obligate wetland plant found in forested freshwater wetlands, such as Atlantic white cedar and red maple swamps bordering meandering streamlets, headwater wetlands, sphagnous Atlantic white cedar swamps, and spring seepage areas (USFWS 2016a). The swamp pink is a member of the lily family with smooth, oblong, dark green leaves that form an evergreen rosette. It was listed under the ESA as Threatened in 1988 (53 FR 35076). In spring, some rosettes produce a flowering stalk that can grow over 3 feet (1 meter) tall. The stalk is topped by a 1- to 3-inch (2.5- to 7.6-centimeter) long cluster of 30 to 50 small, fragrant, pink flowers dotted with pale blue anthers. The evergreen leaves of swamp pink can be seen year-round, and flowering occurs between March and May. Swamp pink habitat tends to have mucky substrates. Specific hydrologic requirements limit its occurrence to areas with lateral groundwater movement that are perennially saturated, but not inundated. The species also requires a water table at or near the surface, with only slight fluctuations in water levels throughout the year. Swamp pink often grows on hummocks formed by trees, shrubs, and sphagnum moss. Swamp pink is a shade-tolerant plant and has been found growing in wetlands with canopy closure varying between 20 and 100 percent. Its growth in sites with minimal canopy closure is less vigorous due in part to competition from other species.

The primary threats to swamp pink are herbivory by deer and the indirect effects of offsite activities and development, such as pollution, introduction of invasive species, and subtle changes in groundwater and surface water hydrology. Hydrologic changes include increased sedimentation from offsite construction; groundwater withdrawals or diversion of surface water; reduced infiltration (recharge) of groundwater; increases in erosion; increases in the frequency, duration, and volume of flooding caused by direct discharges to wetlands (such as stormwater outfalls); and increased runoff from upstream development. Other threats to this species include direct destruction of habitat from wetland clearing, draining, and filling; collection; trampling; and climate change.

4.14.2 Swamp Pink in the Action Area

Swamp pink can be found throughout central and southern New Jersey, which supports most of the known swamp pink populations (SJRCDC 2002). NJDEP makes available a list of known locations of swamp pink in New Jersey by county and municipality (NJDEP 2008b). Within the Onshore Action Area, NJDEP has identified Egg Harbor Township and the City of Pleasantville

(Atlantic County), and Howell Township and Wall Township (Monmouth County) as locations of known occurrences of swamp pink.

Habitat studies within the vicinity of the Atlantic City Landfall to Cardiff POI and the O&M facility occurred on June 22 and 24, 2020, and September 14, 2021, where habitat is described as 55 percent developed/disturbed. The remainder consists of mixed forest, scrub-shrub, old fields, herbaceous fields, and herbaceous tidal and non-tidal wetlands. Apart from tidal herbaceous wetlands, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat. Habitat assessment studies were conducted between June 24 and June 26, 2020, December 7, 8, and 10, 2020, and September 15, 2021, in the vicinity of Monmouth County Landfall to Larrabee POI where habitat is described as 69 percent developed/disturbed. The remainder consists of edges of mixed forest, scrub-shrub old fields, herbaceous fields, agricultural pastures, and forested, scrub-shrub, and herbaceous non-tidal wetlands. Apart from wetlands and stream crossings, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat. In February 2023, targeted habitat suitability surveys were conducted in areas along the Atlantic City Landfall to Cardiff POI and Monmouth County Landfall to Larrabee POI export cable routes mapped as potential swamp pink habitat by the USFWS. Along the Atlantic City Landfall to Cardiff POI route, potential swamp pink habitat was identified within the Project Area along West Jersey Avenue: however, this habitat was deemed unsuitable due to the open canopy and heavily altered hydrology (EDR 2023c). Potential suitable habitat within the Allaire State Park along the Monmouth County to Larrabee POI route is not ideal due to the limited number of wetlands with long-lasting perennial water tables, an open canopy, fluctuating water flows and water levels within the stream, and the presence of significant invasive species populations as well as a heavy layer of leaf litter (EDR 2023d). Swamp pink was not observed during the aforementioned habitat surveys; however, suitable habitat for swamp pink may be present in forested wetlands identified within the Action Area. For these reasons, swamp pink does have the potential to occur within the Action Area.

5. EFFECTS OF PROPOSED ACTION

This section analyzes the potential direct and indirect effects of the Proposed Action on the federally listed species identified in Section 4 that occur or could occur in the Action Area. This BA incorporates information by reference found in previous assessments on these same species resulting from Project-related actions associated with the construction, O&M, and eventual decommissioning of offshore wind facilities that have been completed by BOEM, which includes BAs (BOEM 2016, 2018b, 2020, 2021b) and other environmental assessments (BOEM 2012, 2013, 2014) (see also Section 1.2, *Consultation History*). This effects analysis uses the following definitions to conclude effects determinations stated in Section 6:

- *No effect:* A listed resource is not exposed to the Proposed Action; therefore, no impacts (positive or negative) would occur.
- *May affect, not likely to adversely affect:* This is the appropriate determination if effects on listed species are:
  - *Beneficial*, meaning entirely positive, with no adverse effects;
  - *Insignificant*, which are related to the size of the impact and include effects that are too small to be measured, evaluated, or are otherwise undetectable; or
  - *Discountable*, which are effects that are extremely unlikely to occur.
- *May affect, likely to adversely affect:* This is the appropriate determination if any direct or indirect adverse effects on listed species that are not entirely beneficial, insignificant, or discountable would occur as a result of the Proposed Action.

The impact-producing factors (IPFs) associated with Project construction, O&M, and decommissioning that have the potential to affect federally listed species under USFWS jurisdiction are summarized in Table 5-1.

Table 5-1 Effects of IPFs Associated with Project Construction, O&M, and Decommissioning

Impact-Producing Factor	Potentially Affected Species	Potential Type of Exposure
Accidental releases (onshore and offshore)	Eastern black rail Piping plover Roseate tern *Rufa* red knot Saltmarsh sparrow Bog turtle	Behavioral Injury and mortality
Cable emplacement and maintenance	Roseate tern Bog turtle Seabeach amaranth	Injury and mortality Prey availability
Land disturbance	Northern long-eared bat Tricolored bat Eastern black rail Piping plover	Behavioral Habitat modification Injury and mortality

Impact-Producing Factor	Potentially Affected Species	Potential Type of Exposure
	Roseate tern *Rufa* red knot Saltmarsh sparrow Monarch butterfly Seabeach amaranth Knieskern's beaked rush Swamp pink	
Lighting	Eastern black rail Piping plover Roseate tern *Rufa* red knot Saltmarsh sparrow	Behavioral
Noise	Northern long-eared bat Tricolored bat Eastern black rail Piping plover Roseate tern *Rufa* red knot Saltmarsh sparrow	Behavioral
Presence of structures	Northern long-eared bat Tricolored bat Eastern black rail Piping plover Roseate tern *Rufa* red knot Monarch butterfly	Behavioral Injury and mortality
Traffic (aircraft)	Piping plover Roseate tern *Rufa* red knot	Behavioral Injury and mortality

5.1. BATS (NORTHERN LONG-EARED BAT AND TRICOLORED BAT)

Potential IPFs from the construction, O&M, and decommissioning of the proposed Project on northern long-eared bat include land disturbance, noise, and presence of structures (offshore)..

5.1.1 LAND DISTURBANCE

Land disturbance impacts associated with construction (and decommissioning) of onshore elements of the Proposed Action could occur if construction activities took place during the active season of northern long-eared and tri-colored bats (generally April through September). Tree clearing during this time could result in injury or mortality of individuals, particularly juveniles who are unable to flush from a roost. Atlantic Shores has indicated that tree clearing would not occur from April 1 to September 30 (Atlantic Shores 2023). Furthermore, any need for tree clearing would be minimal given that the majority of proposed onshore export and interconnection cable routes are in disturbed areas (e.g., roadways) where there is no vegetated habitat suitable for bats. Approximately 19 acres (7.69 hectares) of tree clearing could occur at the Fire Road Onshore Substation/Converter Station site, 4.8 acres (1.94 hectares) of tree clearing could occur at the Lanes Pond Road Onshore Substation/Converter Station site, and 8.8 acres (3.56 hectares) of tree clearing could occur at the Randolph Road Onshore Substation/Converter Station site. Tree clearing and other land disturbance for the two proposed substations or converter stations would occur in an urbanized, fragmented landscape, have a small footprint, and should not eliminate high-quality roosting or foraging habitat for bats. Additionally, reduction in habitat availability, which would be negligible for this Project, is not currently believed to be a factor regulating northern long-eared bat or tri-colored bat population sizes; the current declines in population sizes are primarily attributable to WNS.

The proposed O&M facility is located in a highly urbanized area. If individuals are present, these species are highly mobile and would be able to avoid the area during land disturbance activities through all phases of the Project. Noise is not anticipated to affect the migratory movements or behaviors of these species through the area.

Given the small area of marginal-quality bat habitat that would be affected and the fragmented and disturbed conditions in the surrounding landscape, potential effects such as injury, mortality, behavior modification and/or habitat modification from land disturbance are extremely unlikely to occur to northern long-eared and tri-colored bats. Impacts are therefore considered to be *discountable*. The size of any impact, if it were to occur, would be too small to measure and thus is considered to be *insignificant*.

5.1.2 NOISE

Noise associated with the Proposed Action could result in temporary and highly localized impacts on northern long-eared and tri-colored bats should they be present at the time noise is generated. Impacts, if any, are expected to be limited to behavioral avoidance of noise-generating construction activities, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016), where the majority for this potential would occur during construction activities.

Onshore construction would produce noise in excess of ambient conditions due to vehicles and heavy equipment used to construct the cable landfall adjacent to the nearshore zone (e.g., HDD installation), the onshore interconnection cables, and the substations and/or converter stations. Construction activity would be temporary and localized, but nighttime work may be required on an as-needed basis. Activities could generate noise sufficient to cause avoidance behavior by individual bats (Schaub et al. 2008). Some bats foraging or roosting in the vicinity of construction activities may be disturbed during construction. These individuals would be expected to move to different foraging areas or roosting areas farther from construction noise. Frequent roost switching is common among bats (Hann et al. 2017; Whitaker 1998). Occurrence of northern long-eared bats and tri-colored bats in the Onshore Action Area is low and in small numbers; therefore, exposure to noise would be minimal. Additionally, the proposed O&M facility is located in a highly urbanized area, and it is unlikely that northern long-eared bats and tri-colored bats would be in the area of this facility.

Offshore, the greatest potential impact of noise during construction would likely be caused by localized pile-driving activities during construction (if a pile-driven foundation solution is selected). This impact would likely be limited to behavioral avoidance of pile driving. Atlantic Shores has indicated that pile driving would follow a schedule that avoids pile driving after dark and from May to December (Atlantic Shores 2023).

Once construction is completed, the WTGs would produce operational airborne noise in the offshore marine environment. The frequency and sound level generated from operating WTGs depends on WTG size, wind speed and rotation, foundation type, water depth, seafloor characteristics, and wave conditions. BOEM (2019) noted that the level of noise appeared to be significantly influenced by natural ambient noise, suggesting the airborne noise from WTG operation would likely be less than 65 decibels equivalent continuous sound pressure level ($L_{Aeq,1m}$), measured at 164 feet (50 meters) from a WTG tower, and even this level of noise appears to be significantly influenced by natural ambient noise. This level is not much greater than ambient noise in a large city and would thus be unlikely to impact bats in the vicinity of WTGs.

It is expected that noise levels associated with decommissioning activities would be similar in scope, nature, and intensity to noise impacts associated with construction, as described above. Similarly, noise impacts resulting from decommissioning would be localized and temporary, lasting only for the duration of structure removal.

Given the limited habitat for northern long-eared and tri-colored bats in the Onshore Action Area, their unlikely occurrence in the Offshore Action Area, the temporary and localized nature of potential noise impacts, and the expected insignificant response to those impacts, the impact of onshore and offshore construction noise, operational WTGs, and decommissioning activities on northern long-eared and tri-colored bats is considered to be *discountable*.

5.1.3 PRESENCE OF STRUCTURES (OFFSHORE)

The primary potential impact of the operational component of the Project on northern long-eared and tri-colored bats is mortality or injury resulting from collision with WTGs. Bat mortality is common at onshore wind farms in North America (Cryan and Barclay 2009; Hayes 2013; Smallwood 2013; Martin et al. 2017; Pettit and O'Keefe 2017), including northern long-eared bats and tri-colored bats. As such, the Project may pose risks to northern long-eared and tri-colored bats due to collision or barotrauma (mortality due to sudden change in air pressure). However, cave-hibernating bats such as the northern long-eared bat and tri-colored bat are less likely to be killed by WTGs than are migratory tree bats (AWWI 2018; Kunz et al. 2007), and they are unlikely to occur over the open ocean. There have been limited studies of the movements of the northern long-eared bat near the ocean, but all evidence to date suggests that the species does not forage offshore (Dowling et al. 2017). Although there are records of *Myotis* bat species and other bats occurring offshore in the Mid-Atlantic (Sjollema et al. 2014; Solick and Newman 2021), there are no records of northern long-eared bats or tri-colored bats from offshore surveys in New Jersey. During the offshore construction of the Block Island Wind Farm, bats were monitored with acoustic detectors on boats, and no northern long-eared bats and a small number of tri-colored bats were detected among the 1,546 recorded bat passes (Stantec 2018). During post-construction monitoring from August 2017 to January 2018, no northern long-eared bats or tri-colored bats were detected out of the 1,086 passes recorded by bat acoustic detectors mounted on two turbines 3 miles (4.8 kilometers) from shore. During the post-construction surveys, 99 percent of bat passes occurred when wind speeds were less 6.4 feet per second (5 meters per second) (33 percent when there was no wind); likewise, almost 80 percent of the passes occurred when wind speeds were less than 6.4 feet per second (5 meters per second) (Stantec 2018). Additionally, bird and bat monitoring (August 2021 to November 2021) for Dominion Energy's CVOW offshore wind pilot project 27 miles off the coast of Virginia Beach, Virginia, did not detect any northern long-eared bats (Dominion Energy 2022).

Collectively, this information indicates that occurrence of northern long-eared bats and tri-colored bats in the offshore portions of the Offshore Action Area is likely to be very rare, in very small numbers of individuals, and only likely when winds are below the cut-in speed of WTGs; therefore, exposure would be minimal and would only occur on rare occasions during migration, is unlikely to occur, and is thus *discountable*. If northern long-eared and tri-colored bats were to migrate over water, movements would likely occur closer to the mainland than where WTGs are proposed. Bats are agile fliers, making it likely that they would avoid colliding with vessels and stationary structures in the Offshore Action Area. Furthermore, with the wide spacing between the proposed WTGs, any bats migrating in the vicinity of the Lease Area would be expected to pass through the Lease Area with only slight course corrections, if any, to avoid operating WTGs. As seen with some birds (Masden et al. 2012, Peschko et al. 2021), wide spacing between WTG rows is expected to reduce barrier effects by providing bats ample space to fly through wind farms while staying far away from the nearest WTG. Overall, due to the unlikely exposure of northern long-eared bats and tri-colored bats to the Offshore Action Area, the impacts on these species would be too small to be measured or evaluated (*insignificant*).

5.1.4 AVOIDANCE, MINIMIZATION AND MITIGATION MEASURES

Thirteen APMs are specifically focused on bats, and one APM under birds will also be applicable to bats (see Section 2.5, Table 2-4):

- Monitoring
  - BAT-01: Two years of preconstruction vessel-based acoustic surveys for bats have been implemented to build upon and fill knowledge gaps from previous survey efforts.
  - BAT-05: Develop an offshore post-construction bat monitoring plan.
  - BIR – 01: Implement an Avian and Bat Survey Plan in conjunction with BOEM and USFWS that includes digital aerial surveys and a satellite telemetry study of the federally protected red knot to further characterize the WTA and support consultations.
- Lighting
  - BAT-02: Limit lighting during O&M to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of bats and their insect prey and therefore reducing the effects of light on potential collisions of bats at night.
  - BAT-03: Red flashing FAA lights and yellow flashing marine navigation lights will be used on the WTGs instead of constant white light, which has been shown to reduce eastern red bat fatality rates, the most prevalent species observed offshore. Furthermore, ADLS is being considered to significantly reduce the number of hours FAA lighting will be illuminated.

- BAT-04: Use down-lighting and down-shielding to the maximum extent practicable.
- BAT-09: Onshore construction lighting will be temporary and localized to the work area.
- BAT – 10: Limit lighting during onshore O&M to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of bats or their insect prey and therefore reducing the effects of light on potential collisions of bats at night.
- BAT-13: Minimize onshore work at night to the maximum extent practicable.
- BAT – 11: Down-lighting and down-shielding will be used to the maximum extent practicable.

- Land Disturbance
  - BAT-06: Site onshore facilities to avoid bat habitat to the maximum extent practicable.
  - BAT-07: Minimize tree clearing to the maximum extent practicable.
  - BAT-08: Any required tree removal activities will take place outside of the "active season" for northern long-eared bats, which is defined as April 1 to September 30.
- Noise
  - BAT-12: Reasonable efforts will be made to minimize onshore construction noise.

Of the APMs proposed by Atlantic Shores (see Section 2.5, Table 2-4), there are twelve other measures that would also serve to conserve northern long-eared and tri-colored bats and their habitat. In addition, Atlantic Shores may be required to implement five additional BOEM measures to avoid and minimize impacts to bats (see Section 2.5, Table 2-5).

5.2. BIRDS (EASTERN BLACK RAIL, PIPING PLOVER, RUFA RED KNOT, ROSEATE TERN, AND SALTMARSH SPARROW)

Potential IPFs from the construction, operation, and decommissioning of the proposed Project on one or more federally listed birds include: accidental releases, cable emplacement and maintenance, land disturbance, lighting, noise, presence of structures (offshore), noise, and traffic (aircraft).

5.2.1 ACCIDENTAL RELEASES

Roseate tern is the only federally listed species considered in this BA with the potential to be affected by accidental releases in the offshore environment. Accidental releases would not affect eastern black rail, piping plover, or *rufa* red knot, as these species do not forage offshore, and implementation of an Oil Spill Response Plan would be expected to contain offshore accidental releases close to their origin and away from shore. Some potential exists for bird mortality, decreased fitness, and health effects due to the accidental release of fuel, hazardous materials, and trash and debris from vessels and activities associated with construction, O&M, and decommissioning of the Offshore Project elements, as well as from the WTGs and OSSs themselves. At regular intervals, WTG, OSS, and met tower foundations would be inspected to assess their condition, including checking for fluid leaks. Ingestion of fuel and other hazardous contaminants has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in oiling of feathers can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities, including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). Vessels associated with the Proposed Action may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. BOEM expects accidental trash releases from offshore vessels to be rare and localized in nature. In the unlikely event of a release, lethal and sublethal impacts on individuals could occur as a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019).

United States Geological Survey (USGS) regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Atlantic Shores has prepared and would implement an Oil Spill Response Plan, which would minimize the potential for spills and identify procedures in the event of a spill. Additionally, Atlantic Shores will develop a detailed chemical and waste management plan for onshore and Offshore Project components, which will describe waste streams, chemical and waste storage and handling, and plans for proper disposal, recovery, recycling, or reuse. Accidental releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on roseate tern.

Accidental releases of fuel, hazardous materials, and trash and debris occurring at the Onshore Project components have the potential to affect bird species present in the Action Area. Atlantic Shores will store all onshore waste likely to cause environmental harm in containers placed in designated, secure, and bermed locations away from surface water conveyances until collected by the waste contractor. Spill kits will be provided at all locations where hazardous materials will be held, and spill-prevention protocols will be in place. Materials required to be removed for use away from storage areas will be kept in portable, temporary spill berms. These protocols, along with those described in the chemical and waste management plan described above, would minimize effects on bird species resulting from the accidental release of debris, fuel, hazardous materials, or waste at Onshore Project locations.

The release of nontoxic drilling mud during HDD at the export cable landfall sites would be unlikely, but possible. Atlantic Shores would implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at the export cable landfall sites and estuarine portions of the export cable routes, thus minimizing effects on bird species.

As previously described in this BA, the occurrence of roseate terns in the offshore portions of the Action Area is very rare and in very small numbers; therefore, exposure to accidental releases would be minimal. In addition, any offshore or onshore accidental releases are anticipated to be rare and localized, and USCG regulations and Atlantic Shores' Oil Spill Response Plan, offshore and onshore chemical and waste management plans, and HDD Contingency Plan would further minimize potential exposure to accidental releases. Therefore, potential effects of accidental releases are extremely unlikely to occur and are therefore discountable, and the size of any impact, were it to occur, would be too small to be measured or evaluated and thus *insignificant*.

5.2.2 CABLE EMPLACEMENT AND MAINTENANCE

Seafloor and benthic habitat disturbance resulting from the installation of the offshore export cables would not affect eastern black rails, piping plovers, *rufa* red knots, and saltmarsh sparrows as these species do not forage offshore. While disturbance to individual foraging roseate terns may occur as a result of offshore export cable installation in appropriate habitat, the disturbance is not expected to be different from typical construction equipment (barges or dredges), and cable installation would not adversely affect roseate terns (USFWS 2008). Offshore cable installation would be conducted using jet trenching, plowing/jet plowing, and/or mechanical trenching. For the Atlantic ECC, sediment transport modeling predicted that suspended sediment concentrations ≥10 milligrams per liter would have a maximum excursion of approximately 1 mile (1.7 kilometers) from the route centerline, with most locations experiencing exposures of less than 3 hours, and only a few areas experiencing exposures of 4 to 6 hours. Sediment deposition between 1 and 5 millimeters was predicted to occur close to the route centerline. For the Monmouth ECC, sediment transport modeling predicted that suspended sediment concentrations ≥10 milligrams per liter would have a maximum excursion of approximately 1.6 miles (2.6 kilometers) from the route centerline, with most locations experiencing exposures of less than 4 hours, and only a few areas experiencing exposures between 6 and 12 hours. Sediment deposition between 1 and 5 millimeters was predicted to occur close to the route centerline (COP Volume II, Appendix II-J3, Section 4.3.2; Atlantic Shores 2023). Installation activities that occur from May through September have the potential to result in short-term disturbance of individual staging roseate terns (USFWS 2008).

Impacts on benthic habitats and increased turbidity during cable-laying activities have the potential to affect sand lance, an important prey resource for roseate terns (USFWS 2008). Given the nature of the construction techniques, adverse impacts such as increased turbidity would be short term in duration and localized in nature and would not directly affect terns because the activity would be underwater. Water quality effects and disturbance resulting from the installation of offshore export cables are not expected due to the short-term duration of disturbance and water column sedimentation from submarine cable construction activities (USFWS 2008). It is estimated that water turbidity conditions would return to normal within a few hours of cable installation (COP Volume II, Appendix II-J3, Section 4.3.2; Atlantic Shores 2023). As such, adverse effects on roseate terns, if any, resulting from installation of the offshore export cables would be insignificant and discountable (USFWS 2008). Cable-laying activities would have no effect on eastern black rail, piping plover, *rufa* red knots, and saltmarsh sparrows for reasons described above.

5.2.3 LAND DISTURBANCE

Land disturbance from construction equipment could impact ESA-listed birds if they were to occur in the vicinity of the landfall sites, the onshore cable routes, the onshore substations and/or converter stations, or the O&M facility. ESA-listed bird species are not expected to occur outside of the tidal habitats; therefore, land disturbances in these areas are not discussed here, and the analysis focuses only on land disturbances in proximity to landfall and coastal areas and the proposed O&M facility.

No surface disturbance would occur from export cable installation from offshore to the landing site because HDD methods would be used to install the export cable for the offshore to onshore transition. As such, export cable installation from offshore to the onshore landing site would avoid beach and dune habitats associated with the federally listed species because of the subsurface installation methods. Additionally, all HDD activities would be managed by an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid to ensure the protection of marine and inland surface waters from an accidental release of drilling fluid. Land disturbance associated with construction of the O&M facility would not affect eastern black rail, piping plover, roseate tern, *rufa* red knot, and saltmarsh sparrow habitat because the site is situated within an urbanized area that was formerly used for vessel docking and other port activities.

As the Onshore Action Area consists predominantly of previously disturbed and developed areas, land disturbance activities would not impact habitat utilized by ESA-listed birds. Any ESA-listed birds occurring in adjacent areas would be expected to be habituated to and tolerant of construction activity given that existing levels of human disturbance in these areas are already high. As such, indirect impacts on any adjacent areas that could be used by ESA-listed birds would not be expected to result from construction, O&M, and decommissioning activities in the Onshore Action Area. Therefore, impacts on ESA-listed birds from land disturbance are considered *discountable*.

5.2.4 LIGHTING

The Onshore Project facilities would be located in developed areas, with existing ambient light sources. Any ESA-listed bird species potentially present nearby would therefore already be exposed to light, and nighttime lighting introduced during onshore construction, O&M, or decommissioning would represent a negligible addition to an already light-polluted landscape.

Under the Proposed Action, WTGs and OSSs would be lit with USCG navigational and FAA hazard lighting; these lights have some potential to attract birds and result in increased collision risk (Hüppop et al. 2006). Under poor visibility conditions (fog and rain), some migrating birds may become disoriented and circle lighted structures instead of continuing on their migratory path, increasing their risk of collision (Hüppop et al. 2006).

In accordance with BOEM lighting guidelines (2021) and as outlined in the COP (Volume 1, Section 5.3; Atlantic Shores 2023), all WTGs in excess of 699 feet (213 meters) above ground level would be lit with two synchronized red flashing obstruction lights (with medium-intensity FAA model L-864 and light-emitting diode color between 800 and 900 nanometers) placed on the back of the nacelle on opposite sides, and up to three FAA model L-810 red flashing lights at mid-mast level, adding up to 1,000 new red flashing lights to the offshore environment where none currently exist. Red flashing aviation obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit WTG towers (Kerlinger et al. 2010; Orr et al. 2013) and are thus recommended by BOEM over steady burning lights for offshore WTGs to reduce potential attraction or disorientation of birds in the marine environment (BOEM 2021). Marine navigation lighting would consist of multiple types of flashing yellow lights on corner WTGs/significant peripheral structures, outer boundary WTGs, and interior WTGs. All WTGs would be equipped with three yellow flashing navigation lanterns, compliant with the requirements for visible spread from 360 degrees as stated in the document "*Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development*, (BOEM April 28, 2021)", as well as USCG Private Aids to Navigation guidance. Significant Peripheral Structures (SPS) (e.g., corner WTGs) have visible range of 3 to 5 nautical miles (5.6 to 9.3 kilometers)(9.3 kilometers) and will all flash in unison. SPSs have a quick-flash characteristic of 60 flashes per minute (0.5 second on/0.5 second off). Interior WTGs have an operational range of 2 nautical miles (3.7 kilometers) and would flash at a sequence different from that of the SPSs and Intermediate Perimeter Structures. Lights would be mounted on the platform, which would be roughly 60 feet (18 meters) above sea surface. Shielding of lights may adversely affect navigation; it is therefore subject to USCG approval and not committed to for the Proposed Action at this time. However, the lighting would fulfill the requirements given in BOEM's 2021 the document "Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development, BOEM April 28, 2021."

To reduce the amount of light at night, Atlantic Shores is considering the use of an FAA-approved ADLS (COP Volume I, Section 5.3; Atlantic Shores 2023), which is a lighting system that would only activate WTG lighting when aircraft enter a predefined airspace. For the Proposed Action, based on historical air traffic data, obstruction light activation under ADLS was estimated to occur 11 hours per month over the course of 1 year, which equals less than 1 percent of the time that full-time obstruction lights would be active (Draft EIS Section 3.5.3). To further reduce impacts on birds, Atlantic Shores would limit, where practicable, lighting (not required by FAA and USCG) during offshore construction to reduce attraction of birds (Draft EIS Appendix G and COP Volume 2, Section 4.3.2; Atlantic Shores 2023).

During construction and decommissioning activities, there would be a temporary increase in lighting from construction equipment and vessels. Vessel traffic and associated vessel lighting during O&M would occur at a lower frequency than during construction and decommissioning. The risk of increased collision due to attraction to lighting during nighttime construction activities is considered to be temporary (Fox et al. 2006) and is unlikely to affect bird populations. In addition to applicable USCG and BOEM requirements, Atlantic Shores will use down-lighting and down-shielded lighting, as practicable, to avoid and minimize effects.

Based on this information, and the anticipated limited occurrence of ESA-listed species in the Offshore Action Area, potential impacts from artificial lighting of associated with the Offshore Action Area on federally listed bird species would be *discountable*.

5.2.5 NOISE

Federally listed bird species present within the Action Area may be exposed to periodic construction noise exceeding ambient levels. This exposure could theoretically lead to behavioral effects, including potential species avoidance of the affected area. There are currently no established in-air noise exposure thresholds for the federally listed birds analyzed in this BA, so potential species effects are evaluated based on extent and magnitude of effects relative to baseline ambient conditions and the likelihood of species exposure.

Project construction vehicle use would not significantly alter baseline noise levels, and no vehicle use would occur on or in proximity to shoreline or marsh habitats known or potentially used by ESA-listed birds. HDD installation for the landfalls and other wetland/watercourse crossings can be considered a noisy activity, but these will be behind the primary dune at landfall or in developed areas inland. ESA-listed birds in proximity to the HDD sites may be able to detect noise created by construction and maintenance equipment, but that disturbance is likely insignificant relative to existing baseline conditions. Species responses may range from escape behavior to mild annoyance. Construction and maintenance vehicle activity would also not significantly increase or alter the existing levels of disturbance within onshore areas.

The proposed O&M facility is located in a highly urbanized area. If individuals are present, these species are highly mobile and would be able to avoid the area during noise-generating activities through all phases of the Project. Noise is not anticipated to affect the migratory movements or behaviors of these species through the area.

Installation of offshore WTG and OSS foundations using an impact pile driver (if a pile-driven foundation solution is selected) would produce the loudest airborne noise effects associated with the proposed Project. The area potentially affected by pile driving at any given time would be limited to the effect radius around the pile being installed. *Rufa* red knots, roseate terns, and piping plovers would only be exposed to impact hammer noise if monopile or pin pile installation occurs during the migratory period and if the species happened to be present as far offshore as the Lease Area when pile driving is occurring. Based on observed flight behavior, migrating birds would be able to detect and avoid noise-producing activities at a considerable distance with a minimal shift in flight path. Individual birds may hear Project construction noise, including pile driving, but would be able to limit exposure without significantly altering behavior. This conclusion is supported by the fact that these species are periodically exposed to elevated baseline noise levels from sources like large ships without apparent harm.

Once construction is completed, the WTGs would produce operational airborne noise in the offshore marine environment. The frequency and sound level generated from operating WTGs depends on WTG size, wind speed and rotation, foundation type, water depth, seafloor characteristics, and wave conditions. BOEM (2019) noted that the level of noise appeared to be significantly influenced by natural ambient noise, suggesting the airborne noise from WTG operation would likely be less than 65 decibels equivalent continuous sound pressure level at 164 feet (50 meters) from a WTG tower, and even this level of noise appears to be significantly influenced by natural ambient noise. This level would be unlikely to impact birds in the vicinity of WTGs.

It is expected that noise levels associated with decommissioning activities would be similar in scope, nature, and intensity to noise impacts associated with pile driving and construction, as described above. Similarly, noise impacts resulting from decommissioning would be localized and temporary, lasting only for the duration of structure removal. If these activities were to occur during the migration period, most *rufa* red knots, roseate terns, and piping plovers, if even present in the area, would be flying well above the Action Area. However, should any federally listed birds occur in the area, they would be expected to easily fly around the noise source; therefore, the noise generated is not anticipated to adversely affect bird movement or behavior through the Action Area.

Collectively, this information indicates that occurrence of federally listed birds in the Offshore Action Area is very rare and in very small numbers; therefore, exposure to noise would be minimal. In the Onshore Action Area, federally listed birds could be present primarily in the offshore export cable landing areas. Any noise would be temporary, lasting only the duration of construction, maintenance, or decommissioning. Potential effects from noise are extremely unlikely to occur and the size of the impact, were it to occur, would be too small to be measured or evaluated; therefore, the potential impacts of noise on ESA-listed bird species would be *insignificant* and *discountable*.

5.2.6 PRESENCE OF STRUCTURES (OFFSHORE)

This section discusses the potential for impacts on federally listed species resulting from collisions with WTGs, offshore substations, and construction and maintenance vessels, OSS, and construction/maintenance vessels associated with the Proposed Action. These species are agile flyers and rarely collide with stationary structures such as bridges, communication towers, lighthouses, light poles, or moving vessels (e.g., boats). Birds will avoid colliding with fixed structures, such as WTG and OSS foundations, and vessels. As such, the likelihood of collisions with fixed structures (e.g., met towers) or vessels associated with the Proposed Action would be *insignificant* and *discountable*.

The primary hazard posed to ESA-listed birds from offshore wind energy development would be collision mortality associated with the operational WTGs (Everaert and Stienen 2007; Furness et al. 2013; Robinson Willmott et al. 2013). This section focuses on the collision risk for the eastern black rail, piping plover, *rufa* red knot, roseate tern, and saltmarsh sparrow, and uses the most relevant information about known occurrences and species' interactions with offshore wind on the Atlantic OCS. BOEM has followed the parameterization of the Band Model (Band 2012) to evaluate the risk of bird collision with operating WTGs in offshore wind farms. The Band Model factors bird size and flight behavior, the number of individuals passing through the migratory corridor, the width of the migratory corridor and wind farm, the number of turbines, the RSZ area (see schematic in Figure 2-10), the percentage of individuals flying at altitudes within the RSZ, the predicted operating time during the migration season by month, and a behavioral avoidance modifier to estimate collision risk. To further inform this ESA consultation, BOEM used the Stochastic Collision Risk Assessment for Movement (SCRAM) to estimate the likelihood of "take" or fatality due to collision with a rotating turbine blade – more specifically, to estimate the relative likelihood of the take of one individual in a year and during the 35-year operation period of the wind farm. SCRAM uses bird passage rates based on modeled flight paths of birds fitted with nanotag transmitters (Gilbert et al 2022). The use of tracking data is representative of bird movements, because the locations are recorded day and night for weeks and even months regardless of weather conditions. The wind farm and turbine operational inputs were similar to those used in the analysis using the Band model, and the developer also provided estimates of wind speed and monthly turbine down time. The minimum air gap between the water and the lowest point of the blade was 78 feet (23.8 meters). As recommended, the model was run for 1,000 iterations using Option 3 (Gilbert et al 2022). The threshold number of collisions was set at one – this represents a lethal take of one or more individuals and can be used to estimate the annual probability of take by dividing the number of iterations with takes by the total number of iterations. Lethal take is likely if the cumulative probability of lethal take during the life of the Project is greater than 50 percent. Therefore, the annual probability of take would have to be greater than 2 percent (annual probability = 100 percent × (1-cumulative probability)^(1/years) = 100 percent × (1-0.5)^(1/35) = 2.08 percent).

Because relatively few, if any, individuals from some of these species are likely to occur within the proposed wind farm, collision risk is analyzed qualitatively for those species.

Vattenfall (a European energy company) recently studied bird movements within an offshore wind farm situated 3-4.9 km off the coast of Aberdeen, Scotland (Vattenfall 2023). The purpose of the study was to improve the understanding of seabird flight behavior inside an offshore wind farm with a focus on the bird breeding period and post-breeding period when densities are highest. The study was robust in that seabirds were tracked inside the array with video cameras and radar tracks, which allowed for measuring avoidance movements (meso- and micro-avoidance)[4] with high confidence and at the species level. Detailed statistical analyses of the seabird flight data were enabled both by the large sample sizes and by the high temporal resolution in the combined radar track and video camera data. Meso-avoidance behavior showed that species avoided the RSZ by flying in between the turbines with very few avoiding by changing their flight altitude in order to fly either below or above the rotors. The most frequently recorded adjustment under micro-avoidance behavior was birds flying along the plane of the rotor; other adjustments included crossing the rotor either obliquely or perpendicularly, and some birds cross the rotor swept area without making any adjustments to the spinning rotors. The study concluded that, together with the recorded high levels of micro-avoidance in all species (>0.96), it is now evident that seabirds will be exposed to very low risks of collision in offshore wind farms during daylight hours. This was substantiated by the fact that no collisions or even narrow escapes were recorded in over 10,000 bird videos during the two years of monitoring covering the April – October period. The study's calculated micro-avoidance rate (above 0.96) is similar to Skov et al. (2018).

Energy costs of any minor course corrections or avoidance of the Lease Area by ESA-listed birds due to the presence of WTGs would be expected to be biologically insignificant, with no individual fitness or population-level effects. Because most structures would be spaced 1 nautical mile (1.9 kilometer) apart, ample space between WTGs should allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. The effects of offshore wind farms on bird movement ultimately depends on the bird species, size of the offshore wind farm, the spacing of the turbines, and the extent of extra energy cost incurred by the displacement of flying birds (relative to normal flight costs pre-construction) and their ability to compensate for this degree of added energy expenditure. Little quantitative information is available on how offshore wind farms may act as a barrier to movement, but Masden et al. (2012) modeled bird movement through offshore wind farms using common eider movement data collected at the Nysted offshore wind farm in the western Baltic Sea, just south of Denmark. After running several hundred thousand simulations for different layouts/configurations for a 100 WTG offshore wind farm, the proportion of birds traveling between turbines increased as distance between turbines increased. With eight WTG columns at 0.1-nautical mile (200-meter) spacing, no birds passed between the turbines. However, increasing inter-turbine distance to 0.27 nautical mile (500 meters) increased the percentage of birds to more than 20 percent, while a spacing of 0.54 nautical mile (1,000 meters) increased this further to 99 percent. The 1-nautical mile (1.9-kilometer) spacing of the proposed Project is greater than the distance at which 99 percent of the birds passed through in the model. As such, adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of the Lease Area would not be expected to be biologically significant. Any additional flight distances would likely be small for most migrating birds when compared with the overall migratory distances traveled, and no individual fitness or population-level effects would be expected to occur.

[4] Micro-avoidance is flight behavior within and in the immediate vicinity of individual wind turbine rotor swept areas (i.e., last second action to avoid collision); meso-avoidance is flight behavior within and in the immediate vicinity of the wind farm (i.e., anticipatory/impulsive evasion of rows of turbines in a wind farm).

5.2.6.1 Eastern Black Rail

Although the eastern black rail is one of 72 species populations (out of 177 species on the Atlantic OCS) ranked "medium" in relative vulnerability to collision with wind turbines (Robinson Willmott et al. 2013), the potential effects of offshore wind turbines was not listed as one of the nine factors that USFWS (2019b) considered to potentially affect the viability of the eastern black rail. Migration routes follow the distribution of available habitat and also include stopover habitat in wet prairies, wet meadows, or hay fields during migration (USFWS 2020b). There is no evidence of the species migrating or otherwise occurring within the offshore portion of the Action Area. Furthermore, although Watts (2016) estimated there to be 40 to 60 breeding pairs in New Jersey, NJDEP (2018, 2019) has found no occurrences of eastern black rail during focused surveys since 2015. Thus, due to the very small number of eastern black rails in New Jersey and the extremely low likelihood of occurrence on the Atlantic OCS 15 miles (24 kilometers) from land, the collision risk to the eastern black rail is *insignificant*. Impacts associated with behavioral avoidance and collision risk to offshore structures are, therefore, *discountable*.

5.2.6.2 Piping Plover

The distance from shore to the offshore portions of the Action Area precludes use by nesting and foraging piping plovers. As discussed previously, migration occurs mostly along the coast during favorable weather conditions, thus the birds are expected to easily avoid the widely spaced turbines.

Although "take" (a fatality due to colliding with a moving turbine blade) is unlikely due to reasons described above, a quantitative analysis was conducted. Typically, quantitative analyses are performed when take is expected and there is a need to estimate the amount of take. Nevertheless, the quantitative analysis was conducted as an alternative approach to determine if there would be take.

BOEM used the Band Model (Band 2012) to estimate the risk of piping plover collision with the proposed WTGs in the Atlantic Shores project area. A snapshot of the Band model input parameters used to estimate piping plover collision risk for the Project is presented in Appendix B. Radio telemetry studies of piping plover migratory behavior in the vicinity of the Action Area indicate that piping plover could fly through the Project area. Loring et al. (2019) found that 11 percent (2 out of 19) of tagged plovers leaving breeding areas in Massachusetts and Rhode Island during fall migration flew through the New Jersey WEA. Extrapolating that percentage to recent population size[5] an estimated 1,148 piping plovers could have migrated through the WEA in 2021, 444 adults in spring and 704 adults and subadults in fall.

Most of the model inputs (e.g., migration passage, proportion flying in the RSZ, turbine specifications, and facility dimensions) were obtained or calculated from the COP or from the developer. Turbine avoidance rate of 95.01 percent was used for the piping plover (Cook 2021). A total of 200 operating turbines was used in the model. Developer-provided turbine data including monthly wind availability, average revolutions per minute (rpm) for a turbine operating at the site, and pitch. The flight height distribution was derived from the midpoints of

[5] Based on a breeding population abundance of 2,020 pairs in Canada, Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey an abundance-weighted mean productivity of 1.17 chicks fledged per pair (USFWS 2022b), equating to 4,040 adults in spring and 6,403 adults and subadults in fall.

2,756 10-minute observations of 62 piping plovers flying nonstop over federal waters (Loring et al. 2019). Given that the flight height distribution is known for this species, fatalities estimated are based on calculations from the extended model (Option 3).

To further inform this ESA consultation, BOEM used SCRAM to estimate the annual likelihood of collision and the annual number of collisions with rotating turbine blades. SCRAM uses bird passage rates based on modeled flight paths of birds fitted with nanotag transmitters (Gilbert et al. 2022). The use of tracking data is representative of bird movements, because the locations are recorded day and night for weeks and even months regardless of weather conditions. As recommended, the model was run for 1,000 iterations using Option 3 (Gilbert et al. 2022). The threshold number of collisions was set at one—this represents a collision of one or more individuals (including values less than would be biological nonsensical). SCRAM also estimates the average annual number of collisions with a 95 percent confidence interval (any value less than one is also biologically nonsensical). SCRAM does not estimate the probability of a collision or the number of collisions for the life of a project. However, the probability of a collision and number of collisions during the life of the project by extrapolating from the annual estimates from SCRAM; of course, this approach adds a whole new set of biological and statistical assumptions.

SCRAM predicts that the annual probability of a collision in each scenario was <0.430, thus, a single collision during fall migration is possible (Table 5-2). SCRAM also predicts that the average annual number collisions is approximately 1 (Table 5-2). Based on this information, the probability of a collision event during the 35-year operational period is likely, 1.000 (= 1- (1-0.001)$^{35\ \text{years}}$). Similarly, the average number of collisions and the 95 percent confidence interval is greater than one (Table 5-3).

Based on the above findings including the results from the SCRAM collision risk model, the chance of a fatality due to collision is possible, and thus the estimated annual number of fatalities for migrating piping plovers was greater than one**.** Likewise, the estimated number of fatalities during the 35-year operations term was also greater than one. Therefore, based on the above findings, the likelihood of collision fatalities resulting from the Proposed Action is possible, and the proposed action is likely to adversely affect to piping plovers.

5.2.6.3 Rufa Red Knot

Despite the presence of many onshore wind turbines along the red knot's overland migration route (Diffendorfer et al. 2017), there are no records of red knot colliding with turbines built through roughly 2013 (78 FR 60024). The *rufa* red knot is one of 72 species populations (out of 177 species on the Atlantic OCS) ranked "medium" in relative vulnerability to collision with wind turbines (Robinson Willmott et al. 2013). Occurrence of *rufa* red knots offshore is limited almost exclusively to spring and fall migration. The distance from shore to the Lease Area would preclude use by foraging red knots because their local movements at stopover areas (e.g., commuting flights between foraging locations related to tidal changes) generally occur within 3 miles (4.8 kilometers) of the shore (Burger et al. 2011); this is confirmed by recent telemetry tracking (Loring et al 2018; BRI and WRP 2022; Feigin et al. 2022). Thus, *rufa* red knot exposure to the Project's WTGs would be limited to individuals making regional-scale or long-distance migratory movements as opposed to local and landscape-scale movements. Based on the best available information on *rufa* red knot migratory movements (see Section 4.7.2, *Rufa Red*

Knot in the Action Area), 67 red knots could pass through the Lease Area during spring migration, and 185 red knots could pass through during fall migration. However, knowledge gaps regarding offshore migration patterns of *rufa* red knots remain and these numbers are rough estimates based on the best information currently available.

Although there is antidotal evidence of *rufa* red knots flying at great heights during migration, in the range of 3,281 to 9,843 feet (1,000 to 3,000 meters) (78 FR 60024; Burger et al. 2011; USFWS 2014), recent telemetry studies suggest that red knot fly much lower (Loring et al 2018; BRI and Wildlife Restoration Partners 2022; Feigin et al. 2022). Loring and others (2018) derived flight height estimates using data collected from red knots fitted with nanotags; these estimates were subject to large error bounds (typically 328 to 656 feet [100 to 200 meters]) and should be interpreted with caution. However, more recent telemetry studies near the Project using GPS satellite tags yielded more precise results and found that none of the red knots near the Lease Area flew within the RSZ, but instead mostly flew below the RSZ (BRI and Wildlife Restoration Partners 2022; Feigin et al. 2022). Therefore, the flight height data suggest that it is unlikely that migrating red knots would collide with operating WTG based on how high red knots fly with respect to the Project's spinning turbine blades. In addition, red knots migrate through federal waters of the Atlantic OCS primarily during clear skies with little to no precipitation and a tailwind blowing in their direction of travel (Loring et al. 2018; BRI and Wildlife Restoration Partners 2022; Feigin et al. 2022) when turbines should be more visible and avoidable. However, flights during low visibility and/or precipitation can also occur and red knots most often migrate at night (Loring et al. 2018). There is no evidence that nocturnally migrating red knots are attracted to obstruction and marine navigation lighting; nevertheless attraction to the WTGs would be expected to be avoided through the use of flashing rather than steady burning lights, and an ADLS system to limit the operation of FAA obstruction lighting to only when aircraft are approaching.

BOEM used the Band Model (Band 2012) to estimate the risk of *rufa* red knot collision with operating WTGs in the Lease Area. The input parameters and results are presented in Appendix C. A total of 200 operating turbines was used in the model. The developer provided turbine data including monthly wind availability, average rpm for a turbine operating at the site, and pitch. Turbine avoidance rate of 95.01 percent was used for red knot (Cook 2021). The monthly proportion of time the turbines were in operation is based on the proportion of the time the wind was above turbine cut-in speeds. The flight height distribution was derived from the midpoints of 379 ten-minute observations of 51 red knots flying nonstop over federal waters (Loring et al. 2018); approximately 50 percent flew within the rotor RSZ (as mentioned above, the estimated errors are large, ranging from 328 to 656 feet [100 to 200 meters]).[6] Given that the flight height distribution is known for this species, fatalities estimated are based on calculations from the extended model (Option 3).

To further inform this ESA consultation, BOEM used SCRAM to estimate the annual likelihood of collision and the annual number of collisions with rotating turbine blades. SCRAM uses bird passage rates based on modeled flight paths of birds fitted with nanotag transmitters (Gilbert et al. 2022). The use of tracking data is representative of bird movements, because the locations are recorded day and night for weeks and even months regardless of weather conditions. As

[6] The flight height distribution derived from GPS tracked red knots from the BRI and Wildlife Restoration Partners (2022) and the Feigin et al. (2022) studies was not available at this time.

recommended, the model was run for 1,000 iterations using Option 3 (Gilbert et al. 2022). The threshold number of collisions was set at one—this represents a collision of one or more individuals (including values less than would be biological nonsensical). SCRAM also estimates the average annual number of collisions with a 95 percent confidence interval (any value less than one is also biologically nonsensical). SCRAM does not estimate the probability of a collision or the number of collisions for the life of a project. However, the probability of a collision and number of collisions during the life of the project by extrapolating from the annual estimates from SCRAM; of course, this approach adds a whole new set of biological and statistical assumptions.

SCRAM predicted that the annual probability of a collision was 0.999 (Table 5-2) suggesting that collision with turbines is very likely. SCRAM also predicted that the average annual number of Red Knot collisions were greater than 1 (Table 5-2). Not surprisingly, the probability of a collision event during the 35-year operational period is also very likely 1.00 (Table 5-3), and the average number of Red Knot collisions were greater than one (Table 5-3).

The model has multiple built in biases that substantially inflate the estimated number of collisions: 1) SCRAM uses Red Knot population sizes that is larger than the number of birds that are likely to be transiting waters near the US Atlantic offshore leases during fall migration. A recent study found that 81% (118 out 146) of the red knots fitted with radio transmitters could transit the US Atlantic region where offshore leases are located during fall migration (Loring et al. 2020); this suggests that the fall population sizes used in SCRAM are likely biased high by 19 precent. 2) SCRAM uses population sizes and movement data to estimate the number of birds within a 50 km x 50 km grid cell containing the project. In some grid cells, the modeled estimate of the number of birds can be extremely large. For example, in a grid cell for another project, the estimated number of birds during September exceeds the population size of 72,2501[7] by more than 10,000 birds, thus leading to wildly inflated estimates of collisions. Similarly, the 50 km x 50 km grid cell that contains Atlantic Shores estimated 38,850 red knots also in September (107,809 red knots from August-November) – obviously an unrealistic high number of birds. When summed across all grid cells, one must wonder how many birds does SCRAM think are on the US Atlantic? Although the possibility of a red knot colliding with a spinning turbine blade during the life of the project exists, BOEM believes that the estimated number of red knot collisions are unreasonably biased and extremely high.

Based on the above information and major issues with the estimated number of collisions reported from SCRAM, there is currently a non-zero chance of fatalities due to collision with turbines during the Project's operational period. Therefore, based on the above findings, the Proposed Action is *likely to adversely affect* red knot.

5.2.6.4 Roseate Tern

The roseate tern is one among 61 species populations (out of 177 on the Atlantic OCS) that was ranked "higher" in its relative vulnerability to collision with WTGs (Robinson Willmott et al. 2013). This high ranking is partially driven by the amount of time the species spends foraging on the ocean; if time on the ocean was restricted to migration, the population would be ranked "medium." Roseate terns are unlikely to collide with turbines in the proposed Project for several reasons. First, there are no known nesting roseate terns in New Jersey, and the Action Area is not

[7] See Table 3 in SCRAM report.

within the range of foraging roseate terns that nest in New York and New England. Relatively few roseate terns are predicted to occur near the Offshore Action Area according to the MDAT models (Winship et al. 2018). Second, the few individuals present are unlikely to traverse the Lease Area for foraging because it is 8.7 miles (14 kilometers) offshore when they can forage in shallow water near the shore. Third, the offshore migratory routes used by the northeast roseate tern population are farther offshore than the Lease Area. Geolocator data from six roseate terns tagged at Bird Island, Massachusetts, suggest that southbound migration flight paths are transoceanic until reaching the Caribbean, where terns may stop over for a period of time (Mostello et al. 2014). However, it is possible that some roseate terns may occur in the Action Area ephemerally during spring and fall as migrants (Burger et al. 2011), juveniles, or non-breeding adults, and they have recently been recorded in eBird as occurring on the New Jersey shore during August and September. In a telemetry study that tracked 150 roseate terns from their breeding grounds in New York and New England, only one of the tagged roseate terns was detected in coastal New Jersey during mid-August of 2016, suggesting flights of the other birds were far enough offshore to be out of range of the land-based receiver network (Figure 4-10. Fourth, the species typically migrates under high-visibility conditions, below turbine cut-in speed (Loring et al. 2019) and thus would be expected to be able to see and avoid the WTGs from considerable distance without significantly modifying their flight path. Finally, flights of breeding and post-breeding roseate terns in federal waters were found to be at low heights and only reach an RSZ of 82 to 820 feet (25 to 250 meters) 6.4 percent of the time (Loring et al. 2019); migrants may fly similarly, in which case exposure to collision when migrating through the Atlantic OCS may be low. Migratory flight heights of the closely related (congeneric) common tern (*Sterna hirundo*) are most often around wave-top height and rarely extend above 82 feet (25 meters) (Burger et al. 2011), which suggests roseate terns may fly similarly during migration.

Based on the evidence above, the risk of roseate terns colliding with the WTGs is considered highly unlikely because very few individuals could be present in the Action Area and those that are would be there for only a very short time (including those migrating through). Roseate terns are low flying and are agile fliers that are thus expected to be able to avoid wind turbines and fly below the RSZ of offshore turbines. Any associated behavioral effects are likely to be insignificant because this species would be expected to detect and avoid the WTGs from distance with only a minimal change in course. In conclusion, the collision risk for roseate terns would be *insignificant.*

To further inform this ESA consultation, BOEM used SCRAM to estimate the annual likelihood of collision and the annual number of collisions with rotating turbine blades. SCRAM uses bird passage rates based on modeled flight paths of birds fitted with nanotag transmitters (Gilbert et al. 2022). The use of tracking data is representative of bird movements, because the locations are recorded day and night for weeks and even months regardless of weather conditions. As recommended, the model was run for 1,000 iterations using Option 3 (Gilbert et al. 2022). The threshold number of collisions was set at one—this represents a collision of one or more individuals (including values less than would be biological nonsensical). SCRAM also estimates the average annual number of collisions with a 95 percent confidence interval (any value less than one is also biologically nonsensical). SCRAM does not estimate the probability of a collision or the number of collisions for the life of a project. However, the probability of a collision and number of collisions during the life of the project by extrapolating from the annual estimates from SCRAM; of course, this approach adds a whole new set of biological and statistical assumptions.

SCRAM predicts that the annual probability of a collision in each scenario was <0.001, thus a single collision during fall migration is extremely unlikely under both scenarios (Table 5-2). SCRAM also predicts that the average annual number of collisions and 95 percent confidence interval is well below 1 (biologically nonsensical; Table 5-3). Based on this information, the probability of a collision event during the 35-year operational period is also very small 0.034 (= 1- $(1\text{-}0.001)^{35\ \text{years}}$).

Based on the results of the SCRAM model, the chance of a roseate tern fatality due to collision is extremely unlikely. The estimated annual number of fatalities for roseate terns is zero, and thus, the estimated number of fatalities during the 35-year operations term is also zero. Therefore, based on the above findings, the likelihood of collision fatalities resulting from the Proposed Action would be too small to be measured or evaluated (insignificant) and unlikely to occur (discountable), and the Proposed Action is *not likely to adversely affect* roseate terns.

Table 5-2. Annual model outputs

Species	SCRAM Probability of collision [a]	SCRAM Collisions (95% Prediction Interval) [b]
Piping Plover	0.430	**1.0** (0.7 – 1.5)
Red Knot	0.999	**77.0** (63.4 – 93.9)
Roseate Tern	< 0.001	0.000 (0.000 - 0.000)

Note: Values greater than one are in bold.
[a] SCRAM report, SCRAM run details, p. 2
[b] SCRAM report, Table 9

Table 5-3. Life of project (35 years)

Species	Probability of collision [a]	Collisions (95% Prediction Interval) [b]
Piping Plover	1.000	**35.7** (25.4 – 51.5)
Red Knot	1.000	**2,695** (2,219 – 3,283)
Roseate Tern	0.034	0.0 (0.0 - 0.0)

Note: Values are extrapolated from model outputs. Values greater than one are in bold.
[a] $\text{Probability}_{\text{life}} = 1\text{-}(1\text{-Probability}_{\text{annual}})^{\text{Years}}$
[b] $\text{Collisions}_{\text{life}} = \text{Collisions}_{\text{annual}} \times \text{Years}$

5.2.6.5 Saltmarsh Sparrow

Saltmarsh sparrows are thought to migrate at night, traveling along the coastline in relatively short-distance hops among its preferred habitat of coastal salt marshes (Greenlaw et al. 2020). There is no evidence that saltmarsh sparrow migrate over the open ocean; therefore, they are extremely unlikely to occur 8.7 miles (14 kilometers) from land within the Lease Area, and thus the potential collision risk for the saltmarsh sparrow from the Proposed Action is *discountable*.

5.2.7 TRAFFIC (AIRCRAFT)

The possible use of aircraft (e.g., helicopters) during construction, O&M, and decommissioning could pose a collision threat to federally listed birds that may be in the area of aircraft use. However, general aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Helicopter and fixed-wing aircraft would only be in operation intermittently during construction, O&M, and decommissioning, and would fly at altitudes usually ranging from 500 to 1000 feet (150 to 300 meters) above sea level. Aircraft flights associated with the Project are expected to be minimal in comparison to baseline conditions, aircraft strikes with federally listed birds are highly unlikely to occur. In addition, as previously described in this BA, the occurrence of federally listed birds in the offshore portions of the Action Area is very rare and in very small numbers. Potential effects from aircraft-related collisions are extremely unlikely and would therefore be *discountable*.

5.2.7 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

- Fifteen APMs are specifically focused on birds (see Section 2.5, Table 2-4):Monitoring
  - BIR-01: Implement an Avian and Bat Survey Plan in conjunction with BOEM and the USFWS that includes digital aerial surveys and a satellite telemetry study of the federally protected red knot to further characterize the WTA and support consultations.
  - BIR-02: Use the Motus Wildlife Telemetry System to track the offshore movement of nanotagged bird species within the WTA, following forthcoming USFWS guidance on how to integrate automated radio telemetry into pre- and post-construction monitoring plans for offshore wind farms.
  - BIR-08: Develop and implement an avian post-construction monitoring plan.
  - BIR-09: Report any dead or injured birds to BOEM on an annual basis. Birds with USFWS bands will be reported to the USGS Bird Banding Lab.
- Lighting
  - BIR-03: Limit lighting during operations to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of birds.
  - BIR-05: Use red flashing FAA lights and yellow flashing marine navigation lights on the WTGs, instead of constant white light, to reduce further bird attraction, and consider ADLS to significantly reduce the number of hours FAA lighting will be illuminated.
  - BIR-06: Use down-lighting and down-shielding to the maximum extent practicable.
  - BIR-13: Onshore construction lighting will be temporary and localized to the work area.
  - BIR-14: Limit lighting during operations to the minimum required by regulation and for safety, minimizing the potential for any light driven attraction of birds.
- Land Disturbance
  - BIR-11: HDD at the landfall site and trenchless cable installation techniques for wetland crossings will be used to avoid impacts on wetlands and shoreline habitats, including any potential shoreline nesting areas, such as those for the federally listed threatened piping plover and red knot.

- BIRD – 12: Minimize brush/tree clearing to the maximum extent practicable. This limited brush/tree clearing will be the minimum required to install facility components, will not include mature trees, and will be conducted in the winter months.

Presence of Structures/Collision

- BIR-04: Reduce attraction to structures by using perch deterrents to the maximum extent practicable.
- BIR-10: Bury onshore cables, avoiding collision risk to birds associated with overhead structures and conductors.
- BIR – 15: The communication antenna will be designed in accordance with USFWS guidelines, to the extent practicable, including lighting and support system characteristics.

- Accidental Releases
  - BIR-07: Marine debris caught on offshore project structures will be removed, when safe and practicable, to reduce the risk of bird entanglement.

Of the APMs proposed by Atlantic Shores (See Section 2.5, Table 2-4), there are seventeen other measures that would also serve to conserve ESA-listed birds and their habitat. In addition, Atlantic Shores may be required to implement six additional BOEM measures to avoid and minimize impacts to birds (see Section 2.5, Table 2-5).

5.3 BOG TURTLE

Potential IPFs from the construction, operation, and decommissioning of the proposed Project on the bog turtle include accidental releases and cable emplacement and maintenance.

5.3.1 Accidental Releases

Accidental releases of fuel, hazardous materials, and trash and debris occurring at the onshore Project components have the potential to affect big turtles present in the Action Area. Atlantic Shores will store all onshore waste likely to cause environmental harm in containers placed in designated, secure, and bermed locations away from surface water conveyances until collected by the waste contractor. Spill kits will be provided at all locations where hazardous materials will be held, and spill-prevention protocols will be in place. Materials required to be removed for use away from storage areas will be kept in portable, temporary spill berms. These protocols, along with those described in the chemical and waste management plan described above, would minimize effects on bog turtles resulting from the accidental release of debris, fuel, hazardous materials, or waste at onshore Project locations.

The release of nontoxic drilling mud during HDD activities at wetlands and waterbodies along the onshore export cable routes would be unlikely, but possible. Atlantic Shores would implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at HDD sites along the onshore export cable routes, thus minimizing effects on bog turtles.

5.3.2 Cable Emplacement and Maintenance

Potential effects on the bog turtle associated with cable emplacement and maintenance could occur during onshore export cable emplacement in the vicinity of wetlands located along the

Atlantic City to Cardiff POI and Monmouth County Landfall to Larrabee POI export cable routes. The release of nontoxic drilling mud during HDD activities at wetlands and waterbodies along the onshore export cable routes would be unlikely, but possible. Atlantic Shores would implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at HDD sites along the onshore export cable routes, thus minimizing effects on bog turtles.

5.3.3 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

No APMs are specifically focused on the bog turtle, but nineteen measures would serve to reduce potential Project effects on the species (see Section, 2.5, Table 2-4).

5.4 MONARCH BUTTERFLY

Potential IPFs from the construction, operation, and decommissioning of the proposed Project on the monarch butterfly include land disturbance and the presence of structures (offshore)..

5.4.1 LAND DISTURBANCE

Potential effects on the monarch butterfly associated with land disturbance could occur during onshore facility construction in the vicinity of undeveloped lands where milkweed and other native nectar plants may be present. While adult monarch butterflies have the mobility to avoid construction equipment, larval stages could be vulnerable to being crushed by construction equipment, particularly during land clearing and ground excavation. Some adult monarch butterflies could also be affected by vehicle collisions (McKenna et al. 2001; Kantola et al. 2019). Also, there is some evidence that monarch caterpillars exposed to highway noise for short periods had elevated heart rates, a sign that they may experience stress along loud roadsides (Davis et al. 2018).

Although Project construction, O&M, and decommissioning could potentially affect a small number of monarch butterflies, impacts are anticipated to be limited to behavioral avoidance of construction activity. Collision with Project vehicles and equipment is unlikely because the Projects would not cause a noticeable increase in traffic. Suitable habitat is not present in the Action Area due to the developed nature of the Onshore Project area, and the Project would not cause an increase in noise to the extent that they would adversely affect monarch butterflies. If any adult butterflies were disturbed by Project activities, they would likely utilize adjacent habitat and repopulate these areas once construction ceases. Temporarily disturbed habitat would be restored to pre-existing conditions. If suitable monarch butterfly habitat is affected by construction activities, the small loss of habitat would be considered insignificant and population-level effects are unlikely to occur. Based on this information, potential effects on monarch butterflies from land disturbance and related activities (e.g., construction vehicle use) would be unlikely and would therefore be *discountable*. The size of any impact, were it to occur, would be too small to be measured or evaluated and would therefore be *insignificant*.

5.4.2 PRESENCE OF STRUCTURES

Monarch butterflies are generally reluctant to cross over water (Brower 1995). Although monarchs are far-ranging fliers, they are easily blown off course, often by storms, and there have been reports of monarch butterflies on offshore oil platforms and ships at sea. This would be a small proportion of the overall migratory population, and large numbers of monarch butterflies would not be found on the Atlantic OCS.

There is limited information about butterfly mortalities caused by collisions with WTGs, especially for monarch butterflies in the offshore environment. Some studies have investigated the density of insect splatter on onshore WTG blades and concluded that there was a negligible effect on insects (Gipe 1995), while others have suggested that the impacts of WTGs on insect populations, in general, may be significant (Trieb 2018; Voigt 2021). Monarch butterfly migration is well studied, and the species has been recorded to fly at heights over 10,000 feet (3,048 meters) above ground elevation, taking advantage of favorable winds and moving downwind at high elevation (Monarch Joint Venture 2014). Therefore, while their flight patterns could occasionally put them within the blade heights of WTGs, monarch butterflies would be unlikely to occur within the RSZ of the Projects during migration. They are also believed to generally be capable of avoiding WTGs due to their high-altitude migration (Monarch Joint Venture 2021).

Based on this information, potential collisions with structures are extremely unlikely, and impacts on the monarch butterfly would be considered *discountable*.

5.4.3 Avoidance, Minimization, and Mitigation Measures

No APMs are specifically focused on the monarch butterfly, but 20 measures would serve to reduce potential Project effects on the species (see Section, 2.5, Table 2-4). 5.5 Plants (Knieskern's Beaked-Rush, Swamp Pink, Seabeach Amaranth)

Potential IPFs from the construction, operation, and decommissioning of the proposed Project on ESA-listed plants include cable emplacement and maintenance and land disturbance.

5.5.1 Cable Emplacement and Maintenance

Impacts to seabeach amaranth plants, which may occur on open beaches and vegetated dunes present at the Monmouth County Landfall at Sea Girt National Guard Beach, would be avoided by using HDD for transition of the export cables from offshore to onshore and by avoiding routing project entry or intrusion in these habitats following construction. Atlantic Shores would implement measures to avoid and minimize impacts, including an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at HDD sites along the onshore export cable routes. Therefore, HDD activities at the Monmouth County Landfall site are not expected to affect suitable habitat for seabeach amaranth and any Project effects on the species would be insignificant.

5.5.2 Land Disturbance

Land disturbance impacts associated with construction, O&M, and decommissioning of the onshore elements of the proposed Project Action on the ESA-listed plant species could occur if construction activities took place in their associated habitats. Habitat disturbance with construction at the landfall sites could adversely affect habitats and disturb plants (damage or crushing) if performed at times of year when they are present. The major threat to ESA-listed species is loss and degradation due to encroaching development, sedimentation, pollution, succession, and wetland drainage. Such disturbance would threaten ESA-listed plants regardless of the time of year due to the damage to habitat.

Atlantic Shores plans to install its onshore facilities in existing developed or disturbed areas to the greatest extent practicable. Swamp pink and Knieskern's beaked-rush are both found in wetland habitats, and Atlantic Shores has committed to using trenchless methods of cable installation when crossing sensitive habitats, including wetlands. Therefore, these plants (if present) and/or their habitat would be avoided during construction. As such, the potential effect of land disturbance on ESA-listed plant species is extremely unlikely to occur and would therefore be *discountable.*

5.5.3 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

While Atlantic Shores does not propose any APMs specifically focused on ESA-listed plants, 21 measures would serve to reduce potential Project effects on the species (See Section 2.5, Table 2-4). Effects Determinations

5.3. PROPOSED ACTION

5.3.1 NORTHERN LONG-EARED BAT AND TRI-COLORED BAT

Given that individual northern long-eared and tri-colored bats occur in portions of the Action Area and as described in Section 5.1, there is potential risk to the species during construction, O&M, and decommissioning, the proposed Projects may affect northern long-eared and tri-colored bats. However, few (if any) northern long-eared and tri-colored bats are expected in the onshore or offshore portions of the Action Area, and habitat is generally lacking in the onshore portion of the Action Area. For these reasons, the potential effects related to collisions with structures, noise, and land disturbance are extremely unlikely to occur and are therefore, *discountable*. APMs implemented by Atlantic Shores would avoid and minimize any impacts that could occur. Moreover, the size of any effect, were it to occur, would be too small to be measured or evaluated and would therefore be *insignificant*. For these reasons, BOEM anticipates that the Proposed Action **may affect, but is not likely to adversely affect** the northern long-eared bat and the tri-colored bat.

5.3.2 BIRDS (EASTERN BLACK RAIL, PIPING PLOVER, *RUFA* RED KNOT, SALTMARSH SPARROW)

Given that the eastern black rail, piping plover, *rufa* red knot, roseate tern, and saltmarsh sparrow may occur in portions of the Action Area and, as described in Section 5.2, there is potential risk to the species during construction, O&M, and decommissioning, the proposed Project may affect these bird species. Within the Offshore Action Area, the occurrence of these species is very rare and in very small numbers; therefore, exposure to IPFs in the offshore environment would be infrequent . Furthermore, none of these species have a high risk of collision with offshore WTGs and are rarely expected to occur within the RSZ. Band (2012) and SCRAM (Gilbert et al. 2022) collision risk models both predicted there would be zero collision fatalities of piping plovers and roseate terns annually and over the 35-year operational period of the Proposed Action. Annual and 35-year estimates of *rufa* red knot collision mortality were also predicted to be zero by the Band (2012) model, although the SCRAM model (Gilbert et al. 2022) indicated a non-zero chance of at least one *rufa* red knot fatality annually and over the 35-year operational term of the Proposed Action. Effects of noise and aircraft traffic would be temporary and localized, and unlikely to impact any of these species. Impacts from structure lighting would also be significantly minimized with the installation of an FAA-approved ADLS on WTGs and OSSs, such that lighting would only be on when aircraft are detected in the vicinity of the windfarm.

Potential onshore impacts on ESA-listed birds would be limited to the vicinity of the export cable landfall locations and coastal bay crossings, where beach/dune/tidal wetland habitat is present. To avoid and minimize potential impacts on these species, Atlantic Shores has committed to trenchless technology (e.g., HDD) for the Atlantic and Monmouth export cable landing sites. The export cable would be installed under the beach, which would avoid disturbance to beach habitat for nesting shorebirds. Atlantic Shores would also limit tree clearing to winter months (Draft EIS Appendix G; COP Volume II, Section 4.3.2.6; Atlantic Shores 2023). No impacts on ESA-listed birds or their habitat would occur farther inshore. As such, impacts on these species from construction activities at the landfall location would be avoided or minimized.

Overall, potential effects from the IPFs to the eastern black rail, piping plover, roseate tern, and saltmarsh sparrow are extremely unlikely to occur and would be *discountable*. Moreover, the size of any effect, were it to occur, would be too small to be measured or evaluated and would therefore be *insignificant*. For these reasons, BOEM anticipates that the Proposed Action **may affect, but is not likely to adversely affect** the eastern black rail, roseate tern, or saltmarsh sparrow. Because the chances of annual and 35-year collision mortality of *rufa* red knots predicted by the SCRAM model are 1, it can be concluded the Proposed Action is **likely to adversely affect** the piping plover and *rufa* red knot.

5.3.3 Bog Turtle

Potential onshore impacts to the bog turtle would be limited to the vicinity of the onshore export cable routes where suitable wetland habitat is present. To avoid and minimize potential impacts on this species, Atlantic Shores has committed to trenchless technology (e.g., HDD) for wetland, waterbody, and sensitive habitat crossings along the Atlantic and Monmouth export cable routes. The export cables would be installed under wetlands, which would avoid disturbance to habitat for bog turtles. All HDD activities will be managed by an HDD Contingency Plan for the Inadvertent Releases of Drilling Fluid to minimize the potential effects from an accidental release of drilling fluid inland surface waters. Additionally, all drilling fluids will be collected and recycled upon HDD completion. Based on the use of HDD to avoid impacts to bog turtle habitat, and considering sediment control and other avoidance measures, and potential effects on the bog turtle, were these effects to occur, would be unlikely to occur and would therefore be *discountable*. For these reasons, BOEM anticipates that the Proposed Action **may affect, but is not likely to adversely affect** the bog turtle.

5.3.4 Monarch Butterfly

Given that the monarch butterfly may occur in portions of the Action Area and, as described in Section 5.4, there is potential risk to the species during construction, O&M, and decommissioning, the proposed Projects may affect the monarch butterfly. Within the offshore portions of the Action Area, collision risk with WTGs is unlikely because monarch butterflies are known to migrate at higher elevations that the RSZ. Based on the highly developed urban character of the onshore portions of the Action Area and the specific habitat preferences of the monarch butterfly, and considering avoidance measures and post-construction habitat restoration, any potential effects on monarch butterfly, were these effects to occur, would be temporary and localized. Therefore, potential effects from the IPFs are extremely unlikely to occur and would be *discountable*. Moreover, the size of any effect, were it to occur, would be too small to be measured or evaluated and would therefore be *insignificant*. If USFWS were to list the monarch butterfly as Threatened or Endangered in the future, BOEM anticipates the Proposed Action **may affect, but is not likely to adversely affect** the species.

5.3.5 Plants (Knieskern's Beaked-Rush, Seabeach Amaranth, and Swamp Pink)

Within the onshore portion of the Action Area, Project facilities would be co-located with existing developed areas, which would limit disturbance to Knieskern's beaked-rush, seabeach amaranth, and swamp pink and their habitats. To avoid and minimize potential impacts in the vicinity of the export cable landfall locations and wetland and waterbody crossings, where beach/dune and wetland habitat is present, Atlantic Shores has committed to trenchless technology (e.g., HDD) in these areas. The export cable would be installed under the beach and wetlands, which would avoid disturbance to beach and wetland habitats where these species may be located. The proposed pre-construction survey for ESA-listed plants and other avoidance and minimization measures proposed by the applicant (COP Volume II, Section 4.2.2.6; Atlantic Shores) would reduce the likelihood of impacts on these species and would mean that land disturbance to habitat for these species would be unlikely to occur and would therefore be *discountable.* Moreover, the size of any effect, were it to occur, would be too small to be measured or evaluated and would therefore be *insignificant*. For these reasons, BOEM anticipates that the Proposed Action **may affect, but is not likely to adversely affect** Knieskern's beaked-rush, seabeach amaranth, or swamp pink.

5.4. OTHER RELEVANT PROJECT ALTERNATIVES

BOEM considered four relevant alternatives to the Proposed Action (Alternatives C through F in the Draft EIS) (see Table 2-3). The impact analyses, effects determinations, and conclusions for each of the alternatives would not be materially different from those of the Proposed Action for the following reasons:

- Onshore impacts on ESA-listed species under Alternatives C, D, E, and F would be the same as those of the Proposed Action, because these alternatives differ only with respect to the offshore components of the Proposed Action; therefore, IPFs and the associated effects would be the same as those described as the Proposed Action for the Onshore Action Area.
- Under Alternatives C, D, E, and F potential impacts on ESA-listed species from the presence of structures could be reduced if the number of WTGs was reduced, but any such difference compared to the Proposed Action would likely be immeasurable.
- Alternatives F1 and F2 would result in less construction noise associated with the suction bucket or gravity-based solutions; however, any change in impacts on ESA-listed species would likely be immeasurable due to the already discountable impacts from noise for these species.

Overall, BOEM anticipates that the impacts from Alternatives C through F would not differ compared to those of the Proposed Action, and that the various alternatives **may affect, but are not likely to adversely affect** the northern long-eared bat, tricolored bat, eastern black rail, piping plover, *rufa* red knot, roseate tern, saltmarsh sparrow, monarch butterfly, Knieskern's beaked-rush, or swamp pink.

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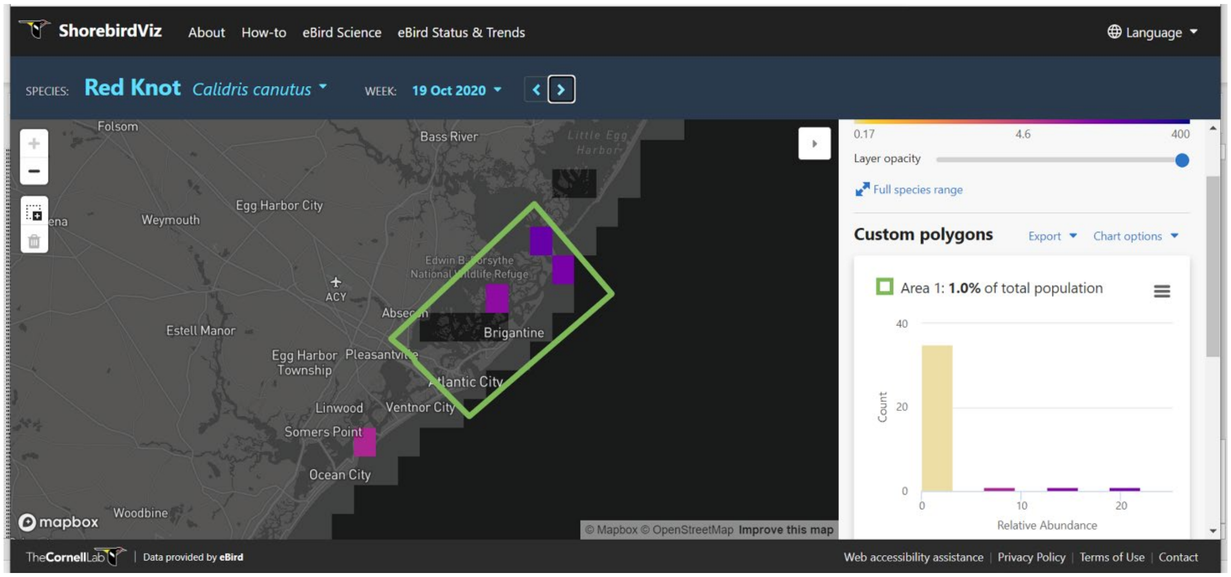
Appendix A. eBird Status and Trends for *Rufa* Red Knot



Source : Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, O. Robinson, S. Ligocki, W. Hochachka, L. Jaromczyk, C. Wood, I. Davies, M. Iliff, L. Seitz. 2021. eBird Status and Trends, Data Version: 2020; Released: 2021. Cornell Lab of Ornithology, Ithaca, New York. Available: https://doi.org/10.2173/ebirdst.2020.

Figure A1 Relative Abundance of Red Knots During Week of October 19, 2020

Appendix B. Band Model Input Parameters and Outputs for Piping Plover Collision Risk Assessment

COLLISION RISK ASSESSMENT
Sheet 1 - Input data

Key	
used in overall collision risk sheet	used in available hours sheet
used in migrant collision risk sheet	used in large array correction sheet
used in single transit collision risk sheet or extended model	not used in calculation but stated for reference

Bird data	Units	Value	Data sources	Source
Species name		Piping plover		
Bird length	m	0.18		Gilbert et al 2022, Table A12
Wingspan	m	0.38		Gilbert et al 2022, Table A12
Flight speed	m/sec	9.3		Gilbert et al 2022, Table A12
Nocturnal activity factor (1-5)		4		Loring et al 2019, Fig 66; value = 4
Flight type, flapping or gliding		flapping		

Data sources

Bird survey data	Units	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daytime bird density	birds/sq km													
Proportion at rotor height	%													
Proportion of flights upwind	%	8.6%												

Data sources

Birds on migration data	Units	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Source
Migration passages	birds				148	148	148			704					Adult & fledgings derived from USFWS 2022, P.Loring et al 2019
Width of migration corridor	km	97													Length of NJ WEA
Proportion at rotor height	%	15%													Loring et al 2019, Table 26
Proportion of flights upwind	%	8.6%													Loring et al 2019, Fig 72

Windfarm data	Units	Value	Data sources	Source
Name of windfarm site		Atlantic Shores		
Latitude	degrees	39.00		
Number of turbines		200		BA, Table 1
Width of windfarm	km	24		Measured from BA Figure 1
Tidal offset	m	1		

Turbine data	Units	Value	Data sources	Source
Turbine model		V236-15MW		https://www.atlanticshoreswind.com/vestas-and-atlantic-shores/
No of blades		3		
Rotation speed	rpm	8.4		AS comment
Rotor radius	m	115.5		https://www.vestas.de/content/dam/vestascom/de/v236150MWBrochureOffshore.pdf.coredownload.inline.pdf
Hub height	m	139.3		Gap Min value=23.8, AS comment; plus rotors radius
Monthly proportion of time operational	%		see below	MonWindAvail - AverDownTime; AS comment & SCRAM default
Max blade width	m	5.100		AS comment
Pitch	degrees	1		

Monthly proportion of time operational	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
%	89%	89%	86%	87%	84%	87%	86%	87%	88%	86%	88%	88%

Avoidance rates used in presenting results		Data sources (if applicable)
95.01%	X	Cook 2021, Table A2 "All Gulls and Terns" Extended Band (2012) model
98.00%		
99.00%		
99.50%		

COLLISION RISK ASSESSMENT (BIRDS ON MIGRATION)
Sheet 2 - Overall collision risk

All data input on Sheet 1:
no data entry needed on this sheet!
other than to choose option for final tables

Key: from Sheet 1 - input data; from Sheet 6 - available hours; from Sheet 3 - single transit collision risk; from survey data; calculated field

Bird details:															
Species		Piping plover													
Flight speed	m/sec	9.3													
Flight type		flapping													
Windfarm data:															
Number of turbines		200													
Rotor radius	m	115.5													
Minimum height of rotor	m	139.3													
Total rotor frontal area	sq m	8381926													
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year average
Proportion of time operational	%		89%	89%	86%	87%	84%	87%	86%	87%	88%	86%	88%	88%	87.1%
Stage A - flight activity															**per annum**
Migration passages			0	0	148	148	148	0	0	704	0	0	0	0	**1148**
Migrant flux density	birds/ km		0	0	1.5258	1.5258	1.52577	0	0	7.25773	0	0	0	0	
Proportion at rotor height	%	15%													
Flux factor			0	0	55	55	55	0	0	263	0	0	0	0	
Option 1 -Basic model - Stages B, C and D															
Potential bird transits through rotors			0	0	8	8	8	0	0	40	0	0	0	0	**65**
Collision risk for single rotor transit	(from sheet 3)	3.4%													
Collisions for entire windfarm, allowing for non-op time, assuming no avoidance	birds per month or year		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**
Option 2-Basic model using proportion from flight distribution			**0**	**0**	**1**	**1**	**1**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**4**
Option 3-Extended model using flight height distribution															
Proportion at rotor height	(from sheet 4)	32.7%													
Potential bird transits through rotors	Flux integral	0.3676	0	0	20	20	20	0	0	97	0	0	0	0	**158**
Collisions assuming no avoidance	Collision integral	0.01605	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**6**
Average collision risk for single rotor transit		4.4%													
Stage E - applying avoidance rates															
Using which of above options?	**Option 3**	0.00%	0	0	1	1	1	0	0	4	0	0	0	0	**6**
Collisions assuming avoidance rate	birds per month or year	95.01%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		98.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.50%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Collisions after applying large array correction		95.01%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		98.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.50%	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Appendix C. Band Model Input Parameters and Outputs for *Rufa* Red Knot Collision Risk Assessment

COLLISION RISK ASSESSMENT
Sheet 1 - Input data

Key	
(light green)	used in overall collision risk sheet
(yellow-green)	used in migrant collision risk sheet
(orange)	used in single transit collision risk sheet or extended model
(lavender)	used in available hours sheet
(light yellow)	used in large array correction sheet
(pink)	not used in calculation but stated for reference

	Units	Value	Data sources	Source
Bird data				
Species name		RedKnot		
Bird length	m	0.24		Gilbert et al 2022, Table A12
Wingspan	m	0.50		Gilbert et al 2022, Table A12
Flight speed	m/sec	20.1		Gilbert et al 2022, Table A12
Nocturnal activity factor (1-5)		5		Table A-8, Robinson Willmott et al., 2013; Loring et al 2018
Flight type, flapping or gliding		flapping		

Data sources

Bird survey data	Units	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daytime bird density	birds/sq km													
Proportion at rotor height	%													
Proportion of flights upwind	%	34.6%												

Data sources

Birds on migration data	Units	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Source
Migration passages	birds						67		62	62	62				see BA section 5.2.1.2
Width of migration corridor	km	24													assume all pass through turbine project area
Proportion at rotor height	%	0%													Feigin et al., 2022, Table A
Proportion of flights upwind	%	34.6%													Loring et al 2018, Fig. 14

Windfarm data	Units	Value	Data sources	Source
Name of windfarm site		Atlantic Shores		
Latitude	degrees	39.00		
Number of turbines		200		BA, Table 1
Width of windfarm	km	24		Measured from BA Figure 1
Tidal offset	m	1		

Turbine data	Units	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Source
Turbine model		V236-15MW													https://www.atlanticshoreswind.com/vestas-and-atlantic-shores/
No of blades		3													
Rotation speed	rpm	8.4													AS comment
Rotor radius	m	115.5													https://www.vestas.de/content/dam/vestascom/de/v236150MWBrochureOffshore.pdf.coredownload.inline.pdf
Hub height	m	139.3													Gap Min value=23.8, AS comment; plus rotors radius
Monthly proportion of time operational	%		89%	89%	86%	87%	84%	87%	86%	87%	88%	86%	88%	88%	MonWindAvail - AverDownTime; AS comment & SCRAM default
Max blade width	m	5.100													AS comment
Pitch	degrees	1													

Avoidance rates used in presenting results			Data sources (if applicable)
	95.01%	X	Cook 2021, Table A2 "All Gulls and Terns" Extended Band (2012) model
	98.00%		
	99.00%		
	99.50%		

COLLISION RISK ASSESSMENT (BIRDS ON MIGRATION)
Sheet 2 - Overall collision risk

All data input on Sheet 1:
no data entry needed on this sheet!
other than to choose option for final tables

Key	
(light green)	from Sheet 1 - input data
(lavender)	from Sheet 6 - available hours
(orange)	from Sheet 3 - single transit collision risk
(yellow)	from survey data
(light blue)	calculated field

Bird details:

Species		RedKnot
Flight speed	m/sec	20.1
Flight type		flapping

Windfarm data:

Number of turbines		200
Rotor radius	m	115.5
Minimum height of rotor	m	139.3
Total rotor frontal area	sq m	8381926

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year average
Proportion of time operational	%		89%	89%	86%	87%	84%	87%	86%	87%	88%	86%	88%	88%	87.1%
Stage A - flight activity															**per annum**
Migration passages			0	0	0	0	67	0	62	62	62	0	0	0	**253**
Migrant flux density	birds/ km		0	0	0	0	2.79167	0	2.58333	2.58333	2.58333	0	0	0	
Proportion at rotor height	%	0%													
Flux factor			0	0	0	0	101	0	94	94	94	0	0	0	
Option 1 -Basic model - Stages B, C and D															
Potential bird transits through rotors			0	0	0	0	0	0	0	0	0	0	0	0	**0**
Collision risk for single rotor transit	(from sheet 3)	3.3%													
Collisions for entire windfarm, allowing for non-op time, assuming no avoidance	birds per month or year		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Option 2-Basic model using proportion from flight distribution			**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
Option 3-Extended model using flight height distribution															
Proportion at rotor height	(from sheet 4)	57.8%													
Potential bird transits through rotors	Flux integral	0.5440	0	0	0	0	55	0	51	51	51	0	0	0	**208**
Collisions assuming no avoidance	Collision integral	0.01046	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**3**
Average collision risk for single rotor transit		1.9%													
Stage E - applying avoidance rates															
Using which of above options?	**Option 3**	0.00%	0	0	0	0	1	0	1	1	1	0	0	0	**3**
Collisions assuming avoidance rate	birds per month or year	95.01%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		98.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.50%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Collisions after applying large array correction		95.01%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		98.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.00%	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		99.50%	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Appendix D. Summary of Simulation Results from SCRAM: A Stochastic Collision Risk Assessment for Movement Data – Piping Plover

Summary of Simulation Results from SCRAM: A Stochastic Collision Risk Assessment for Movement Data

29 November 2022

SCRAM was developed by Biodiversity Research Institute, the University of Rhode Island, and the U.S. Fish and Wildlife Service with funding from the Bureau of Ocean Energy Management.

SCRAM RUN DETAILS

SCRAM – the Stochastic Collision Risk Assessment for Movement version ## Version: 0.91.1 – Lyrical Brachycarpus

Iterations: 1000

Model option: Option 3: slower but more accurate assessment ## Project: Atlantic Shores Offshore Wind South

Modeler: David Bigger

The model run was started at: Tue Nov 29 16:21:19 2022 EST ## The model run was completed at: Tue Nov 29 16:44:32 2022 EST

Run 1: the probability of exceeding specified threshold (1) is <0.001

MODEL INPUTS USED FOR THIS ANALYSIS

Table 1: Species Input Parameters (mean and 95 perc. Range).

Species	Turbine Model	Avoidance	Wing span	Body length	Speed
Piping Plover	V236-15MW	0.93 (0.92, 0.94)	0.38 (0.38, 0.38)	0.18 (0.17, 0.18)	11.86 (3.4, 20.84)

Table 2: Species Monthly (Jan-Jun) Population Estimates ± SD and Assumptions/Limitations as Specified by the USFWS Using the Most Recent Data.

Species	Jan	Feb	Mar	Apr	May	Jun
Piping Plover	0 ± 0	0 ± 0	4578 ± 0	4578 ± 0	4578 ± 0	4578 ± 0

Table 3: Species Monthly (Jul-Dec) Population Estimates ± SD and Assumptions/Limitations as Specified by the USFWS Using the Most Recent Data.

Species	Jul	Aug	Sep	Oct	Nov	Dec
Piping Plover	4578 ± 0	7423 ± 0	7423 ± 0	7423 ± 0	0 ± 0	0 ± 0

Population data assumptions/limitations:
1) Entire Atlantic coast population could be present in area during months listed.
2) Occurrence through October to include birds stopping over in mid-Atlantic (e.g. North Carolina). Number of birds still present in Atlantic likely lower.
3) Estimate of HY fledges, uses the 20-year (20022021) average productivity (unweighted).

Table 4: Wind farm Input Parameters (mean and 95 perc. Range).

Species	Turbine model	Num. turbines	Rotor radius	Hub height (m)	Blade width (m)	Wind speed (mps)
Piping Plover	V236-15MW	200 (200, 200)	116 (116, 116)	139 (139, 139)	5.77 (5.77, 5.77)	9.5 (8.57, 10.48)

Table 5: Wind Farm Input Parameters (mean and 95 perc. Range).

Species	Turbine model	Prop. Upwind	Rotor speed (rpm)	Pitch (radians)	Farm Width (km)	Lat.	Long.
Piping Plover	V236-15MW	1 (1, 1)	4.3 (3.88, 4.74)	0.03 (0.03, 0.04)	24 (24, 24)	39.29	-74.09

Table 6: Monthly Wind Farm Operational Data (mean and 95 perc. Range) Is Given for Each Wind Farm Specification.

Species	Turbine Model	Jan Op.	Feb Op.	Mar Op.	Apr Op.	May Op.	Jun Op.
Piping Plover	V236-15MW	90 (86.3, 94.1)	91.1 (87.3 95),	90.2 (86.6, 93.8)	90.5 (86.9, 94.1)	89.4 (85.7, 93.)	88.2 (84.7, 91.8)

Table 7: Monthly Wind Farm Operational Data (mean and 95 perc. Range) Is Given for Each Wind Farm Specification.

Species	Turbine Model	Jul Op.	Aug Op.	Sep Op.	Oct Op.	Nov Op.	Dec Op.
Piping Plover	V236-15MW	86.4 (82.5, 89.9)	84.8 (81.2, 88.3)	86.4 (83, 90)	88.7 (85.3, 92.1)	88.8 (85.2, 92.4)	90 (86.2, 93.7)

RESULTS FOR THE SCRAM SIMULATION

Table 8: The Predicted Mean and 95 perc. Prediction Intervals of the Number of Collisions per Month and the Total Summed Monthly Number of Collisions and 95 perc. Prediction Interval.[1]

Species	Turbine Model	Month	Mean Number of Collisions	Lower Pred. interval	Upper Pred. Interval
Piping Plover	V236-15MW	Jan			
Piping Plover	V236-15MW	Feb			
Piping Plover	V236-15MW	Mar			
Piping Plover	V236-15MW	Apr			
Piping Plover	V236-15MW	May	0	0	0
Piping Plover	V236-15MW	Jun	0.001	0.001	0.001
Piping Plover	V236-15MW	Jul	0.001	0.001	0.001
Piping Plover	V236-15MW	Aug	0.021	0.016	0.028
Piping Plover	V236-15MW	Sept	0	0	0
Piping Plover	V236-15MW	Oct			
Piping Plover	V236-15MW	Nov			
Piping Plover	V236-15MW	Dec			
Piping Plover	V236-15MW	Annual	0.023	0.018	0.03

[1] Results are not shown for months that do not have movement data.

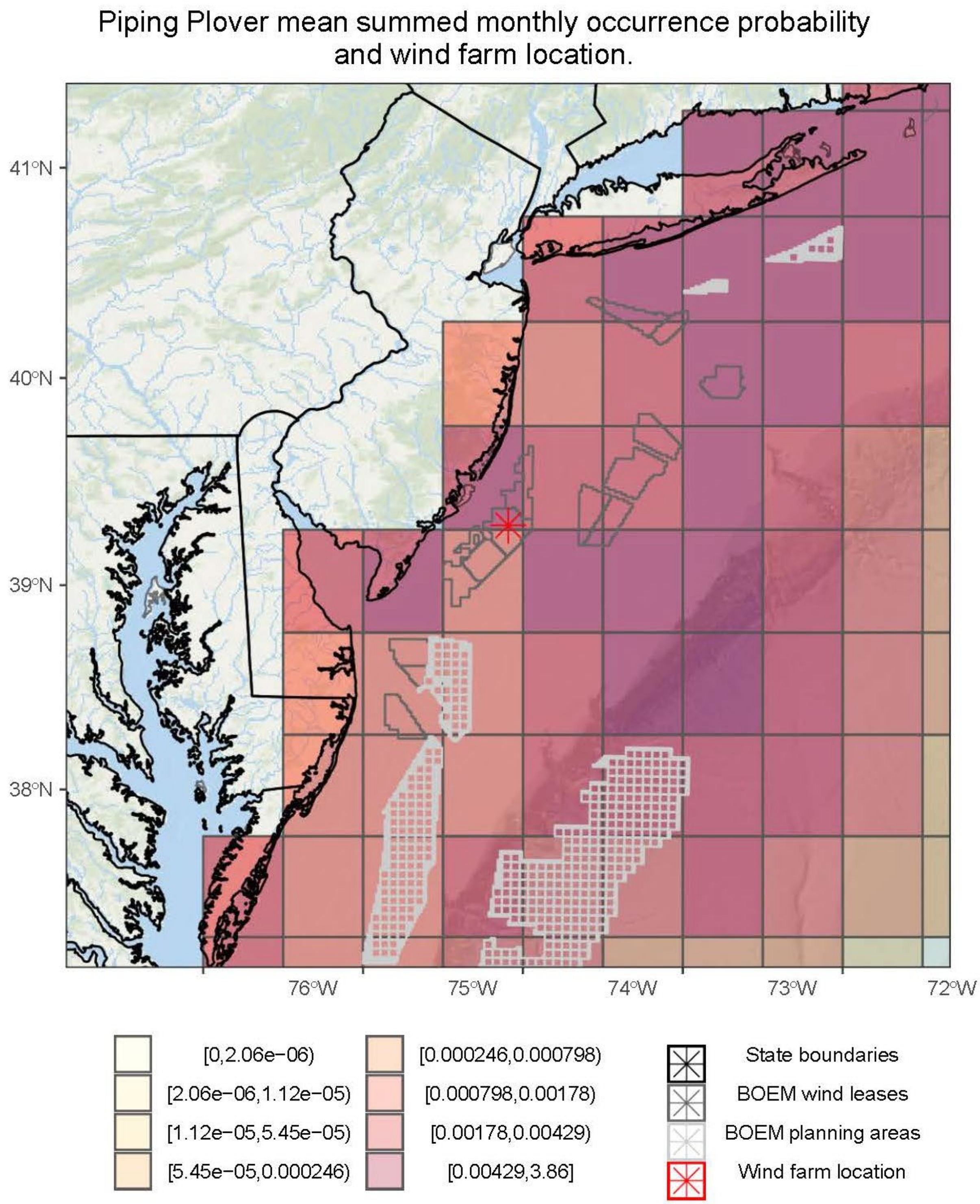
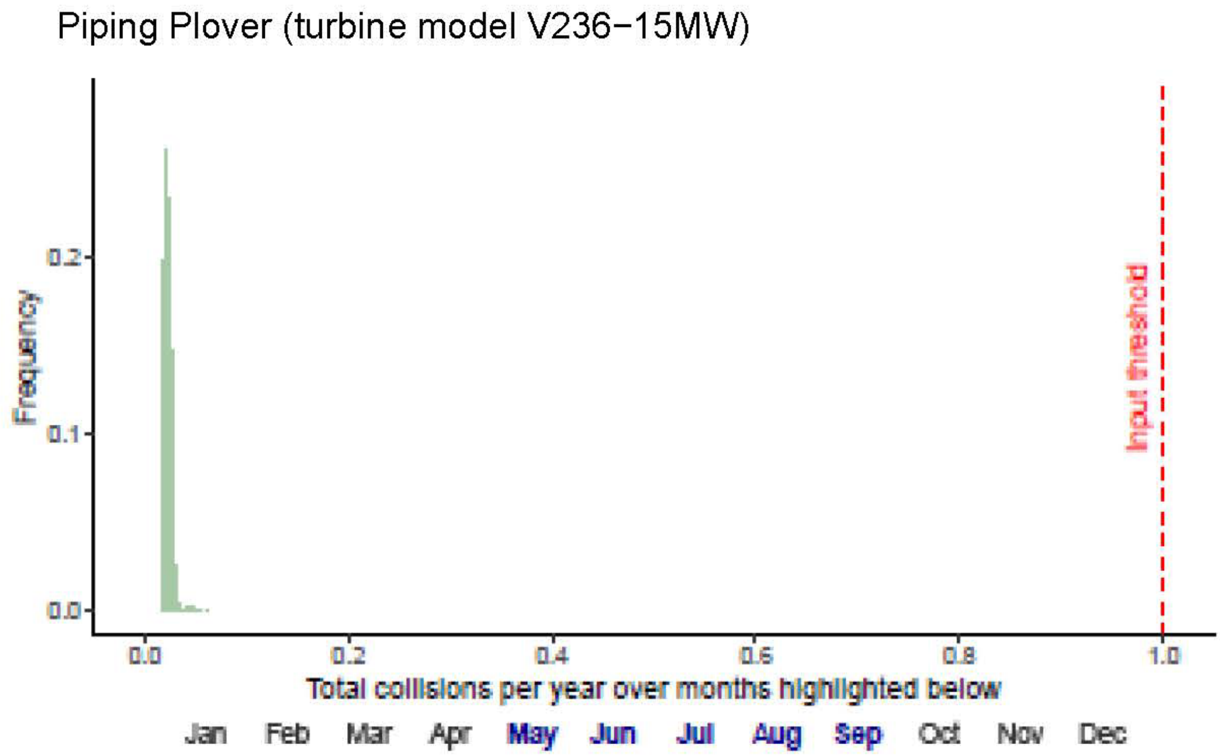
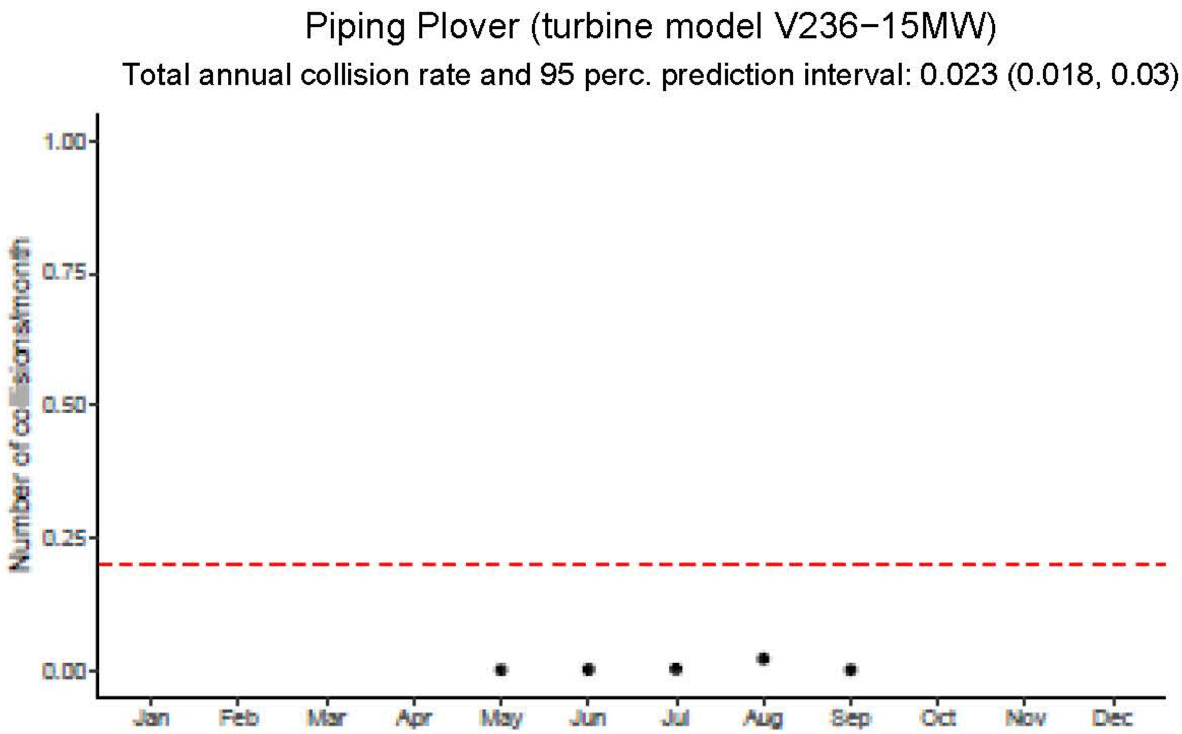


Figure 1: Map of the Species Occurrence Probabilities and Wind Farm Location.



Note: The heights of the bars show the relative frequency of each value. Months for which movement data were provided or available are shown in bold; only bold months are shown in histogram of annual collisions.

Figure 2: Frequency Histogram of the Total Number of Collisions per Year.



Note: Results are not shown for months that do not have movement data. Total annual collision rate and 95 perc. prediction interval are given at top. The threshold is shown divided by the number of months that movement data were available.

Figure 3: Predicted Mean and 95 perc. Prediction Intervals of the Number of Collisions per Month.

Appendix E. Summary of Simulation Results from SCRAM: A Stochastic Collision Risk Assessment for Movement Data – *Rufa* Red Knot

Summary of Simulation Results from SCRAM: A Stochastic Collision Risk Assessment for Movement Data

04 January 2023

SCRAM was developed by Biodiversity Research Institute, the University of Rhode Island, and the U.S. Fish and Wildlife Service with funding from the Bureau of Ocean Energy Management.

SCRAM RUN DETAILS

SCRAM – the Stochastic Collision Risk Assessment for Movement version ## Version: 0.91.1 – Lyrical Brachycarpus

Iterations: 1000

Model option: Option 3: slower but more accurate assessment ## Project: Atlantic Shores Offshore Wind South

Modeler: David Bigger

The model run was started at: Wed Jan 04 08:59:37 2023 EST ## The model run was completed at: Wed Jan 04 09:22:20 2023 EST

Run 1: the probability of exceeding specified threshold (1) is >0.999

MODEL INPUTS USED FOR THIS ANALYSIS

Table 1: Species Input Parameters (mean and 95 perc. Range).

Species	Turbine Model	Avoidance	Wing span	Body length	Speed
Red Knot	V236-15MW	0.93 (0.92, 0.94)	0.5 (0.45, 0.54)	0.24 (0.23, 0.25)	20.03 (16.53, 23.66)

Table 2: Species Monthly (Jan-Jun) Population Estimates ± SD and Assumptions/Limitations as Specified by the USFWS Using the Most Recent Data.

Species	Jan	Feb	Mar	Apr	May	Jun
Red Knot	10400 ± 0	10400 ± 0	10400 ± 0	10400 ± 0	59200 ± 0	59200 ± 0

Table 3: Species Monthly (Jul-Dec) Population Estimates ± SD and Assumptions/Limitations as Specified by the USFWS Using the Most Recent Data.

Species	Jul	Aug	Sep	Oct	Nov	Dec
Red Knot	59200 ± 0	59200 ± 0	72520 ± 0	54720 ± 0	41400 ± 0	10400 ± 0

Population data assumptions/limitations:
1) All pass through in spring - #s consistent w/Lyons et al super-population estimate for 2020 in DE Bay: 40,444 (95 perc. Credible interval: 33,627–49,966).
2) Winter population estimates represent the total # of adults and sub-adults (in general).
3) Southern and northern wintering birds could be present during July–Sept.
4) Only northern wintering birds could be present during Oct–Nov.
5) Only southeast U.S. and Caribbean birds could be present during Dec.
6) Birds from western Gulf population are excluded from totals in Atlantic region due to lack of information on extent to which they use the Atlantic region.
7) Numbers do not include HY birds in fall.
8) Dec number coming from Lyons et al 2017. Just includes SE U.S. Birds, not Caribbean.
9) Issues with double counting addressed because birds may be present in different areas of Atlantic region for weeks to months.

Table 4: Wind Farm Input Parameters (mean and 95 perc. Range).

Species	Turbine model	Num. turbines	Rotor radius	Hub height (m)	Blade width (m)	Wind speed (mps)
Red Knot	V236-15MW	200 (200, 200)	115.5 (115.5, 115.5)	139.3 (139.3, 139.3)	5.1 (5.1, 5.1)	12.5 (11.45, 13.43)

Table 5: Wind Farm Input Parameters (mean and 95 perc. Range).

Species	Turbine model	Prop. Upwind	Rotor speed (rpm)	Pitch (radians)	Farm Width (km)	Lat.	Long.
Red Knot	V236-15MW	1 (1, 1)	5.68 (5.21, 6.11)	0.03 (0.03, 0.04)	24 (24, 24)	39.29	-74.09

Table 6: Monthly Wind Farm Operational Data (mean and 95 perc. Range) Is Given for Each Wind Farm Specification.

Species	Turbine Model	Jan Op.	Feb Op.	Mar Op.	Apr Op.	May Op.	Jun Op.
Red Knot	V236-15MW	89.1 (85.4, 92.7)	89.3 (85.5, 93.2)	86.6 (82.9, 90.1)	86.7 (83.1, 90.3)	84.6 (81.2, 88.2)	87.1 (83.6, 90.9)

Table 7: Monthly Wind Farm Operational Data (mean and 95 perc. Range) Is Given for Each Wind Farm Specification.

Species	Turbine Model	Jul Op.	Aug Op.	Sep Op.	Oct Op.	Nov Op.	Dec Op.
Red Knot	V236-15MW	86.1 (82.6, 89.7)	87 (83.4, 90.6)	88.4 (84.7, 92.2)	86.4 (82.7, 90.1)	88.7 (85, 92.3)	88.6 (84.9, 92.5)

RESULTS FOR THE SCRAM SIMULATION

Table 8: The Predicted Mean and 95 perc. Prediction Intervals of the Number of Collisions per Month and the Total Summed Monthly Number of Collisions and 95 perc. Prediction Interval.[1]

Species	Turbine Model	Month	Mean Number of Collisions	Lower Pred. interval	Upper Pred. Interval
Red Knot	V236-15MW	Jan			
Red Knot	V236-15MW	Feb			
Red Knot	V236-15MW	Mar			
Red Knot	V236-15MW	Apr			
Red Knot	V236-15MW	May			
Red Knot	V236-15MW	Jun			
Red Knot	V236-15MW	Jul			
Red Knot	V236-15MW	Aug	0.883	0.723	1.034
Red Knot	V236-15MW	Sept	1.043	0.86	1.234

Species	Turbine Model	Month	Mean Number of Collisions	Lower Pred. interval	Upper Pred. Interval
Red Knot	V236-15MW	Oct	0.261	0.215	0.304
Red Knot	V236-15MW	Nov	0.688	0.565	0.812
Red Knot	V236-15MW	Dec			
Red Knot	V236-15MW	Annual	2.875	2.374	3.372

[1] Results are not shown for months that do not have movement data.

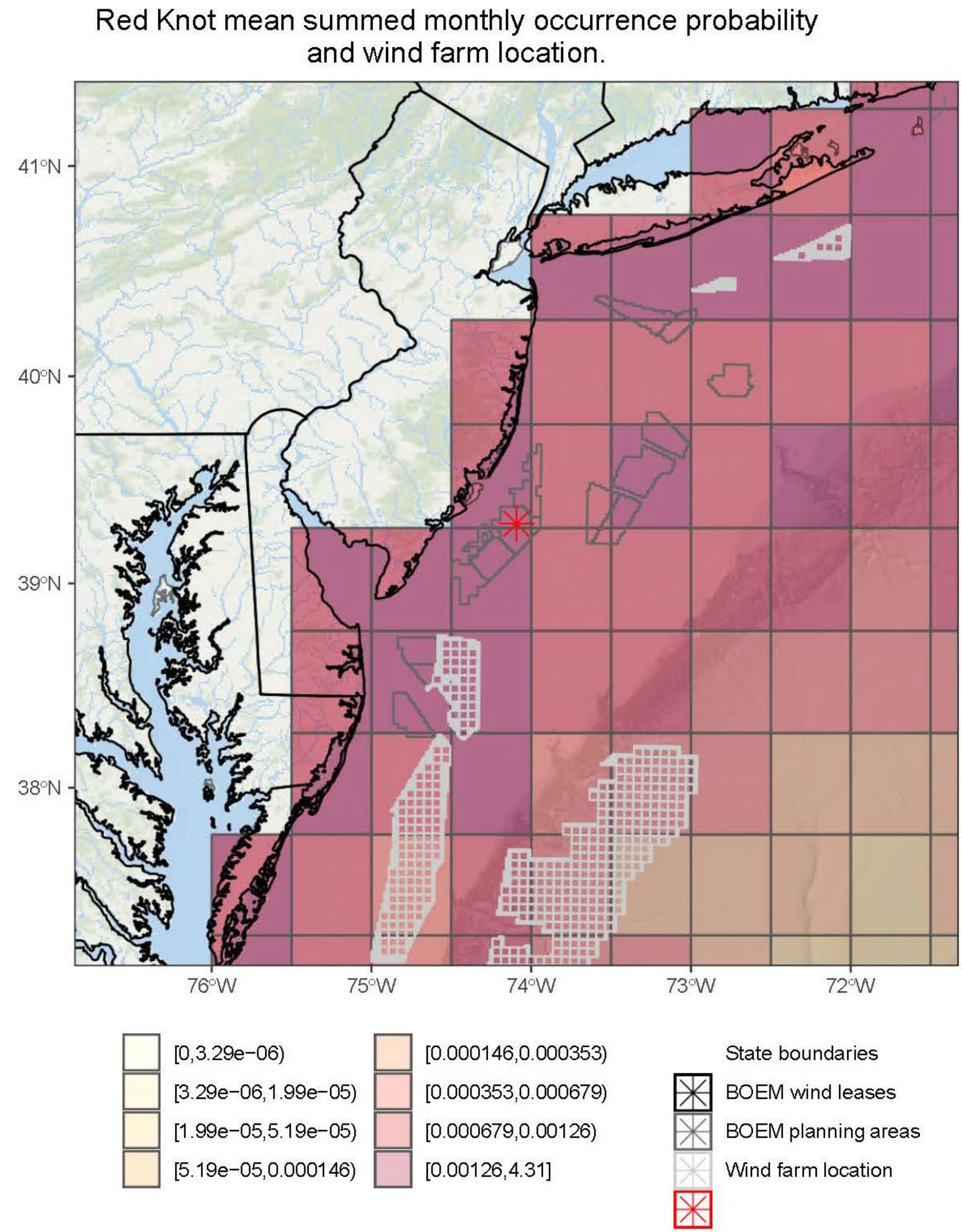
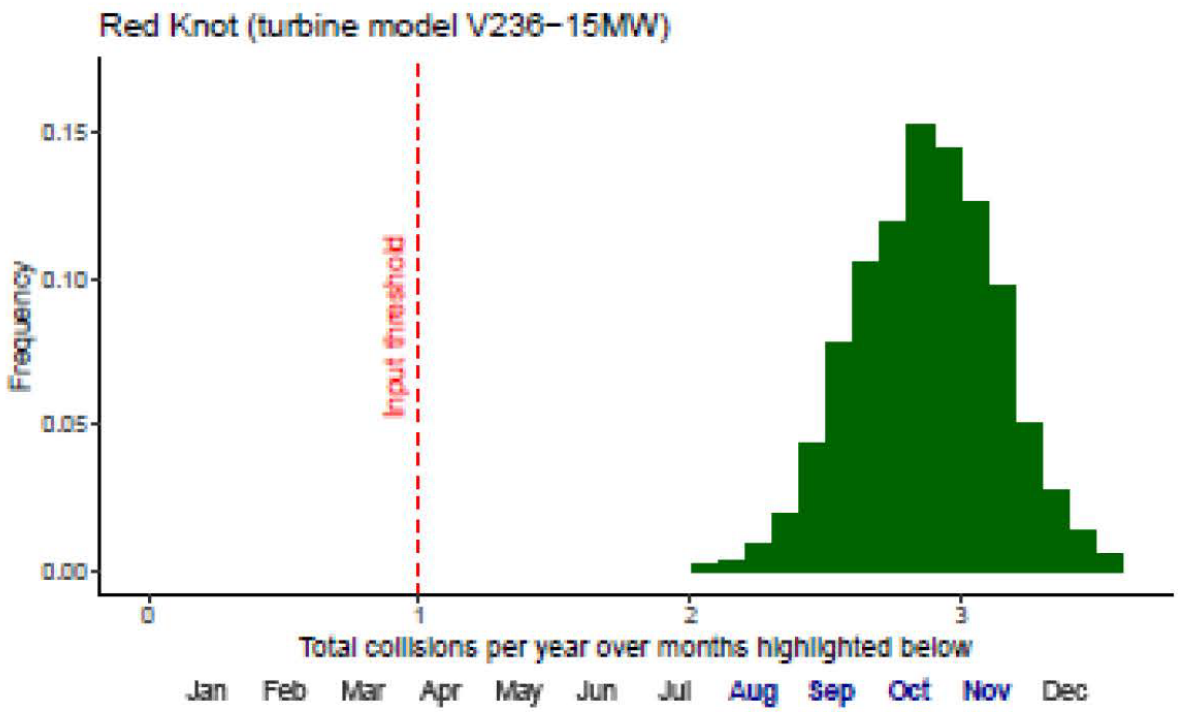


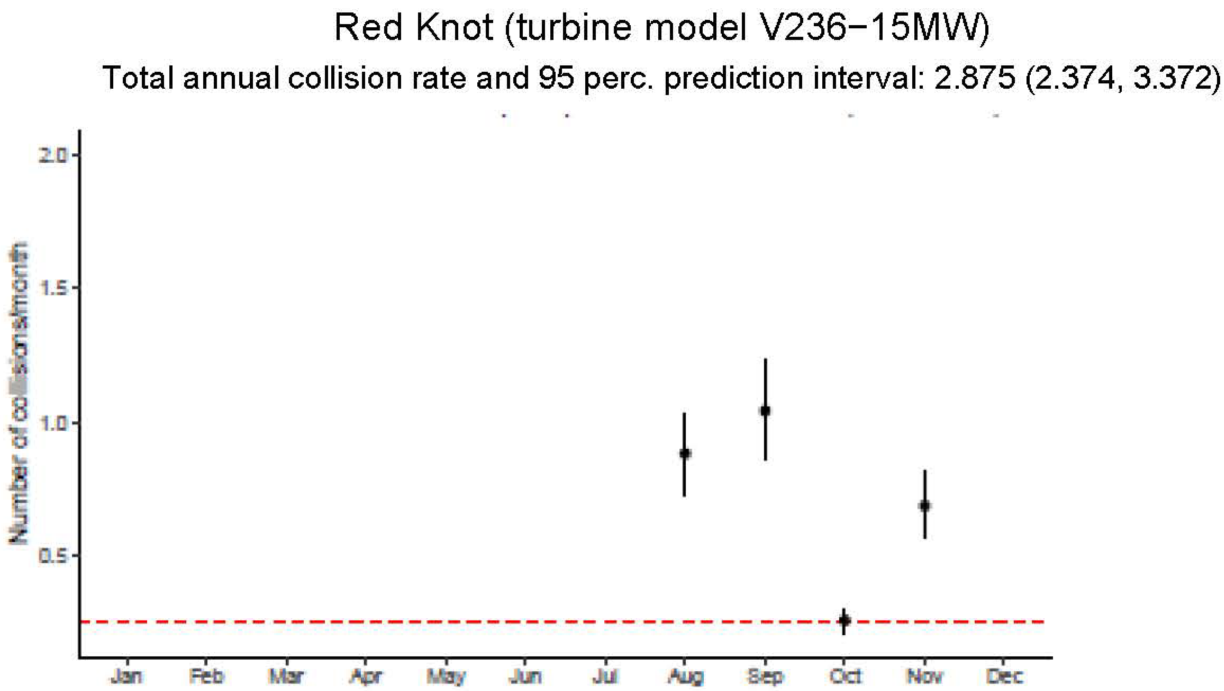
Figure 1: Map of the Species Occurrence Probabilities and Wind Farm Location.

Red Knot (turbine model V236−15MW)



Note: The heights of the bars show the relative frequency of each value. Months for which movement data were provided or available are shown in bold; only bold months are shown in histogram of annual collisions.

Figure 2: Frequency Histogram of the Total Number of Collisions per Year.



Note: Results are not shown for months that do not have movement data. Total annual collision rate and 95 perc. prediction interval are given at top. The threshold is shown divided by the number of months that movement data were available.

Figure 3: The Predicted Mean and 95 Perc. Prediction Intervals of the Number of Collisions per Month.

Appendix F: Summary of Simulation Results from SCRAM: A Stochastic Collision Risk Assessment for Movement Data – Roseate Tern

Summary of Simulation Results from SCRAM: A Stochastic Collision Risk Assessment for Movement Data

30 November 2022

SCRAM was developed by Biodiversity Research Institute, the University of Rhode Island, and the U.S. Fish and Wildlife Service with funding from the Bureau of Ocean Energy Management.

SCRAM RUN DETAILS

SCRAM - the Stochastic Collision Risk Assessment for Movement version ## Version: 0.91.1 - Lyrical Brachycarpus

Iterations: 1000

Model option: Option 3: slower but more accurate assessment ## Project: Atlantic Shores Offshore Wind South

Modeler: David Bigger

The model run was started at: Wed Nov 30 14:35:21 2022 EST ## The model run was completed at: Wed Nov 30 14:57:06 2022 EST

Run 1: the probability of exceeding specified threshold (1) is <0.001

MODEL INPUTS USED FOR THIS ANALYSIS

Table 1: Species Input Parameters (mean and 95 perc. range).

Species	Turbine Model	Avoidance	Wing span	Body length	Speed
Roseate Tern	V236-15MW	0.93 (0.92, 0.94)	0.76 (0.72, 0.8)	0.37 (0.33, 0.41)	12.81 (3.55, 22.1)

Table 2: Species Monthly (Jan-Jun) Population Estimates ± SD and Assumptions/Limitations as Specified by the USFWS Using the Most Recent Data.

Species	Jan	Feb	Mar	Apr	May	Jun
Roseate Tern	0 ± 0	0 ± 0	0 ± 0	10916 ± 0	10916 ± 0	10916 ± 0

Table 3: Species Monthly (Jul-Dec) Population Estimates ± SD and Assumptions/Limitations as Specified by the USFWS Using the Most Recent Data.

Species	Jul	Aug	Sep	Oct	Nov	Dec
Roseate Tern	16251 ± 0	16251 ± 0	16251 ± 0	16251 ± 0	0 ± 0	0 ± 0

Population data assumptions/limitations:
1) Entire NW Atlantic pop could be present in area during months listed.
2) Average of most recent (2018 and 2019) productivity data from three largest colonies (representing >90 perc. o f population) representative of entire population.
3) Fledging and post-breeding dispersal period occurs from July through Sept.
4) Numbers of non-breeding adults are not included.
5) Does not include non-breeding 1- and 2-year-old birds that return but do not breed.
6) From Gochfeld and Burger (2020): Northeastern birds first arrive at Nantucket and Martha's Vineyard, MA, in large flocks, then disperse north as well as west. They arrive 26 Apr-20 May at Bird I., MA (Nisbet 1980, Nisbet 1981, Nisbet 1989), slightly later at Falkner I., CT, and Great Gull I., NY.
7) From Gochfeld and Burger (2020): Apparently all birds migrate directly from the staging area around Cape Cod across the W. North Atlantic to the West Indies (Nisbet 1984, C. Mostello). Very small numbers occur at sea off N. Carolina from late Aug to late Sep, with a peak in early Sep; the latest date was 28 Oct (D. Lee).

Table 4: Wind Farm Input Parameters (mean and 95 perc. range).

Species	Turbine model	Num. turbines	Rotor radius	Hub height (m)	Blade width (m)	Wind speed (mps)
Roseate Tern	V236-15MW	200 (200, 200)	116 (116, 116)	139 (139, 139)	5.77 (5.77, 5.77)	9.49 (8.49, 10.43)

Table 5: Wind Farm Input Parameters (mean and 95 perc. range).

Species	Turbine model	Prop. upwind	Rotor speed (rpm)	Pitch (radians)	Farm Width (km)	Lat.	Long.
Roseate Tern	V236-15MW	1 (1, 1)	4.3 (3.84, 4.72)	0.03 (0.03, 0.04)	24 (24, 24)	39.29	-74.09

Table 6: Monthly Wind Farm Operational Data (mean and 95 perc. range) Is Given for Each Wind Farm Specification.

Species	Turbine Model	Jan Op.	Feb Op.	Mar Op.	Apr Op.	May Op.	Jun Op.
Roseate Tern	V236-15MW	90 (86.2, 93.7)	91.2 (87.6, 94.8)	90.1 (86.6, 93.9)	90.4 (86.6, 94.1)	89.4 (85.9, 93)	88.1 (84.6, 91.8)

Table 7: Monthly Wind Farm Operational Data (mean and 95 perc. range) Is Given for Each Wind Farm Specification.

Species	Turbine Model	Jul Op.	Aug Op.	Sep Op.	Oct Op.	Nov Op.	Dec Op.
Roseate Tern	V236-15MW	86.4 (82.6, 90)	84.8 (81.2, 88.2)	86.4 (82.7, 90)	88.7 (85, 92.2)	88.9 (85.3, 92.6)	90 (86.3, 93.8)

RESULTS FOR THE SCRAM SIMULATION

Table 8: The Predicted Mean and 95 Perc. Prediction Intervals of the Number of Collisions per Month and the Total Summed Monthly Number of Collisions and 95 Perc. Prediction Interval.[1]

Species	Turbine Model	Month	Mean Number of Collisions	Lower Pred. interval	Upper pred. Interval
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Red Knot	V236-15MW	May			
Red Knot	V236-15MW	Jun			
Red Knot	V236-15MW	Jul			
Red Knot	V236-15MW	Aug	0.883	0.723	1.034

Species	Turbine Model	Month	Mean Number of Collisions	Lower Pred. interval	Upper pred. Interval
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Red Knot	V236-15MW	Annual	2.875	2.374	3.372

[1] Results are not shown for months that do not have movement data.

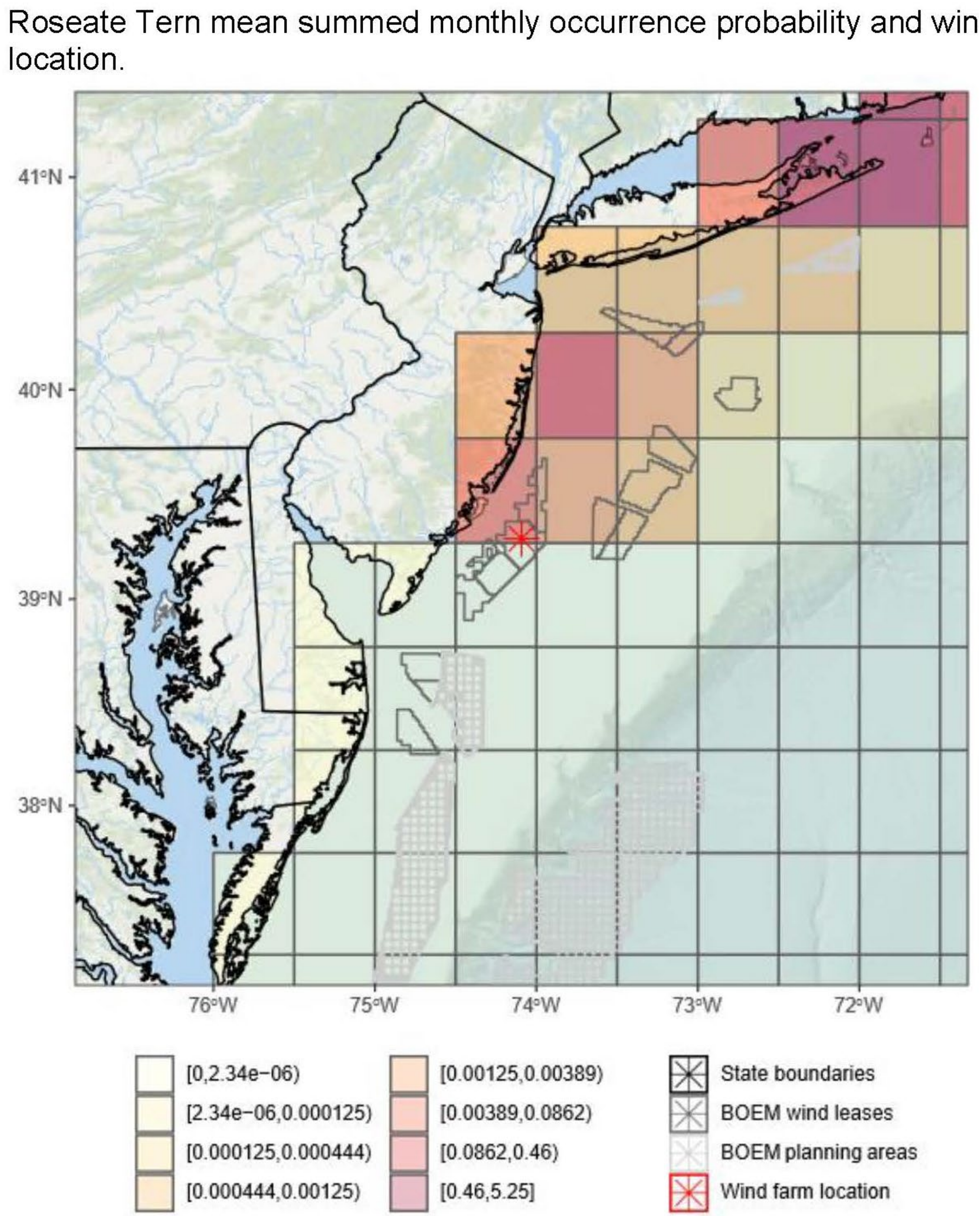
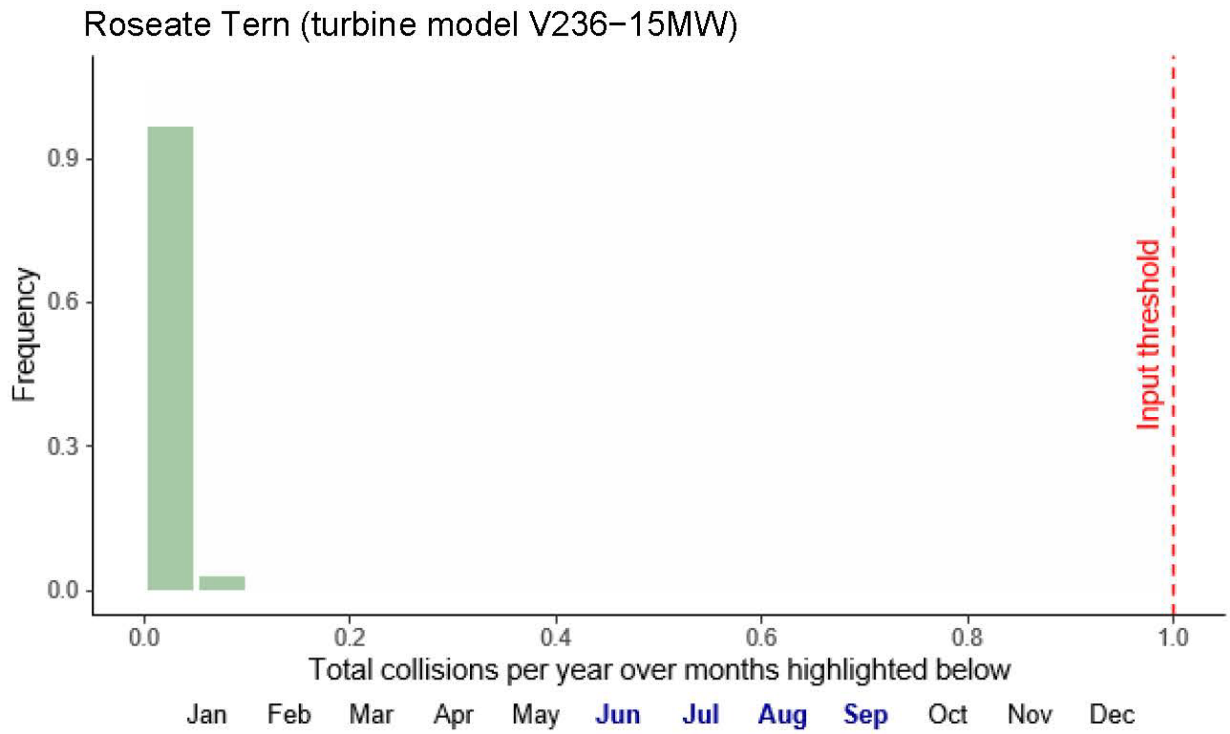


Figure 1: Map of the Species Occurrence Probabilities and Wind Farm Location.



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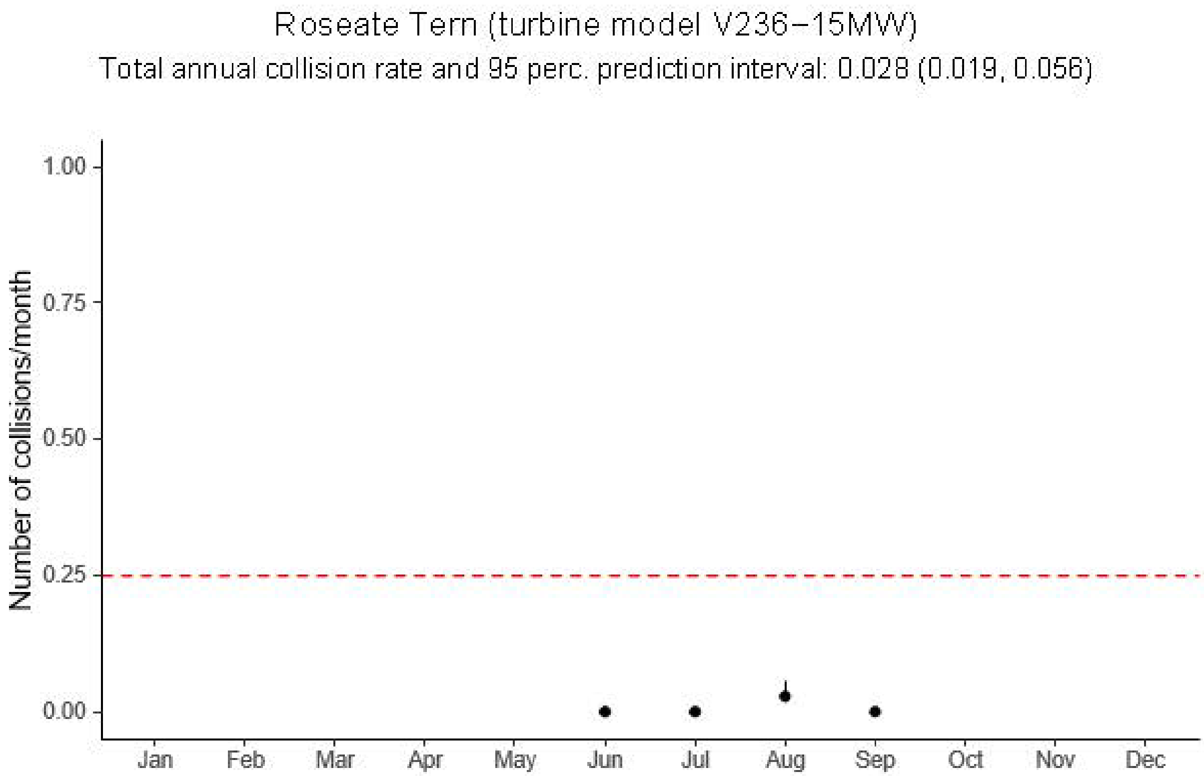

Note: Results are not shown for months that do not have movement data. Total annual collision rate and 95 perc. prediction interval are given at top. The threshold is shown divided by the number of months that movement data were available.

Figure 3: The Predicted Mean and 95 Perc. Prediction Intervals of the Number of Collisions per Month.

Appendix G: Avian and Bat Monitoring Framework

{Placeholder}