# Appendix F

## Assessment of Resources with Moderate (or Lower) Impacts

# Contents

# List of Tables

| Table | | Page |
|---|---|---|

# List of Figures

## F.1 Introduction

To focus on the impacts of most concern in the main body of this Final EIS, BOEM has included the analysis of resources with no greater than **moderate** adverse impacts below. These include air quality; water quality; bats; benthic resources; birds; coastal habitat and fauna; finfish, invertebrates, and essential fish habitat; sea turtles; wetlands; demographics, employment, and economics; environmental justice; land use and coastal infrastructure; and recreation and tourism. Those resources with potential impact ratings greater than **moderate** are included in Chapter 3, *Affected Environment and Environmental Consequences,* of the Final EIS. Locating environmental resource sections with no greater than moderate adverse impacts in Appendix F supports the 300-page limits of the body of the EIS (40 CFR 1502.7).

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# 3.4 Physical Resources

## 3.4.1 Air Quality

This section discusses potential impacts on air quality from the proposed Project, alternatives, and ongoing and planned activities in the air quality geographic analysis area. The air quality geographic analysis area, as shown on Figure 3.4.1-1, includes the airshed within 25 nautical miles (46.3 kilometers) of the WTA and the airshed within 15.5 nautical miles (28.7 kilometers) of onshore construction areas and ports that may be used for the Project. The geographic analysis area also considers potential air quality impacts associated with the onshore construction areas and the mustering port(s) outside of the OCS permit area. Given the dispersion characteristics of emissions from marine vessels, equipment and similar emission sources that would be used during proposed construction activities, the maximum potential air quality impacts would likely occur within a few miles of the source. BOEM selected the 15.5-mile (28.7-kilometer) distance to assure that the locations of maximum potential air quality impact would be considered.

### 3.4.1.1 Description of the Affected Environment and Future Baseline Conditions

The overall geographic analysis area for air quality covers much of southern New Jersey and the adjacent portions of the Atlantic Ocean. This includes the air above the WTA and adjacent OCS area, the offshore export cable routes, onshore cable routes, the onshore substations, the construction staging areas, the onshore construction and proposed Project-related sites, and the ports in New Jersey, Virginia, and Texas used to support proposed Project activities. COP Volume II, Section 3.1.1 (Atlantic Shores 2024), provides further description of the air quality geographic analysis area. Appendix B, *Supplemental Information and Additional Figures and Tables,* provides information on climate and meteorological conditions in the Project region.

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

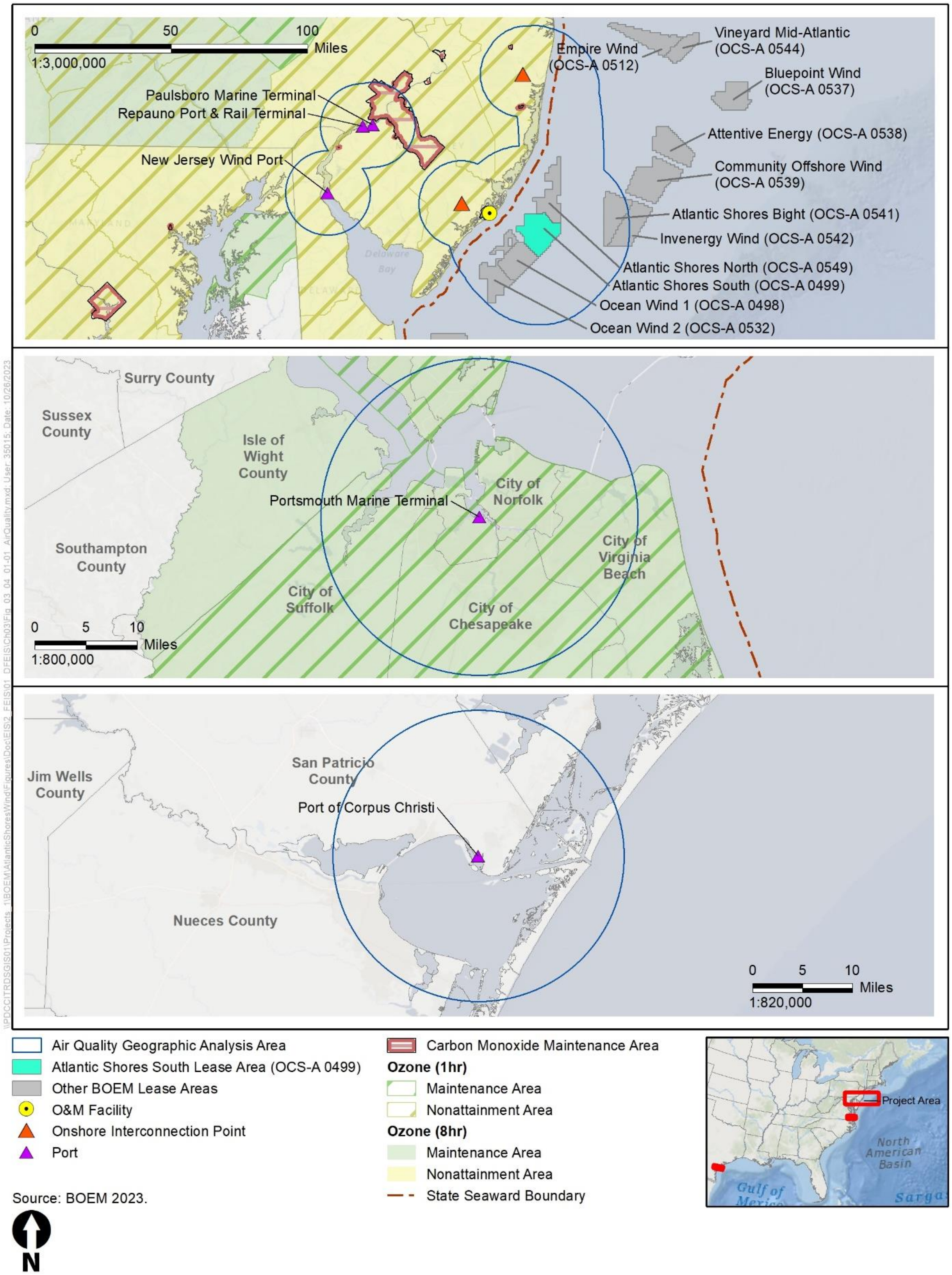



**Figure 3.4.1-1. Air quality geographic analysis area and attainment status**

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

| Pollutant | Averaging Period | National Ambient Air Quality Standards (μg/m³) | | New Jersey Ambient Air Quality Standards (μg/m³) | |
|---|---|---|---|---|---|
| | | Primary | Secondary | Primary | Secondary |
| Carbon Monoxide (CO) | 8-hour[1] | 10,000 | None | 10,000 | 10,000 |
| | 1-hour[1] | 40,000 | None | 40,000 | 40,000 |
| Lead (Pb) | Rolling 3-month average[2] | 0.15 | 0.15 | 1.5 | 1.5 |
| Nitrogen Dioxide ($NO_2$) | Annual[2] | 100 | 100 | 100 | 100 |
| | 1-hour[3] | 188 | None | None | None |
| Ozone ($O_3$) | 8-hour[4] | 137 | 137 | None | None |
| | 1-hour[1] | None | None | 235 | 160 |
| Particulate Matter ($PM_{10}$) | 24-hour[5] | 150 | 150 | None | None |
| Particulate Matter ($PM_{2.5}$) | Annual[6] | 9.0 | 15 | None | None |
| | 24-hour[7] | 35 | 35 | None | None |
| Sulfur Dioxide ($SO_2$) | Annual[2] | 80 | None | 80 | 60 |
| | 24-hour[1] | None | None | 365 | 260 |
| | 3-hour[1] | None | 1300 | None | 1,300 |
| | 1-hour[8] | 196 | None | None | None |
| Suspended Particulate Matter | 24-hour[1] | None | None | 260 | 150 |
| | Annual[9] | None | None | 75 | 60 |

Sources: National – 40 CFR 50, New Jersey – NJAC 7:27-13.
μg/m³ = micrograms of pollutant per cubic meter of air.
[1] Not to be exceeded more than once per year.
[2] Not to be exceeded.
[3] 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
[4] Annual 4th-highest daily maximum 8-hour concentration, averaged over 3 years.
[5] Not to be exceeded more than once per year on average over 3 years.
[6] Annual mean, averaged over 3 years.
[7] 98th percentile, averaged over 3 years.
[8] 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
[9] Not to be exceeded (geometric mean of all 24-hour averages).

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

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

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

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

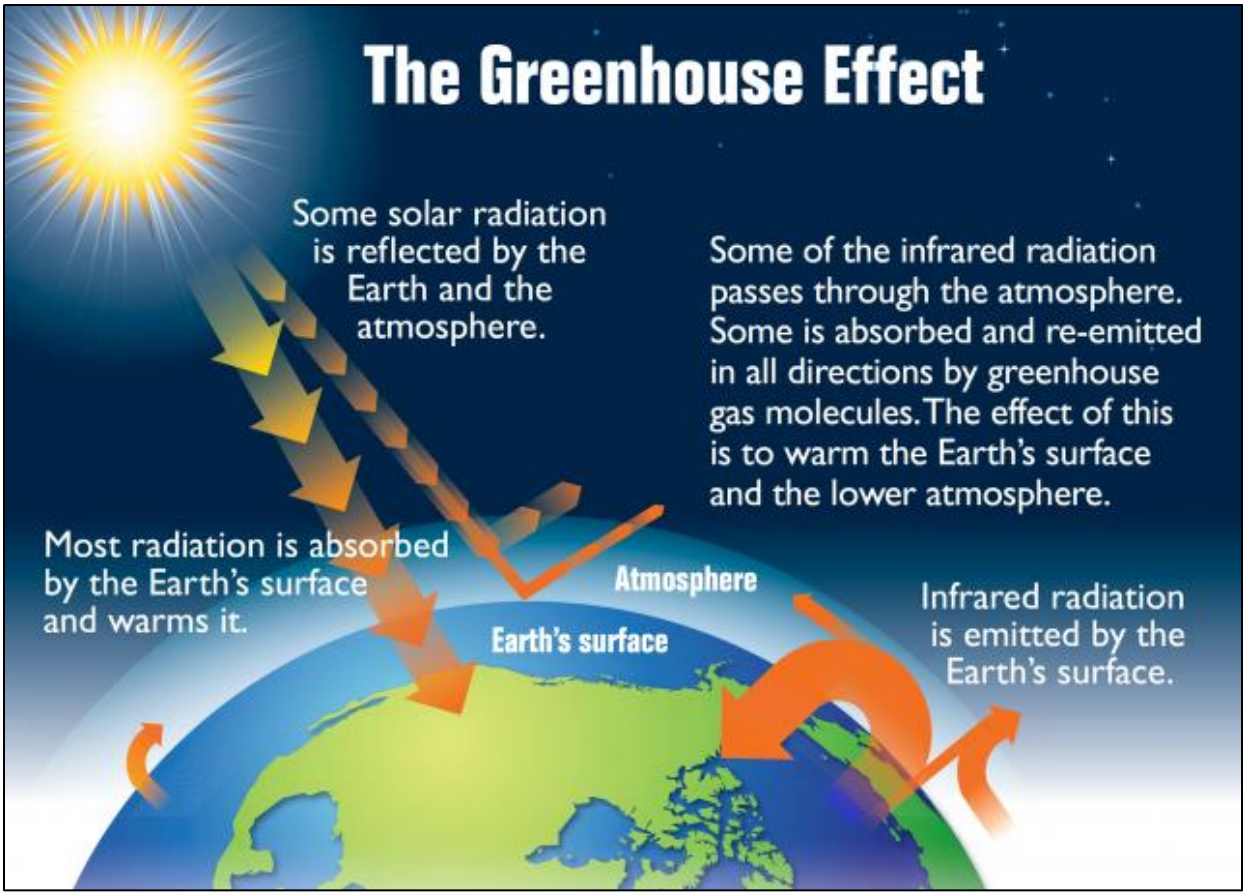
The CAA defines Class I areas as certain national parks and wilderness areas where very little degradation of air quality is allowed. Class I areas consist of national parks larger than 6,000 acres (2,428 hectares) and wilderness areas larger than 5,000 acres (2,023 hectares) that were in existence before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

The CAA amendments (42 USC 7401 et seq., Section 328) directed USEPA to establish requirements to control air pollution from OCS oil- and gas-related activities along the Pacific, Arctic, and Atlantic Coasts and along the U.S. Gulf Coast offshore Florida, east of 87° 30' west longitude. The OCS Air Regulations (40 CFR Part 55) establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement for facilities subject to the CAA. These regulations apply to OCS sources that are beyond state seaward boundaries. Projects within 25 nautical miles (46.3 kilometers) of a state seaward boundary are required to comply with the air

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

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

Greenhouse gases (GHGs) are gases that absorb and re-emit terrestrial infrared radiation (i.e., they trap heat in the atmosphere) and contribute to global climate change by retaining heat in the atmosphere (IPCC 2021). This phenomenon is known as the "greenhouse effect" and is illustrated in Figure 3.4.1-2. The primary GHGs are carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and certain industrial gases. The GHG emissions from the Project are a result of fuel combustion that produces emissions of $CO_2$, $CH_4$, and $N_2O$, as well as leakage of sulfur hexafluoride ($SF_6$) from gas-insulated switchgear. Because each GHG constituent has a different heat-trapping ability, GHG emissions typically are expressed as $CO_2$ equivalent ($CO_2e$) based on the specific global warming potential (GWP) for each gas. The GWP of each GHG reflects how strongly it absorbs energy compared to $CO_2$. $CO_2e$ is calculated based on the sum of the individual GHG emissions weighted by their respective GWPs.[2]




Source: USEPA 2023

**Figure 3.4.1-2. The greenhouse effect**

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

By far the GHG with the largest contribution to warming is $CO_2$. Global atmospheric $CO_2$ concentrations have increased 49.2 percent, from approximately 278 parts per million (ppm) in 1750 (IPCC 2021) to approximately 417.07 ppm in 2022 (NOAA 2023). This rise in the $CO_2$ concentration is largely a result of the release of carbon that had been stored underground and then used to combust fossil fuels (coal, petroleum, and natural gas) to produce electricity, heat buildings, and power motor vehicles and airplanes, among other uses (IPCC 2021). Consistent with the greenhouse effect and increasing $CO_2$ concentrations, global surface temperature increased by approximately 1.8 degrees Fahrenheit (°F) (0.99 degrees Celsius [°C]) from 1850–1900 to 2001–2020 and is projected to continue increasing (IPCC 2021).

IPCC (2021) concludes that, at continental and global scales, numerous long-term changes in climate have been observed. Additionally, IPCC and the GCRP include the following trends observed over the twentieth century as further supporting the evidence of climate-induced changes (IPCC 2021; GCRP 2017):

- Most land areas have very likely experienced warmer and/or fewer cold days and nights along with warmer and/or more frequent hot days and nights.
- Cold-dependent habitats are shifting to higher altitudes and latitudes, and growing seasons are becoming longer.
- Sea level is rising, caused by thermal expansion of the ocean water and melting of snowcaps and ice sheets.
- More frequent weather extremes such as droughts, floods, severe storms, and heat waves have been observed.
- There is high confidence that oceans are becoming more acidic because of increasing absorption of $CO_2$ by seawater, which is driven by a higher atmospheric concentration of $CO_2$.

#### 3.4.1.2 Impact Level Definitions for Air Quality

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

**Table 3.4.1-2. Impact level definitions for air quality**

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

### 3.4.1.3 Impacts of Alternative A – No Action on Air Quality

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

#### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for air quality described in Section 3.4.1.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on air quality are generally associated with existing onshore land uses, including residential, commercial, industrial, and transportation activities, as well as onshore construction activities. Other ongoing activities that could contribute to air quality impacts include construction of undersea transmission lines, gas pipelines, and other submarine cables; marine minerals use and ocean-dredged material disposal; military use; marine transportation; and oil and gas activities. These activities and associated impacts are expected to continue at current trends and have the potential to affect air quality through their emissions. Impacts associated with climate change could affect ambient air quality through increased formation of ozone and particulate matter associated with increasing air temperatures. See Appendix D, Table D.A1-1 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for air quality. There is currently one ongoing offshore wind project within the geographic analysis area for air quality that could contribute to impacts on air quality: Ocean Wind 1 in Lease Area OCS-A 0498.

NJDEP has projected that under a scenario of continuation of current regulations and policies, emissions from electricity generation would decline slowly through 2050 due to improvements in efficiency and switching to cleaner fuels (NJDEP 2019). Under the No Action Alternative, without implementation of other offshore wind projects, the electricity that would have been generated by offshore wind would likely be provided by fossil-fuel fired facilities.[3] As a result, a continuation of activities under the No Action Alternative could lead to less decline in emissions than would occur with offshore wind development. An overall mix of natural gas, solar, wind, and energy storage would likely occur in the future due to market forces and state energy policies. New Jersey EO 307 (September 22, 2022) sets a goal of developing 11 GW of offshore wind energy off the coast of New Jersey by 2040. The New Jersey Energy Master Plan (New Jersey Board of Public Utilities 2019) sets a goal of transitioning New Jersey to 100 percent renewable electricity by 2050. The New Jersey Global Warming Response Act (P.L. 2007 c.112; P.L. 2019 c.197) established a goal of reducing statewide greenhouse gas emissions 80 percent below the 2006 level (a reduction of about 97 million metric tons $CO_2e$) by the year 2050.

#### *Cumulative Impacts of Alternative A – No Action*

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

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

Ongoing and planned offshore wind activities within the geographic analysis area that could contribute to impacts on air quality (based on the scenario shown in Appendix D) include construction and installation of:

- Ocean Wind 1 (OCS-A 0498) (98 WTGs), ongoing 2026–2030,
- Ocean Wind 2 (OCS-A 0532) (111 WTGs), expected 2026–2030, and

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

- Atlantic Shores North (OCS-A 0549) (157 WTGs), expected 2026–2028.[4]

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

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

All projects would be required to comply with the CAA. Primary emission sources would include vessel traffic, increased public and commercial vehicular traffic, air traffic, combustion emissions from construction equipment, and fugitive[5] particle emissions from construction-generated dust. During operations, emissions from ongoing and planned offshore wind projects within the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. COP Appendix II-C (Atlantic Shores 2024) provides details of these emission sources for construction and operations, as well as regulatory applicability of emissions by geographic area for purposes of NEPA and permitting.

The aggregate O&M emissions for all projects within the air quality geographic analysis area would vary by year as successive projects begin operation. As wind energy projects come online, power generation emissions overall would decrease to the extent that wind energy would displace emissions from fossil-fueled electric generating facilities, and the region as a whole would realize a net benefit to air quality. The ongoing and planned offshore wind projects other than the Proposed Action that may result in air pollutant emissions and air quality impacts within the air quality geographic analysis area include projects within all or portions of the following Lease Areas: OCS-A-0549, OCS-A-0498, and OCS-A-0532 (Appendix D, Table D.A2-4). Projects currently in these Lease Areas are Atlantic Shores North (planned), Ocean Wind 1 (ongoing), and Ocean Wind 2 (planned), respectively. These projects would produce 4,603 MW of renewable power from the installation of 364 WTGs (Appendix D, Table D.A2-1). Based on the assumed offshore construction schedule in Appendix D, Table D.A2-1, the three projects within the geographic analysis area would have overlapping construction periods in 2026 through 2030.

During the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than Atlantic Shores South (Atlantic Shores North and Ocean Wind 1 and 2)

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[4] Atlantic Shores Offshore Wind Bight (OCS-A 0541) and Invenergy Wind Offshore (OCS-A 0542) are within the geographic analysis area; however, annual air emission estimates are not yet available for these two projects (both of which are in the planning stage).
[5] Fugitive emissions are emissions that are not emitted from a stack, vent, or other specific point that controls the discharge. For example, windblown dust is fugitive particulate matter.

ongoing or proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 5,450 tons of CO, 24,618 tons of $NO_X$, 938 tons of $PM_{10}$, 814 tons of $PM_{2.5}$, 190 tons of $SO_2$, 619 tons of VOCs, and 1,448,447 tons of $CO_2$ (Appendix D, Table D.A2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would be minor to moderate, shifting spatially and temporally across the air quality geographic analysis area.

During operations, emissions from ongoing and planned offshore wind projects within the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from O&M vessel traffic and emergency diesel generators. The aggregate operational emissions from ongoing and planned offshore wind projects other than Atlantic Shores South would vary by year as successive projects begin operation. Estimated operational emissions would be 122–239 tons per year of CO, 521–1,007 tons per year of $NO_X$, 17–34 tons per year of $PM_{10}$, 16–31 tons per year of $PM_{2.5}$, 1–3 tons per year of $SO_2$, 9–17 tons per year of VOCs, and 34,949–68,610 tons per year of $CO_2$ (Appendix D, Table D.A2-4). Operational emissions would overall be intermittent and dispersed throughout the 241,609-acre (97,776-hectare) lease areas for Ocean Wind 1 and 2 and Atlantic Shores North combined and the vessel routes from the onshore O&M facility, and would generally contribute to small and localized air quality impacts.

Offshore wind energy development, by displacing fossil-fuel energy, would help offset emissions from fossil fuels, improving regional air quality and reducing GHG emissions. Millstein et al. (2018) estimated that between 2007 and 2015, wind power in the U.S. avoided as much as 127,698,000 metric tons (MT) of $CO_2$ per year, 147,000 MT of $SO_2$ per year, 93,000 MT of $NO_X$ per year, and 9,000 MT of $PM_{2.5}$ per year. A study by the U.S. Department of Energy (DOE) estimated emissions for a future scenario with wind energy supplying 10 percent of total U.S. electricity demand by 2020, 20 percent by 2030, and 35 percent by 2050. The study estimated cumulative emissions reductions from 2013 to 2050 of 2.6 million MT of $SO_2$, 4.7 million MT of $NO_X$, and 0.5 million MT of $PM_{2.5}$ (DOE 2015). Similarly, the study scenario was estimated to reduce GHG emissions in the electric sector by 130 million MT of $CO_2$ equivalent ($CO_2e$) in 2020, 380 million MT $CO_2e$ in 2030, and 510 million MT $CO_2e$ in 2050 (DOE 2015).

An analysis by Barthelmie and Pryor (2021) calculated that, depending on global trends in GHG emissions and the amount of wind energy expansion, development of wind energy could reduce predicted increases in global surface temperature by 0.5–1.4 °F (0.3–0.8°C) by 2100. These estimated decreases in temperature rise correspond to development of approximately 5,000 GW (5,000,000 MW) of wind energy worldwide; the decrease in temperature rise and other climate change effects due to any single project would be incremental and would not be measurable.

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

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

**Accidental releases:** Ongoing and planned offshore wind activities could release hazardous air pollutants (HAPs) in the event of accidental chemical spills within the air quality geographic analysis area. Section 3.4.2, *Water Quality*, includes a discussion of the nature of releases that could occur. Based on Appendix D, Table D.A2-3, up to about 1,034,834 gallons (3.9 million liters) of coolants, 2,166,000 gallons (8.2 million liters) of oils and lubricants, and 366,763 gallons (1.4 million liters) of diesel fuel would be contained in the 378 wind turbine and substation structures for the wind energy projects within the air quality geographic analysis area (Atlantic Shores North, and Ocean Wind 1 and 2). If accidental releases occur, they would most likely occur during construction but could occur during operations and decommissioning of offshore wind facilities. These may lead to short periods (hours to days)[6] of HAP emissions through surface evaporation. HAP emissions would consist of VOCs, which may be important for ozone formation. By comparison, the smallest tanker vessel operating in these waters (a general-purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million and 30.3 million liters). Tankers are relatively common in these waters, and the total WTG chemical storage capacity within the geographic analysis area for air quality is much less than the volume of hazardous liquids transported by ongoing activities (U.S. Energy Information Administration 2014). Moreover, liquids associated with the Project would be distributed among hundreds of independent marine-grade containers spread out over many different structures, thus making any kind of full release extremely unlikely. BOEM expects air quality impacts from accidental releases would be negligible because they would be short term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 34-year period with a higher probability of spills during future project construction, but they would not be expected to contribute appreciably to cumulative impacts on air quality.

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

*Conclusions*

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

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

**Cumulative Impacts of Alternative A – No Action**. The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and ongoing and planned offshore wind activities (without the Proposed Action). Under the No Action Alternative, existing environmental trends and activities would continue, and air quality would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in minor to moderate impacts on air quality due to emissions from ongoing and planned activities (including offshore wind). BOEM anticipates that the No Action Alternative combined with all other ongoing and planned activities (including offshore wind) in the geographic analysis area would result in **minor** to **moderate adverse** impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Impacts would be minor to moderate because these emissions would incrementally increase ambient pollutant concentrations (more than would activities without offshore wind or offshore wind alone), though not by enough to cause a violation of the NAAQS or New Jersey AAQS. Most air pollutant emissions and air quality impacts from offshore wind would occur during multiple overlapping project construction phases from 2024 through 2030 (Appendix D, Table D.A2-4). Pollutant emissions associated with offshore wind operations would be generally lower and more transient.

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

### 3.4.1.4 Relevant Design Parameters and Potential Variances in Impacts

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

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

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

### 3.4.1.5 Impacts of Alternative B – Proposed Action on Air Quality

**Air emissions:** The Project would generate emissions that may affect air quality in the New Jersey region and nearby coastal waters during construction, O&M, and decommissioning activities. Onshore emissions would occur at the Monmouth and Atlantic Landfall Sites, in the onshore cable corridors, and at the Larrabee and Cardiff Substation POIs. Offshore emissions would be within the OCS and state offshore waters. Offshore emissions would occur in the Lease Area and the offshore export cable corridors. COP Volume I, Section 1.1 (Atlantic Shores 2024) provides additional information on the landfall locations and onshore cable routes. The emissions estimates in this Final EIS have changed from those in the Draft EIS due to more recent revisions of the COP.

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

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

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

Fuel combustion and solvent use would cause construction-related emissions. Excavation and related earthworks would cause construction-related fugitive dust emissions. The air pollutants would include criteria pollutants, VOCs, and HAPs, as well as GHGs. During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses also could have impacts on air quality. Because the specific combination of ports to be used and the amount of activity that would occur at each port are unknown, construction emissions were calculated for a maximum-emissions scenario with heavy vessels using the New Jersey Wind Port and the Paulsboro Marine Terminal, and crew transfer vessels (CTVs) using the Port of Atlantic City (COP, Volume II, Section 3.1.2; Atlantic Shores 2024). For purposes of calculating emissions from vessels, the full travel distance from the applicable port to the Project area was used. Table 3.4.1-3 summarizes estimated construction emissions of each pollutant by year.

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

| Year | CO | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 2025 | 239 | 880 | 31 | 27 | 3 | 20 | 66,407 | 1.0 | 4.3 | 67,297 |
| 2026 | 239 | 880 | 31 | 27 | 3 | 20 | 66,407 | 1.0 | 4.3 | 67,297 |
| 2027 | 239 | 880 | 31 | 27 | 3 | 20 | 66,407 | 1.0 | 4.3 | 67,297 |
| 2028 | 239 | 880 | 31 | 27 | 3 | 20 | 66,407 | 1.0 | 4.3 | 67,297 |
| **Total** | **954** | **3,519** | **122** | **110** | **10** | **80** | **265,628** | **3.8** | **17.1** | **269,187** |

Source: Appendix D, Table D.A2-4; Atlantic Shores 2024.
Sum of individual values may not equal total due to rounding.

The emissions estimates in this section do not include emissions from raw material extraction, materials processing, and manufacturing of components, i.e., full life-cycle analysis. However, recently published studies have analyzed the life-cycle impacts of offshore wind (Ferraz de Paula and Carmo 2022; Rueda-Bayona et al. 2022; Shoaib 2022). These studies concluded that the materials that have the greatest impact on life-cycle emissions generally are steel and concrete and that materials recycling rates have a large influence on life-cycle emissions. The National Renewable Energy Laboratory (NREL) harmonized approximately 3,000 life-cycle assessment studies with around 240 published life-cycle analyses of land-based and offshore wind technologies (NREL 2021). Although wind energy has higher upstream emissions than many other generation methods, its life-cycle GHG emissions are orders of magnitude lower than from other generation methods. NREL (2021) estimated that the central 50 percent of GHG estimates reviewed were in the range of 9.4–14 grams of $CO_2e$ per kilowatt-hour, while life-cycle GHG estimates for coal and natural gas are on the scale of 1,000 grams of $CO_2e$ per kilowatt-hour (Dolan and Heath 2012) and 480 grams of $CO_2e$ per kilowatt-hour (O'Donoughue et al. 2014), respectively.

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

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

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

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

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

During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. The proposed Project's contribution would be additive with the impact(s) of any and all other operational activities, including offshore wind activities, that occur within the air quality geographic analysis area. COP Section 5.4 (Atlantic Shores 2024) provides a more detailed description of offshore and onshore O&M activities. The annual estimated emissions for O&M are summarized in Table 3.4.1-4.

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

| Period | CO | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC | $CO_2$ | $CH_4$ | $N_2O$ | SF6 | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual | 121 | 520 | 17 | 16 | 1 | 9 | 33,631 | 0.20 | 1.60 | 0.12 | 40,338 |
| Lifetime (30 years) | 3,630 | 15,605 | 498 | 483 | 42 | 263 | 1,008,930 | 6 | 48 | 3.6 | 1,210,151 |

Source: COP Volume II, Table 3.1-3; Atlantic Shores 2024.

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

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

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

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

Increases in renewable energy production could lead to reductions in emissions from fossil-fueled power plants. Atlantic Shores estimated the emissions avoided as a result of the Proposed Action. The avoided emissions estimate is based on the annual power generation and the associated grid emissions for each pollutant. The annual power generation was based on the Project capacity (2,837 MW), the capacity factor (assumed as 50%), a transmission loss factor (assumed as 4%), and annual operating hours (assumed as 8,760 hours per year). The capacity is multiplied by the capacity factor and hours per year and then adjusted down by the transmission loss factor. For the Proposed Action this would be 2,837 MW x 50 percent capacity factor x 8,760 hour/year x (1 minus 4 percent transmission loss factor) = approximately 11,930,000 MWh generated to the grid. The total annual power generated to the grid is then multiplied by the grid average non-baseload annual factors for each pollutant for the Reliability First Corporation – East grid region as found in the USEPA eGRID 2018 v2 data set to get annual emissions displacement per year for each pollutant.

Once operational, the Proposed Action would result in annual avoided emissions of 3,536 tons of $NO_X$, 250 tons of $PM_{2.5}$, 4,170 tons of $SO_2$, and 6,484,000 tons (5,882,155 metric tons) of $CO_2e$ (COP Volume II, Table 3.1-7; Atlantic Shores 2024). This estimate is derived assuming the electricity generation mix for 2018. If renewable energy sources make up more of the electricity generation mix in the future, the amount of avoided emissions would be less. The avoided $CO_2$ emissions represent about 6 percent of the required GHG emissions reduction from 2006 levels by 2050 under the New Jersey Global Warming Response Act. The avoided $CO_2$ emissions are equivalent to the emissions generated by about 1,279,000 passenger vehicles in a year (USEPA 2020a). Through its addition to regional generating capacity and the avoided GHG emissions the Project would contribute toward meeting New Jersey's goals of developing 11 GW of offshore wind energy off the coast of New Jersey by 2040 and transitioning New Jersey to 100 percent renewable electricity by 2050. The avoided $CO_2$ emissions are expected to contribute incrementally to reduction in the rate of temperature rise and other climate effects, though the climate benefits attributable to any single project are too small to be measurable.

Accounting for construction emissions and assuming decommissioning emissions would be the same, and including emissions from future operations, operation of the Proposed Action would offset criteria pollutant emissions related to its development and eventual decommissioning within different time periods of operation depending on the pollutant: $NO_X$ would be offset in approximately 2 years of operation, $PM_{2.5}$ in approximately 1 year, $SO_2$ in 1 month, and $CO_2$ in 2 months. If emissions from future operations and decommissioning were not included, the times required for emissions to "break even" would be shorter. From that point, the Project would be offsetting emissions that would otherwise be generated from another source.

Reductions in criteria pollutant emissions are associated with decreased health effects on a regional scale, especially for ozone, $NO_2$, and $PM_{2.5}$. Long-term $NO_2$ and $PM_{2.5}$ exposures are associated with higher risk for several cancer types, and reducing the emissions of these pollutants may reduce cancer risk in exposed populations (Wei et al. 2023). The potential health benefits of avoided emissions can be evaluated using USEPA's Co-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool (USEPA 2020b). COBRA is a tool that estimates the health and economic benefits of clean energy policies. COBRA was used to analyze the avoided emissions that were calculated for the Proposed Action. Table 3.4.1-5 presents the estimated avoided health effects.

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

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

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

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

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

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

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

Table 3.4.1-6 presents the SC-GHG associated with estimated emissions from the Proposed Action. These estimates represent the present value of future market and nonmarket costs associated with $CO_2$, $CH_4$, and $N_2O$ emissions. In accordance with the IWG's recommendation, four estimates were calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and Atlantic Shores' estimates of emissions in each year. In Table 3.4.1-6, negative values represent social benefits of avoided GHG emissions. The negative values for net SC-GHG indicate that the impact of the Proposed Action on GHG emissions and climate would be a net benefit in terms of SC-GHG. This benefit would be realized during Project operations.

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

| Description | Social Cost of GHGs (2020$) | | | |
|---|---|---|---|---|
| | Average Value, 5% discount rate | Average Value, 3% discount rate | Average Value, 2.5% discount rate | 95th Percentile Value, 3% discount rate |
| **SC-$CO_2$** | | | | |
| Construction, Operation, and Decommissioning[1] | $3,765,000 | $12,985,000 | $19,234,000 | $39,030,000 |
| Avoided Emissions | -$1,893,344,000 | -$7,661,249,000 | -$11,749,164,000 | -$23,439,152,000 |
| Net SCC- $CO_2$ | -$1,889,579,000 | -$7,648,264,000 | -$11,729,930,000 | -$23,400,122,000 |
| **SC-$CH_4$** | | | | |
| Construction, Operation, and Decommissioning[1] | $3,000 | $6,000 | $7,000 | $15,000 |
| Avoided Emissions | -$6,474,000 | -$17,817,000 | -$24,393,000 | -$47,527,000 |

| Description | Social Cost of GHGs (2020$) Average Value, 5% discount rate | Average Value, 3% discount rate | Average Value, 2.5% discount rate | 95th Percentile Value, 3% discount rate |
|---|---|---|---|---|
| Net SCC-$CH_4$ | -$6,471,000 | -$17,811,000 | -$24,386,000 | -$47,512,000 |
| **SC-$N_2O$** | | | | |
| Construction, Operation, and Decommissioning[1] | $97,000 | $306,000 | $448,000 | $808,000 |
| Avoided Emissions | -$7,457,000 | -$28,068,000 | -$42,855,000 | -$74,834,000 |
| Net SCC-$N_2O$ | -$7,360,000 | -$27,762,000 | -$42,407,000 | -$74,026,000 |
| **SC-$SF_6$** | | | | |
| Construction, Operation, and Decommissioning[1] | $789,000 | $3,192,000 | $4,896,000 | $9,767,000 |
| Avoided Emissions | $0 | $0 | $0 | $0 |
| Net SCC-$SF_6$ | $789,000 | $3,192,000 | $4,896,000 | $9,767,000 |
| **SC-GHG** | | | | |
| Construction, Operation, and Decommissioning[1] | $4,654,000 | $16,489,000 | $24,585,000 | $49,620,000 |
| Avoided Emissions | -$1,907,275,000 | -$7,707,134,000 | -$11,816,412,000 | -$23,561,513,000 |
| Net SC-GHG | -$1,902,621,000 | -$7,690,645,000 | -$11,791,827,000 | -$23,511,893,000 |

[1] Emissions from decommissioning were not quantified. Atlantic Shores anticipates the quantities of emissions during decommissioning to be significantly lower than the quantities estimated for construction (Atlantic Shores 2024).
Notes:
Estimates are the sum of the social costs for $CO_2$, $CH_4$, $N_2O$, and $SF_6$ over the Project lifetime. Negative costs indicate benefits.
Estimates are rounded to the nearest $1,000.
SC = social cost.

Table 3.4.1-7 presents the annual emissions, avoided emissions, and net emissions of $CO_2$ over the operational lifetime[7] of the Project for each alternative. Net emissions are the Project emissions minus the avoided emissions. The annual net GHG emissions avoided by the Proposed Action, 5,851,705 metric tons $CO_2$ per year (Table 3.4.1-7), would be equivalent to about 1,272,000 additional passenger vehicles removed from the road per year (USEPA 2020a). Each action alternative is assumed to have the same nameplate capacity for each WTG. Alternatives with fewer WTGs than the Proposed Action would reduce the construction and O&M emissions, but also would reduce the net benefits to the grid because less energy from renewables would be produced compared to the Proposed Action. The estimates of avoided emissions assume the 2018 grid configuration as noted above, but the actual annual quantity of avoided emissions attributable to this proposed facility is expected to diminish over time if the electric grid becomes lower-emitting due to the addition of other renewable energy facilities and retirement of high-emitting generators.

The No Action Alternative would result in no emissions during construction and O&M because the Project would not be built, but would also offer no avoided emissions, resulting in higher GHG emissions over the Project duration due to not displacing fossil-fueled power generation via offshore wind. The

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

emissions not avoided relative to the Proposed Action, 5,882,155 metric tons $CO_2$ per year (Table 3.4.1-7), would be equivalent to about 1,279,000 additional passenger vehicles per year.

**Table 3.4.1-7. Net emissions of $CO_2e$ for each alternative**

| Alternative | $CO_2e$ Emissions (metric tons)[1] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Construction 2025-2028 | | | | | Operation 2029–2058 | | | | Construction + Operation 2025–2058 |
| | 2025 | 2026 | 2027 | 2028 | Total Construction | O&M Emissions (Annual) | Avoided Emissions (Annual) | Net Emissions (Annual) | Operational Lifetime Net Emissions[2] | Total Lifetime Net Emissions |
| A (No Action) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 176,464,654[3] |
| B (Proposed Action) | 61,050 | 61,050 | 61,050 | 61,050 | 244,201 | 36,594 | -5,882,155 | -5,845,561 | -175,366,828 | -175,122,628 |
| C1 [4] | 56,131 | 56,131 | 56,131 | 56,131 | 224,526 | 33,646 | -5,408,237 | -5,374,592 | -161,237,748 | -161,013,222 |
| C2 | 57,289 | 57,289 | 57,289 | 57,289 | 229,155 | 34,340 | -5,519,747 | -5,485,408 | -164,562,237 | -164,333,082 |
| C3 | 59,314 | 59,314 | 59,314 | 59,314 | 237,257 | 35,554 | -5,714,890 | -5,679,336 | -170,380,094 | -170,142,837 |
| C4 | 61,050 | 61,050 | 61,050 | 61,050 | 244,201 | 36,594 | -5,882,155 | -5,845,561 | -175,366,828 | -175,122,628 |
| D1 | 54,974 | 54,974 | 54,974 | 54,974 | 219,896 | 32,952 | -5,296,727 | -5,263,775 | -157,913,258 | -157,693,361 |
| D2 | 52,081 | 52,081 | 52,081 | 52,081 | 208,323 | 31,218 | -5,017,952 | -4,986,734 | -149,602,034 | -149,393,711 |
| D3 | 59,314 | 59,314 | 59,314 | 59,314 | 237,257 | 35,554 | -5,714,890 | -5,679,336 | -170,380,094 | -170,142,837 |
| E | 59,604 | 59,604 | 59,604 | 59,604 | 238,414 | 35,727 | -5,742,768 | -5,707,041 | -171,211,216 | -170,972,802 |
| F1 | 61,050 | 61,050 | 61,050 | 61,050 | 244,201 | 36,594 | -5,882,155 | -5,845,561 | -175,366,828 | -175,122,628 |
| F2 | 61,050 | 61,050 | 61,050 | 61,050 | 244,201 | 36,594 | -5,882,155 | -5,845,561 | -175,366,828 | -175,122,628 |
| F3 | 61,050 | 61,050 | 61,050 | 61,050 | 244,201 | 36,594 | -5,882,155 | -5,845,561 | -175,366,828 | -175,122,628 |
| Preferred Alternative | 59,604 | 59,604 | 59,604 | 59,604 | 238,414 | 35,727 | -5,742,768 | -5,707,041 | -171,211,216 | -170,972,802 |

[1] Positive values are emissions increases; negative values are emissions decreases.
[2] Emissions from decommissioning were not quantified. Atlantic Shores anticipates the quantities of emissions during decommissioning to be significantly lower than the quantities estimated for construction (Atlantic Shores 2024).
[3] Represents emissions from the grid in the absence of the Project.
[4] Emissions for Alternatives C through F are estimated as the Proposed Action emissions times the ratio of the number of foundations for the alternative to the number of foundations for the Proposed Action.

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

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

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

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

Ambient pollutant concentrations that could result from emissions associated with the Project are compared to the NAAQS, USEPA Prevention of Significant Deterioration (PSD) increments, and other criteria. As part of its OCS air quality permit application (Atlantic Shores 2023a), Atlantic Shores used air quality dispersion modeling to estimate pollutant concentrations.[8] The following summarizes the regulatory requirements that are satisfied using air quality dispersion modeling, the modeling techniques used, and the results. The modeling analysis documents compliance with all relevant regulatory standards and demonstrates that the Project would not cause or contribute to any condition of unhealthy air. The OCS air permit application (Atlantic Shores 2023a) provides further information on the ambient concentrations analysis.

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

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

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

[8] As of February 2024, the modeled concentrations are not final because the modeling analyses are undergoing revisions and have not yet been approved by USEPA.

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

When documenting compliance with NAAQS or New Jersey AAQS, modeled concentrations are added to the appropriate measured background concentration, and the total is compared to the standard. Table 3.4.1-8 presents the maximum modeled concentrations across all construction activities and shows that all estimated concentrations associated with construction would be less than the NAAQS and New Jersey AAQS. The modeled concentrations in Table 3.4.1-8 do not include potential contributions from concurrent construction of projects other than Atlantic Shores South. Such contributions potentially could increase concentrations if construction of other projects were to occur at sufficiently high activity levels and in sufficiently close proximity to Atlantic Shores South, at times when Atlantic Shores South construction activity is also occurring.

**Table 3.4.1-8. Estimated ambient concentrations for construction ($\mu g/m^3$) compared to NAAQS**

| Pollutant[1] | Averaging Time | Maximum Modeled Concentration | Secondary[2] Impact Concentration | Background Concentration | Total Concentration | NAAQS | Exceeds NAAQS? |
|---|---|---|---|---|---|---|---|
| CO | 1-hour | 1,105 | N/A | 2,865 | 3,970 | 40,000 | No |
| | 8-Hour | 457 | N/A | 2,636 | 3,092 | 10,000 | No |
| $NO_2$ | 1-Hour | 171.6 [3] | N/A | Variable hourly | 171.6 | 188 | No |
| | Annual | 1.7 | N/A | 11.87 | 13.6 | 100 | No |
| $PM_{10}$ | 24-Hour | 7.28 | N/A | 38 | 45.3 | 150 | No |
| $PM_{2.5}$ | 24-Hour | 5.40 | 0.024 | 14.0 | 19.4 | 35 | No |
| | Annual | 0.053 | 0.0049 | 5.66 | 5.7 | 12 | No |

Source: Atlantic Shores 2023a.
[1] Concentrations of $SO_2$ were not modeled because Project $SO_2$ emissions would be less than the PSD Significant Emission Rate established by USEPA.
[2] Secondary PM is formed by chemical reactions of emissions in the atmosphere and is additional to the modeled PM concentrations which reflect directly-emitted PM.
[3] Includes background concentration.
Sum of concentrations may not equal total due to rounding.
N/A = not applicable

Table 3.4.1-9 presents the maximum modeled concentrations across all O&M activities and shows that all estimated concentrations associated with O&M would be less than the NAAQS and New Jersey AAQS.

**Table 3.4.1-9. Estimated ambient concentrations for O&M ($\mu g/m^3$) compared to NAAQS**

| Pollutant[1] | Averaging Time | Maximum Modeled Concentration | Secondary[2] Impact Concentration | Background Concentration | Total Concentration | NAAQS | Exceeds NAAQS? |
|---|---|---|---|---|---|---|---|
| CO | 1-hour | 637 | N/A | 2,865 | 3,502 | 40,000 | No |
| | 8-Hour | 510 | N/A | 2,636 | 3,146 | 10,000 | No |
| $NO_2$ | 1-Hour | 183.4 | N/A | Variable hourly | 183.4 | 188 | No |
| | Annual | 0.61 | N/A | 11.87 | 12.5 | 100 | No |

| Pollutant[1] | Averaging Time | Maximum Modeled Concentration | Secondary[2] Impact Concentration | Background Concentration | Total Concentration | NAAQS | Exceeds NAAQS? |
|---|---|---|---|---|---|---|---|
| $PM_{10}$ | 24-Hour | 1.73 | N/A | 38 | 39.7 | 150 | No |
| $PM_{2.5}$ | 24-Hour | 5.73 | 0.0077 | 14 | 19.7 | 35 | No |
| | Annual | 0.021 | 0.0016 | 5.66 | 5.7 | 12 | No |

Source: Atlantic Shores 2023a.
[1] Concentrations of $SO_2$ were not modeled because Project $SO_2$ emissions would be less than the PSD Significant Emission Rate established by USEPA.
[2] Secondary PM is formed by chemical reactions of emissions in the atmosphere and is additional to the modeled PM concentrations which reflect directly-emitted PM.
[3] Includes background concentration.
Sum of concentrations may not equal total due to rounding.
N/A = not applicable

Table 3.4.1-10 presents the maximum modeled PSD increment results across all construction activities, and Table 3.4.1-11 presents the maximum modeled PSD increment results across all O&M activities.

**Table 3.4.1-10. Estimated ambient concentration increases for construction (μg/m³) compared to PSD increments**

| Pollutant[1] | Averaging Time | Form[2] | Maximum Modeled Concentration | Secondary[3] Impact Concentration | Total Concentration | PSD Increment | Exceeds Increment? |
|---|---|---|---|---|---|---|---|
| **Class I Increments[4]** | | | | | | | |
| $NO_2$ | Annual | H | 0.088 | N/A | 0.088 | 2.5 | No |
| $PM_{10}$ | 24-Hour | H2H | 0.60 | N/A | 0.60 | 8 | No |
| | Annual | H | 0.0031 | N/A | 0.0031 | 4 | No |
| $PM_{2.5}$ | 24-Hour | H2H | 0.58 | 0.024 | 0.61 | 2 | No |
| | Annual | H | 0.0030 | 0.0038 | 0.0067 | 1 | No |
| **Class II Increments** | | | | | | | |
| $NO_2$ | Annual | H | 1.70 | N/A | 1.70 | 25 | No |
| $PM_{10}$ | 24-Hour | H2H | 8.25 | N/A | 8.25 | 30 | No |
| | Annual | H | 0.059 | N/A | 0.059 | 17 | No |
| $PM_{2.5}$ | 24-Hour | H2H | 8.1 | 0.024 | 8.1 | 9 | No |
| | Annual | H | 0.057 | 0.0049 | 0.062 | 4 | No |

Source: Atlantic Shores 2023a.
[1] Concentrations of CO were not modeled because USEPA has not established PSD increments for this pollutant. Concentrations of $SO_2$ were not modeled because Atlantic Shores estimated that $SO_2$ emissions are below the EPA significant emission rates.
[2] Statistic used for calculation of concentration for the averaging time.
[3] Secondary PM is formed by chemical reactions of emissions in the atmosphere and is additional to the modeled PM concentrations which reflect directly emitted PM.
[4] Class I increments apply to Brigantine National Wilderness Area only.
Sum of concentrations may not equal total due to rounding.
H = highest daily average; H2H = highest second-highest daily average; N/A = not applicable

**Table 3.4.1-11. Estimated ambient concentration increases for O&M (μg/m³) compared to PSD increments**

| Pollutant[1] | Averaging Time | Form[2] | Maximum Modeled Concentration | Secondary[3] Impact Concentration | Total Concentration | PSD Increment | Exceeds Increment? |
|---|---|---|---|---|---|---|---|
| **Class I Increments[4]** | | | | | | | |
| $NO_2$ | Annual | H | 0.613 | N/A | 0.613 | 2.5 | No |
| $PM_{10}$ | 24-Hour | H2H | 0.06 | N/A | 0.06 | 8 | No |
| | Annual | H | 0.0019 | N/A | 0.0019 | 4 | No |
| $PM_{2.5}$ | 24-Hour | H2H | 0.52 | 0.0077 | 0.53 | 2 | No |
| | Annual | H | 0.0019 | 0.0012 | 0.0031 | 1 | No |
| **Class II Increments** | | | | | | | |
| $NO_2$ | Annual | H | 0.61 | N/A | 0.61 | 25 | No |
| $PM_{10}$ | 24-Hour | H2H | 1.84 | N/A | 1.84 | 30 | No |
| | Annual | H | 0.022 | N/A | 0.022 | 17 | No |
| $PM_{2.5}$ | 24-Hour | H2H | 7.5 | 0.007 | 7.5 | 9 | No |
| | Annual | H | 0.021 | 0.0016 | 0.023 | 4 | No |

Source: Atlantic Shores 2023a.
[1] Concentrations of CO were not modeled because USEPA has not established PSD increments for this pollutant. Concentrations of $SO_2$ were not modeled because Atlantic Shores estimated that $SO_2$ emissions are below the EPA significant emission rates.
[2] Statistic used for calculation of concentration for the averaging time.
[3] Secondary PM is formed by chemical reactions of emissions in the atmosphere and is additional to the modeled PM concentrations which reflect directly emitted PM.
[4] Class I increments apply to Brigantine National Wilderness Area only.
Sum of concentrations may not equal total due to rounding.
H = highest daily average; H2H = highest second-highest daily average; N/A = not applicable

As part of its OCS air quality permit application (Atlantic Shores 2023a), Atlantic Shores also assessed project impacts on AQRVs as required under the USEPA PSD regulations (40 CFR 52.21(o)). AQRVs assessed include acidic deposition, visibility, impacts on soils and vegetation, and impacts from associated growth. Associated growth is industrial, commercial, and residential growth that would occur in the area due to the OCS emission sources, and is discussed in Section 3.6.3, *Demographics, Employment, and Economics*. The OCS air permit application (Atlantic Shores 2023a) provides further information on the AQRV analysis.

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

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

To assess potential impacts of acidic deposition on soil and vegetation, modeling of deposition due to the Project's emissions was conducted in accordance with FLAG (2010). The deposition of nitrogen and sulfur was predicted in terms of kilograms per hectare per year (kg/ha/yr). The predicted deposition rate for each species is compared to the applicable deposition analysis threshold (DAT) appropriate for eastern areas, 0.010 kg/ha/yr (FLAG 2010) for each species. These nitrogen and sulfur DATs are not adverse impact thresholds, but do represent conservative screening criteria that allow the FLMs to identify potential deposition fluxes requiring further consideration on a case-by-case basis. Table 3.4.1-12 summarizes the maximum modeled deposition rates during Project construction and O&M. Table 3.4.1-12 shows that all modeled deposition rates are less than the DAT.

**Table 3.4.1-12. Modeled acidic deposition rates at Brigantine National Wilderness Area (kg/ha/yr)**

| Modeled Year | Maximum Annual Nitrogen Deposition Rate | | Maximum Annual Sulfur Deposition Rate | | Nitrogen and Sulfur Deposition Analysis Threshold |
|---|---|---|---|---|---|
| | Construction | O&M | Construction | O&M | |
| 2018 | 0.0093 | 0.003 | 0.0002 | 0.0001 | 0.010 |
| 2019 | 0.0067 | 0.002 | 0.0001 | 0.0001 | 0.010 |
| 2020 | 0.0066 | 0.003 | 0.0002 | 0.0001 | 0.010 |

Source: Atlantic Shores 2023b.

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

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

A second metric used to assess the potential for discernible visibility reduction is the deciview (a measure of the perceptibility of light extinction). A change in visibility of approximately 1.0 deciview is assumed to be detectable to a human observer looking at a distant scene or object. Consistent with USEPA Regional Haze rules (40 CFR Part 51, Appendix Y) and FLAG (2010) guidance, a screening level of 0.5 deciview was used as a benchmark for whether the proposed Project would potentially cause or contribute to visibility impairment at the Brigantine Class I area. As with the visibility extinction threshold, the impairment threshold is exceeded if the 98th percentile change in deciviews is equal to or greater than 5 percent for each year modeled. Exceedance of a threshold does not indicate that a visibility impact is adverse; rather, that USFWS would evaluate the impact further.

Table 3.4.1-13 summarizes the maximum modeled visibility impacts during project construction and O&M. Results are presented in terms of percentage and in deciviews. The results show that the FLAG (2010) thresholds would be exceeded for construction, for the modeled scenario. The construction modeling results in Table 3.4.1-13 show the number of threshold exceedances if the maximum 24-hour emissions were emitted every day from the closest emission sources, which is a very conservative scenario. Actual impacts likely would be much less. The Brigantine Class I area is sufficiently representative of nearby onshore areas that the analysis specific to Brigantine also indicates the likely maximum visibility impacts in the rest of the Project region.

**Table 3.4.1-13. Modeled visibility impacts at Brigantine National Wilderness Area**

| | Percentage Change | | | Change in Deciviews | | |
|---|---|---|---|---|---|---|
| Modeled Year | 98th Percentile 24-Hour Change in Light Extinction | Number of Days with Extinction Change > 5% | Number of Days with Extinction Change > 10% | 98th Percentile 24-Hour Delta-Deciview | Number of Days with Delta-Deciview > 0.5 | Number of Days with Delta-Deciview > 1.0 |
| **Construction** | | | | | | |
| 2018 | 9.1% | 19 | 5 | 0.87 | 18 | 4 |
| 2019 | 6.3% | 12 | 0 | 0.61 | 12 | 0 |
| 2020 | 10.1% | 17 | 8 | 0.96 | 17 | 7 |
| **O&M** | | | | | | |
| 2018 | 1.4% | 0 | 0 | 0.14 | 0 | 0 |
| 2019 | 1.0% | 0 | 0 | 0.10 | 0 | 0 |
| 2020 | 1.7% | 1 | 0 | 0.17 | 1 | 0 |
| **Threshold** | | | | | | |
| FLAG (2010) threshold | 0.5% | No threshold | No threshold | 0.5 | No threshold | No threshold |

Source: Atlantic Shores 2023b.
delta-deciview = change in deciviews.

Evaluation of impacts on sensitive vegetation is performed by comparing predicted concentration impacts with screening levels set by USEPA (1980). The USEPA soil and vegetation screening levels are equivalent to or exceed NAAQS and PSD increments. As a result, impacts that are less than the NAAQS and PSD increments also indicate compliance with the sensitive vegetation screening levels. Tables 3.4.1-8 through 3.4.1-11 show that predicted concentrations for construction and installation and O&M would be less than the NAAQS and PSD increments. Accordingly, predicted concentrations also would be less than the EPA screening levels and no adverse impacts on soils and vegetation are expected.

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

Atlantic Shores has committed to EPMs to avoid, minimize, and mitigate air quality impacts of the Project. These measures include, among others, compliance with all applicable emissions and fuel-efficiency standards to minimize combustion emissions and associated air quality impacts, as discussed in COP Volume II, Section 3.1.2.7 (Atlantic Shores 2024) and in Appendix G, Table G-1, under AQ-01 through AQ-05.

Climate change can make ecosystems, resources, and communities more susceptible as well as lessen resilience to other environmental impacts apart from climate change. In some instances, this may exacerbate the environmental effects of a project. Although the Project would produce criteria pollutant emissions, the predicted impacts would be within applicable standards (see Table 3.4-8 through Table 3.4-11) though some visibility impacts are predicted under a very conservative scenario (Table 3.4-13), and would be unlikely to contribute substantially to increasing susceptibility or decreasing resilience of ecosystems. Similarly, foreseeable climate change would be unlikely to contribute substantially to increasing the impacts of criteria pollutant emissions from the Project.

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

### *Impacts of the Connected Action*

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

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

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

### *Cumulative Impacts of Alternative B – Proposed Action*

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

**Air emissions:** Table 3.4.1-14 summarizes the total construction emissions over all years of construction and provides a comparison to regional emissions levels.

**Table 3.4.1-14. Offshore wind projects construction emissions (U.S. tons)**

| Project | CO | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Atlantic Shores South** | | | | | | | | | | |
| Total Construction | 954 | 3,519 | 122 | 110 | 10 | 80 | 265,628 | 4 | 17 | 269,187 |
| Average Annual | 239 | 880 | 31 | 27 | 3 | 20 | 67,297 | 1 | 4 | 67,297 |
| **Ocean Wind 1 and 2 plus Atlantic Shores North** | | | | | | | | | | |
| Total Construction | 6,182 | 30,388 | 1,000 | 959 | 265 | 748 | 1,837,268 | 17 | 106 | 2,011,518 |
| Average Annual | 1,236 | 6,078 | 200 | 192 | 53 | 150 | 367,454 | 1,236 | 6,078 | 200 |
| **Total Atlantic Shores South, Ocean Wind 1 and 2, and Atlantic Shores North** | | | | | | | | | | |
| Total Construction | 7,136 | 33,907 | 1,122 | 1,069 | 275 | 828 | 2,102,896 | 21 | 123 | 2,280,705 |
| Average Annual | 892 | 4,238 | 140 | 134 | 34 | 104 | 328,874 | 3 | 19 | 354,656 |
| **Regional Emissions** | | | | | | | | | | |
| Region (Annual, Project Counties)[1] | 288,743 | 44,686 | 18,514 | 9,965 | 2,345 | 100,678 | NA | NA | NA | 108,578,231 |
| Atlantic Shores South Average Percent of Region During Construction Period | 0.1% | 2.0% | 0.2% | 0.3% | 0.1% | 0.02% | NA | NA | NA | 0.1% |
| Offshore Wind[2] Average Percent of Region During Construction Period | 0.3% | 9.5% | 0.8% | 1.3% | 1.5% | 0.1% | NA | NA | NA | 0.2% |

Sources: Appendix D, Table D.A2-4; COP, Section 3.1.2, Atlantic Shores 2024; USEPA 2022; NJDEP 2022.
[1] New Jersey counties that are the nearest onshore areas to the WTA or in which Project facilities or ports would be located. Includes Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Monmouth, Ocean, and Salem Counties.
[2] Includes Atlantic Shores South, Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North.
NA = not available

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

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

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

Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would vary spatially and temporally across the air quality geographic analysis area. The largest combined air quality impacts from offshore wind would occur during overlapping construction and decommissioning of multiple offshore wind projects. The construction schedule of the Proposed Action is anticipated to overlap with that of Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects for 3 years: 2026 through 2028 (Appendix D, Tables D.A2-1 and D.A2-4). Most air quality impacts would remain offshore because the highest emissions would occur in the offshore region, and the westerly prevailing winds would result in most emission plumes remaining offshore for some distance. Although air quality offshore is subject to the NAAQS in federal waters and the OCS permit area, the amount of human exposure offshore is typically very low. Ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land.

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

The annual estimated emissions for O&M once all projects are operating are summarized in Table 3.4.1-15.

**Table 3.4.1-15. Offshore wind projects operations and maintenance emissions (U.S. tons)**

| Period | CO | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC | $CO_2$ | $CH_4$ | $N_2O$ | $SF_6$ | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Atlantic Shores South** | | | | | | | | | | | |
| Annual | 122 | 520 | 17 | 16 | 1 | 9 | 33,631 | 0.20 | 1.60 | 0.12 | 40,338 |
| Lifetime (30 years) | 3,648 | 15,605 | 501 | 483 | 42 | 263 | 1,008,936 | 6 | 48 | 4 | 1,210,151 |
| **Ocean Wind plus Atlantic Shores North** | | | | | | | | | | | |
| Annual | 180 | 746 | 25 | 24 | 3 | 15 | 98,934 | 0.7 | 4.7 | 0.07 [1] | 109,579 |
| Lifetime (35 years) | 6,300 | 26,110 | 875 | 840 | 105 | 525 | 3,462,706 | 23 | 166 | 2.3 [1] | 3,835,272 |
| **All Projects** | | | | | | | | | | | |
| Annual | 302 | 1,266 | 42 | 40 | 4 | 24 | 132,566 | 0.9 | 6.3 | 0.18 | 149,918 |
| Lifetime (35 years) | 9,948 | 41,716 | 1,376 | 1,323 | 147 | 788 | 4,471,642 | 29 | 214 | 5.9 | 5,045,424 |

Sources: Appendix D, Table D.A2-4; COP Volume II, Section 3.1.2 and Appendix II-C; Atlantic Shores 2024.
[1] $SF_6$ data are for Atlantic Shores North only. $SF_6$ data are not available for Ocean Wind.

The incremental impacts contributed by the Proposed Action to the cumulative impacts of ongoing and planned activities would be noticeable. Using the assumptions in Appendix D, Table D-3, O&M emissions from ongoing and planned activities, including the Proposed Action, could begin in 2025. Emissions would largely be due to the same source types as for the Proposed Action, including commercial vessel traffic, air traffic such as helicopters, and operation of emergency diesel generators. Such activity would result in intermittent, and widely dispersed, emissions. Planned O&M activities, including the Proposed Action, are estimated to emit 302 tons per year of CO, 1,266 tons per year of $NO_X$, 42 tons per year of $PM_{10}$, 40 tons per year of $PM_{2.5}$, 4 tons per year of $SO_2$, 24 tons per year of VOCs, and 132,566 tons per year of $CO_2$ when all projects are operating (Table 3.4.1-15). Anticipated impacts on air quality from O&M emissions would be transient, small in magnitude, and localized. Additionally, some emissions associated with O&M activities could overlap with other projects' construction-related emissions. Comparison of the combined O&M emissions from all offshore wind projects to the emissions contributions from the Proposed Action alone (as provided in Table 3.4.1-15) shows that the increases in air quality impacts from the Proposed Action would be less than the combined impacts of the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects. In summary, the largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the offshore wind projects within the air quality geographic analysis area. However, a net improvement in air quality is expected on a regional scale as the Project begins operation and displaces emissions from fossil-fueled sources.

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

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

### *Conclusions*

**Impacts of Alternative B – Proposed Action.** The Proposed Action would result in a net decrease in overall emissions over the region compared to the installation of a conventional fossil-fueled power plant. Although there would be some air quality impacts due to various activities associated with construction, O&M, and eventual decommissioning, including fugitive dust emissions from construction, emissions from equipment operation, and potential emissions from accidental releases, these emissions would be relatively small and limited in duration. The Proposed Action would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation (Table 3.4.1-5). **Minor** to **moderate adverse** air quality impacts would be anticipated for a limited time because of emissions during construction and installation, O&M, and decommissioning, but there would be a **minor** to **moderate beneficial** impact on air quality near the WTA and the surrounding region overall to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants. Atlantic Shores has committed to EPMs that would reduce potential impacts through complying with applicable emissions standards (AQ-01, AQ-02, and AQ-03), potential use of alternative fuels where feasible (AQ-03), complying with applicable fuel sulfur content standards (AQ-04), implementing BMPs to reduce emissions (e.g., optimizing construction and O&M activities to minimize vessel operating times and loads) (AQ-05), development of fugitive dust-control plans for onshore construction areas (AQ-05), and complying with all air quality permit conditions (AQ-06 and AQ-07) (COP Volume II, Section 3.1.2.7; Atlantic Shores 2024; Appendix G, Table G-1). Because of the amounts of emissions, the fact that emissions are spread out in time (4 years for construction and then lesser emissions annually during 30-year Project operation), and the large geographic area over which they would be dispersed (throughout the 102,124-acre [41,328-hectare] Atlantic Shores South Lease Area and the vessel routes from the onshore facilities), air pollutant concentrations associated with the Proposed Action are not expected to exceed the NAAQS and the New Jersey AAQS.

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

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

The Proposed Action would produce GHG emissions, primarily from O&M activities, including vessel and equipment operation, and leakage of $SF_6$ from $SF_6$-containing electrical equipment that contributes to climate change; however, its contribution would be less than the emissions displaced during operation of the Project. The GHG emissions estimates provided in this analysis include estimated loss of $SF_6$ from switchgear, which is conservatively based on 0.5 percent loss of the initial charge of $SF_6$ every year of operation with an initial charge of 1,500 kilograms of $SF_6$ to each of the two OSS switchgears (COP Volume II, Appendix II-C; Atlantic Shores 2024). Because GHG emissions disperse and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are largely a function of global emissions. Consequently, the Proposed Action would have negligible impacts on climate change during construction and operation, and an overall net beneficial impact on criteria pollutant and ozone precursor emissions as well as GHGs, compared to a similarly sized fossil-fueled power plant or to the generation of the same amount of energy by the existing grid.

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

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

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

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

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

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

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

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

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

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

### *Conclusions*

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

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

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

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

**moderate adverse** impacts because of emissions from these activities and **minor** to **moderate beneficial** impacts overall due to reduced emissions from fossil-fueled power plants.

#### 3.4.1.7 Impacts of Alternative F on Air Quality

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

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

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

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

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

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

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

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

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

#### *Conclusions*

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

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

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

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

### 3.4.1.8 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Table G-3 and summarized and assessed in Table 3.4.1-16. If one or more of the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts on air quality could be further reduced.

**Table 3.4.1-16. Proposed mitigation measures – air quality**

| Mitigation Measure | Description | Effect |
| --- | --- | --- |
| $SF_6$-free switchgear | BOEM would require Atlantic Shores to use switchgear that does not contain $SF_6$ to the extent practicable based on technical, economic, and supply chain considerations. BOEM proposes this measure to address emissions of $SF_6$, which is the most potent GHG known. $SF_6$ is a synthetic gas that has been used as an anti-arcing insulator in electrical systems for 70 years. Emissions are the result of leaks in switchgear that contains $SF_6$. Switchgear is available that does not contain $SF_6$; however, it tends to be more costly and require more space compared to conventional switchgear, and must be evaluated on a project-specific basis.<br>In the event that the applicant is not able to use $SF_6$-free switch gear, the following mitigation will be required:<br>• Follow manufacturer recommendations for limiting leaks and for service and repair of the affected breakers and switches.<br>• Perform repairs promptly when significant leaks are detected.<br>• Conduct visual inspections of the switchgear and monitoring equipment according to manufacturer recommendations.<br>• Create alarms based on the pressure readings in the breakers and switches, so leaks can be detected when substantial $SF_6$ leakage occurs. Upon a detectable pressure drop that is greater than 10% of the original pressure (accounting for ambient air conditions), perform maintenance to fix seals as soon as feasible. If an event requires removal of $SF_6$, the affected major component(s) will be replaced with new component(s). An event means when any component of a switchgear is damaged and results in $SF_6$ leakage.<br>• Capture and recycle any $SF_6$ removed from breakers and switches during maintenance.<br>• Keep a log of all detected leaks and maintenance procedures potentially affecting $SF_6$ emissions from circuit breakers/switches. | Use of $SF_6$-free switchgear would reduce GHG emissions and thereby reduce the impact of the Project on climate change. |
| Brigantine Wilderness Area air quality related values (AQRV) Mitigation Framework | BOEM, BSEE, USFWS, and the Lessee would develop a framework for the mitigation of AQRV impacts at Brigantine Wilderness Area. The framework would include a description of existing conditions and monitoring objectives; description of preventive and compensatory mitigation measures; identification of the avoidance or offset value for each measure; cost estimates for each measure; schedule for USFWS implementation of each measure; the mechanism for the transfer of funding from the Lessee to USFWS; and | Development of a mitigation framework and the subsequent implementation of preventive and compensatory mitigation measures would offset incremental increases in nitrogen deposition and visibility reducing particles (e.g., plume blight) in the Brigantine Wilderness Area. |

| Mitigation Measure | Description | Effect |
|---|---|---|
| | reporting to demonstrate completion of implementation. | |

*Measures Incorporated in the Preferred Alternative*

BOEM has identified the measures in Table 3.4.1-16, to be incorporated in the Preferred Alternative. These measures, if adopted, would reduce or eliminate GHG emissions from $SF_6$ leakage and would result in the coordinated development and implementation of preventive and compensatory mitigation measures intended to offset air quality impacts. Adoption of these measures would increase the beneficial GHG impacts of the Preferred Alternative or other action alternatives because GHG emissions from $SF_6$ leakage would be reduced or eliminated.

### 3.4.1.9 Comparison of Alternatives

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

Under the No Action Alternative, air quality would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing and planned non-offshore wind activities and offshore wind activities would have continuing regional impacts primarily through air pollutant emissions and accidental releases. Combined impacts of ongoing and planned non-offshore wind activities as well as offshore wind activities, including air pollutant emissions and GHGs, would be minor to moderate because the emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS or New Jersey AAQS. Offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequently minor to moderate beneficial impacts on air quality and climate.

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

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

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

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

#### 3.4.1.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); two WTGs would be removed and 1 WTG would be microsited to establish a 0.81 nautical mile (1.5 kilometer) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical mile (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative would include up to 195 WTGs,[9] up to 10 OSSs, and up to 1 permanent met tower. All permanent structures must be located in the uniform grid spacing

[9] 195 WTGs assumes that 197 total positions are available, and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

and the total number of permanent structures constructed (WTGs, OSSs, and met tower) would not exceed 197.

The air quality and climate impacts associated with the Preferred Alternative would be similar to those of the Proposed Action, but with slightly lower emissions due to the removal of at least 5 WTGs. Because of the altered turbine array layout, the Preferred Alternative also would have different locations and lengths of offshore and onshore cables; therefore, the Preferred Alternative would have different emissions associated with cable construction and installation compared to the Proposed Action. Overall, the differences in emissions between the Proposed Action and the Preferred Alternative would be relatively small, and the air quality and climate impacts from the Preferred Alternative would be substantially the same as described for the Proposed Action: **minor to moderate**.

Similarly, the quantities of coolants, oils and lubricants, and diesel fuel under the Preferred Alternative would be similar to those of the Proposed Action but with somewhat lesser quantities due to the smaller number of WTGs. Therefore, the impacts on air quality from accidental releases are expected to be similar to those of the Proposed Action.

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## 3.4.2 Water Quality

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

### 3.4.2.1 Description of the Affected Environment and Future Baseline Conditions

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

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

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

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

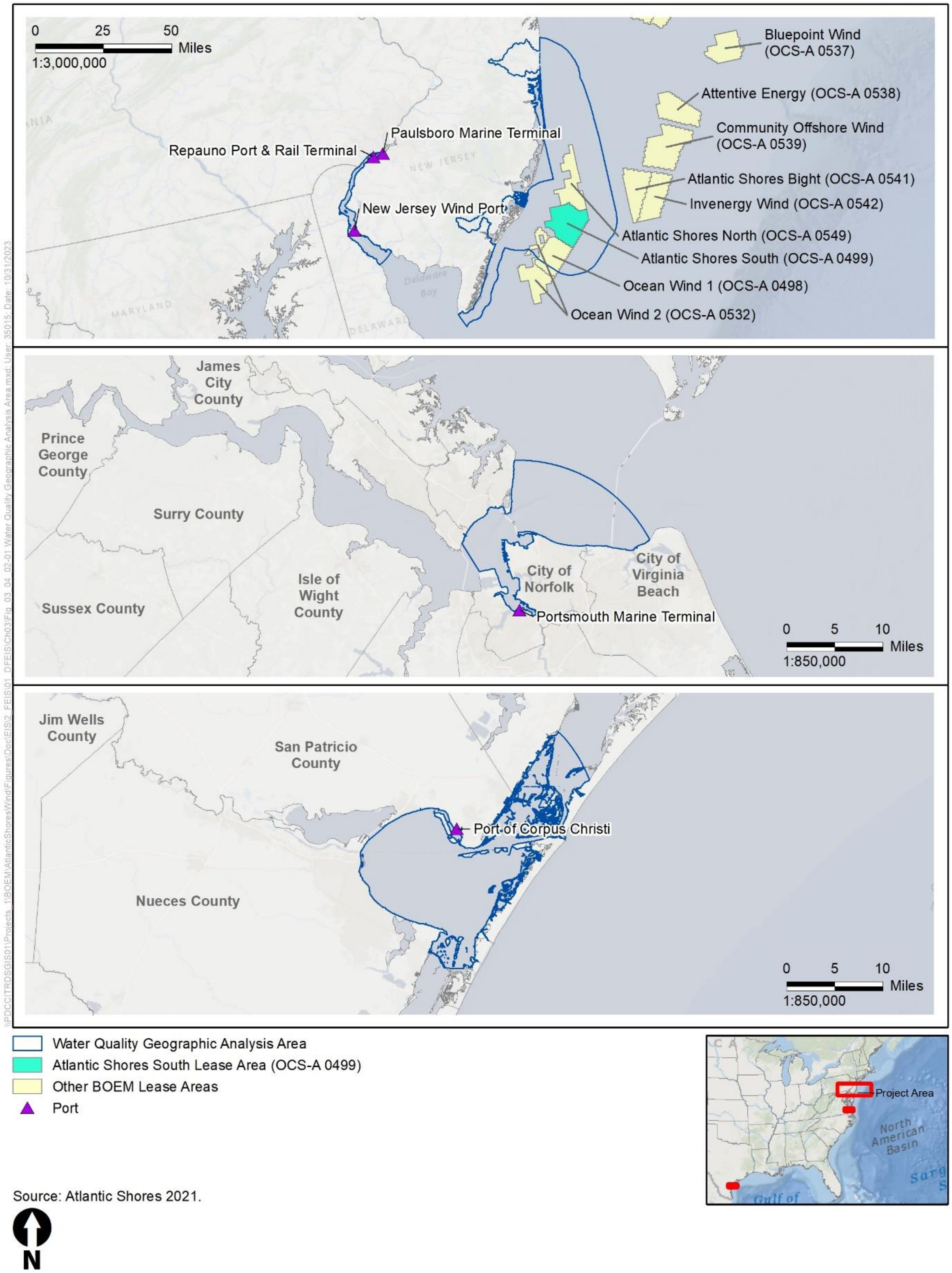


**Figure 3.4.2-1 Water quality geographic analysis area**

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

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

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

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

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

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

### *Water Quality Geographic Analysis Area: Marine Waters*

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

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

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

Stormwater is considered a nonpoint source that transports sediment and/or pollutants from the land to an aquatic system such as wetlands or waterbodies. Most stormwater is not treated; as rainwater or snowmelt travels over surfaces mobilizing unstabilized soils and pollutants from human and animal activity (COP Volume II, Section 3.2.1.1, Atlantic Shore 2024; Mallin et al. 2008). Pollutants frequently found in stormwater runoff include fertilizers, insecticides, herbicides, oil, gas, sediment, and nutrients and bacteria from animals. These pollutants drive water quality degradation due to high levels of fecal coliform, turbidity, orthophosphates, biological oxygen demand, total phosphorus, TSS, surfactant compounds, and organic carbon (COP Volume II, Section 3.2.1.1, Atlantic Shores 2024). Acute and chronic nonpoint source pollution near ocean beaches, coastal bays, and other tidal systems can lead to harmful algal blooms, threats to human health and wildlife, and destruction of habitat in these sensitive areas (COP Volume II, Section 3.2.1.1, Atlantic Shores 2024; Mallin et al. 2008). However, in offshore waters, where depth and circulation drive the transport and dilution of water pollution, impacts from stormwater runoff are limited.

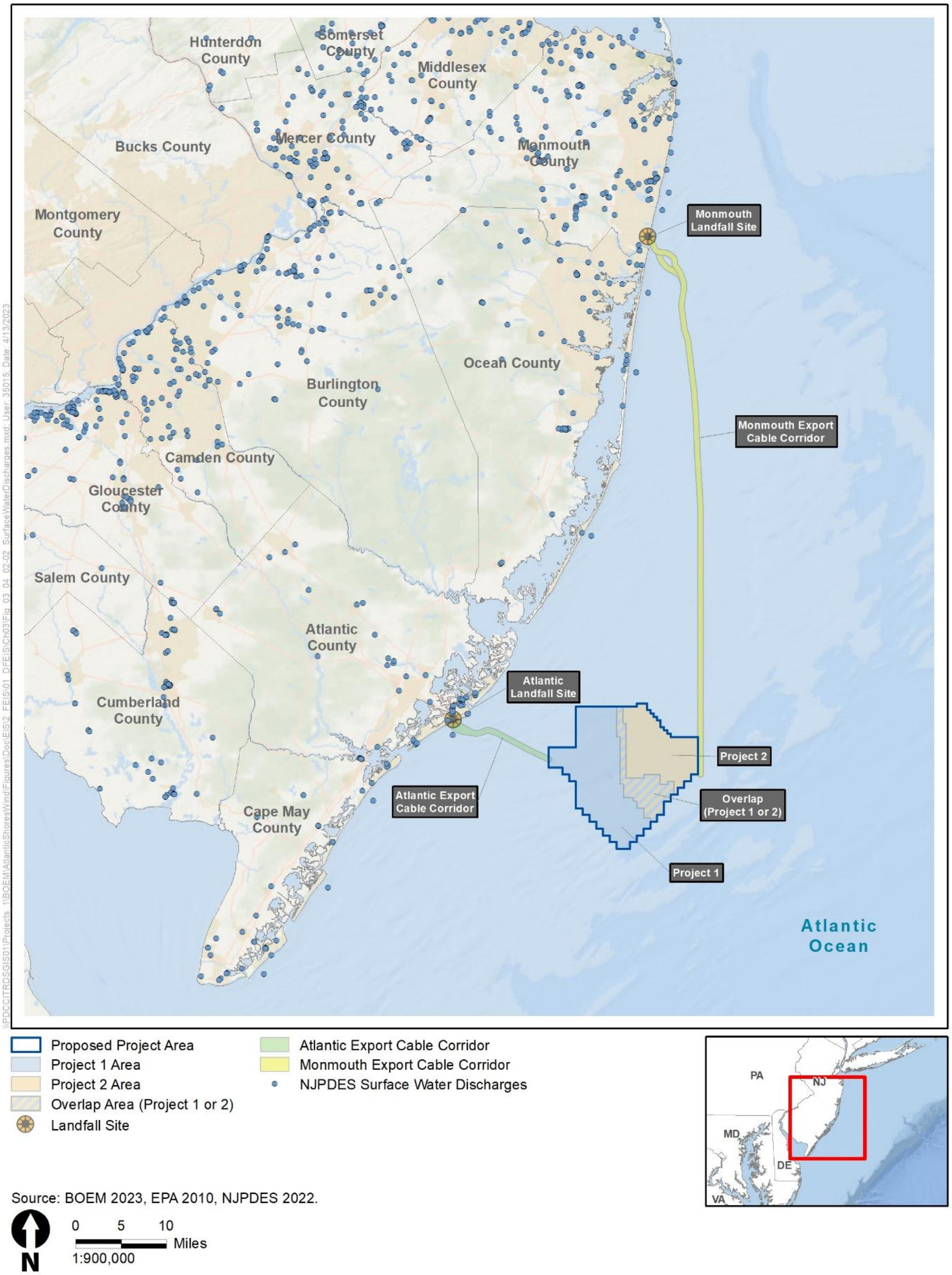


**Figure 3.4.2-2 Permitted surface water discharges**

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

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

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

Source: COP Volume II, Section 3.2.11; Atlantic Shores 2024; * = USEPA 2015; ^ = NJDEP 2020e.
[1] See COP Volume II, Figure 3.2-2 and COP Volume II, Table 3.2-1.

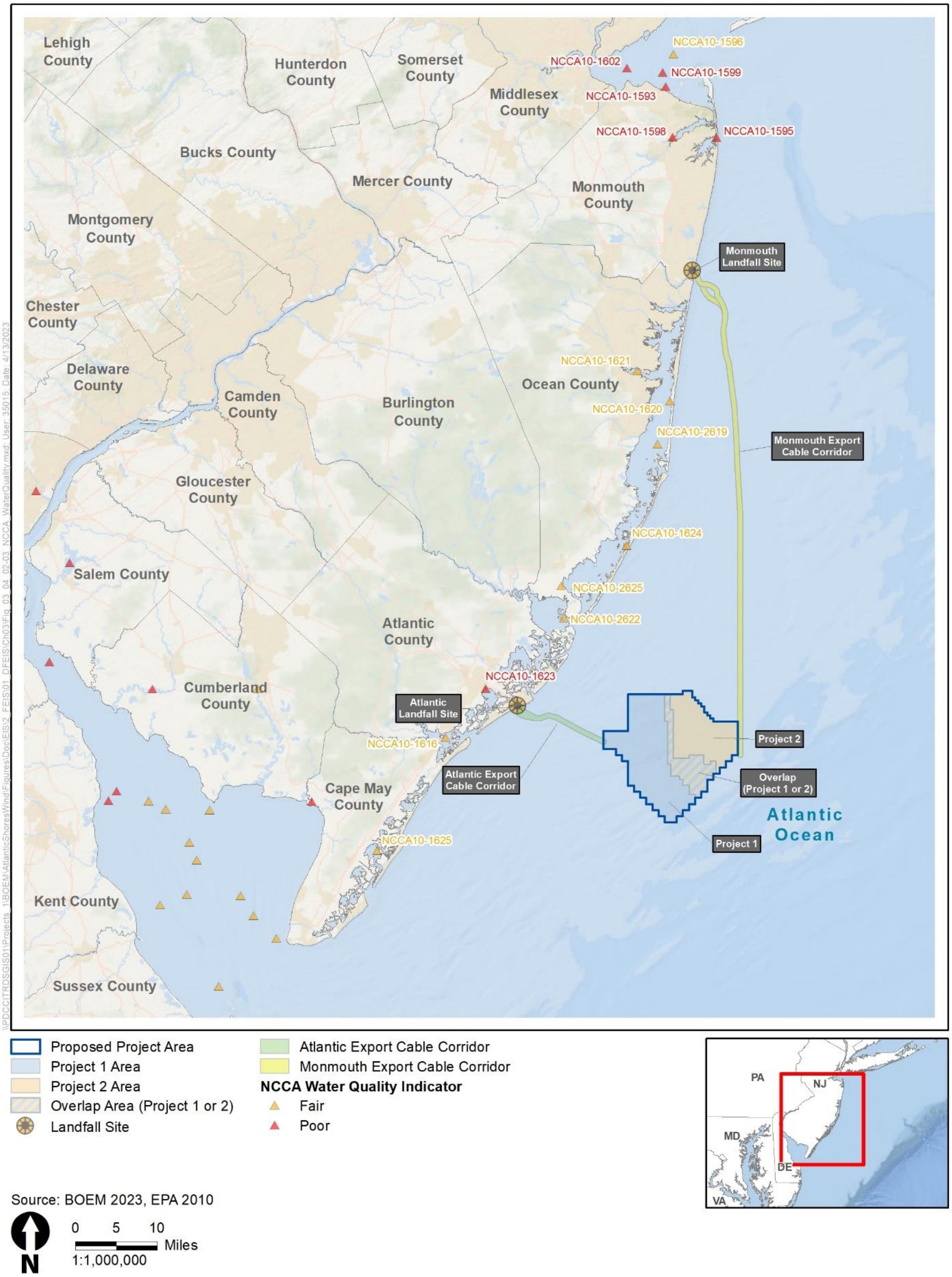


**Figure 3.4.2-3 National Coastal Condition Assessment water quality index**

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

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

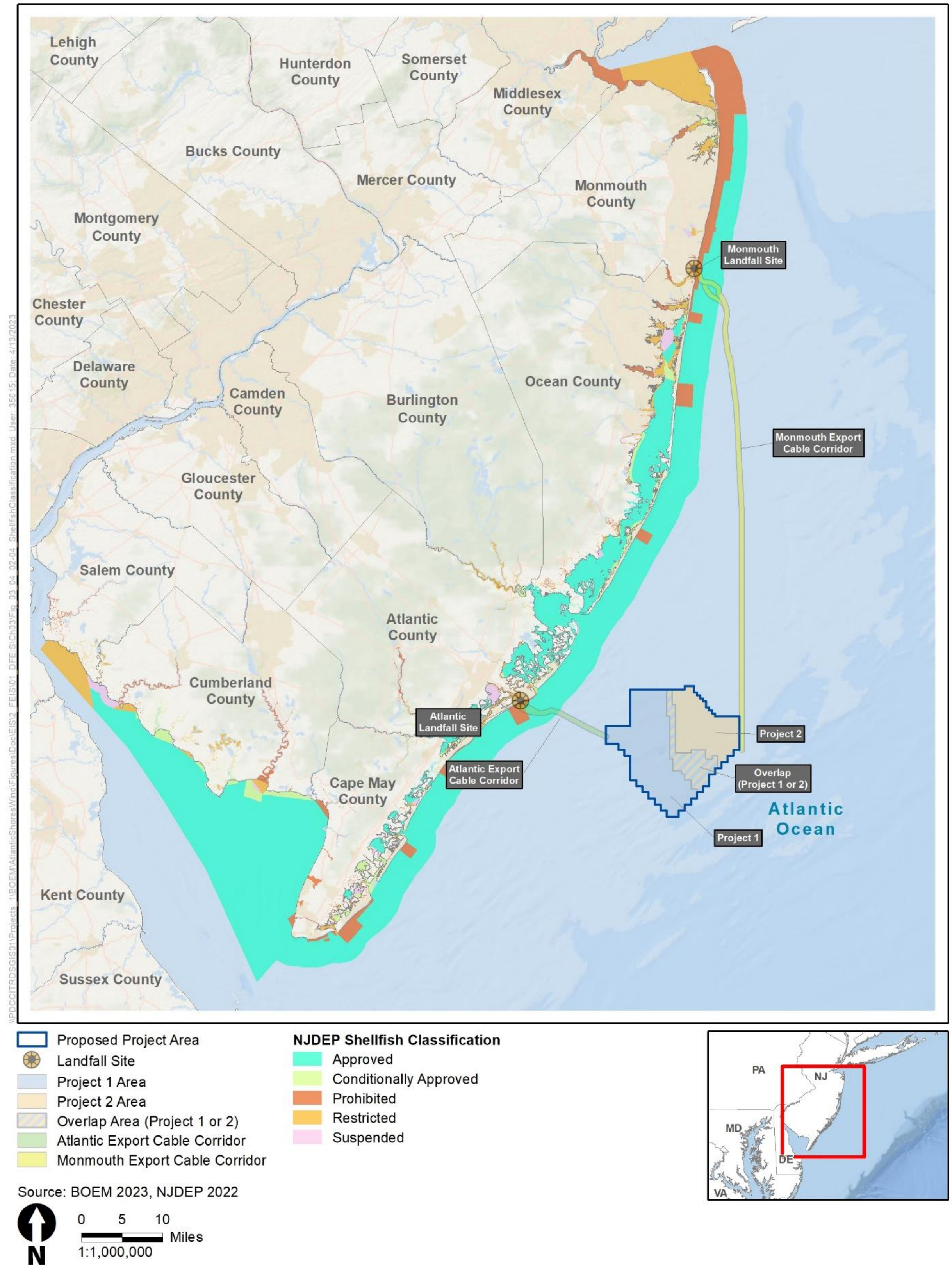


**Figure 3.4.2-4 Shellfish classifications from NJDEP**

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

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

Source: COP Volume II, Section 3.2.1.1, Table 3.2-2; Atlantic Shores 2024.

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

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

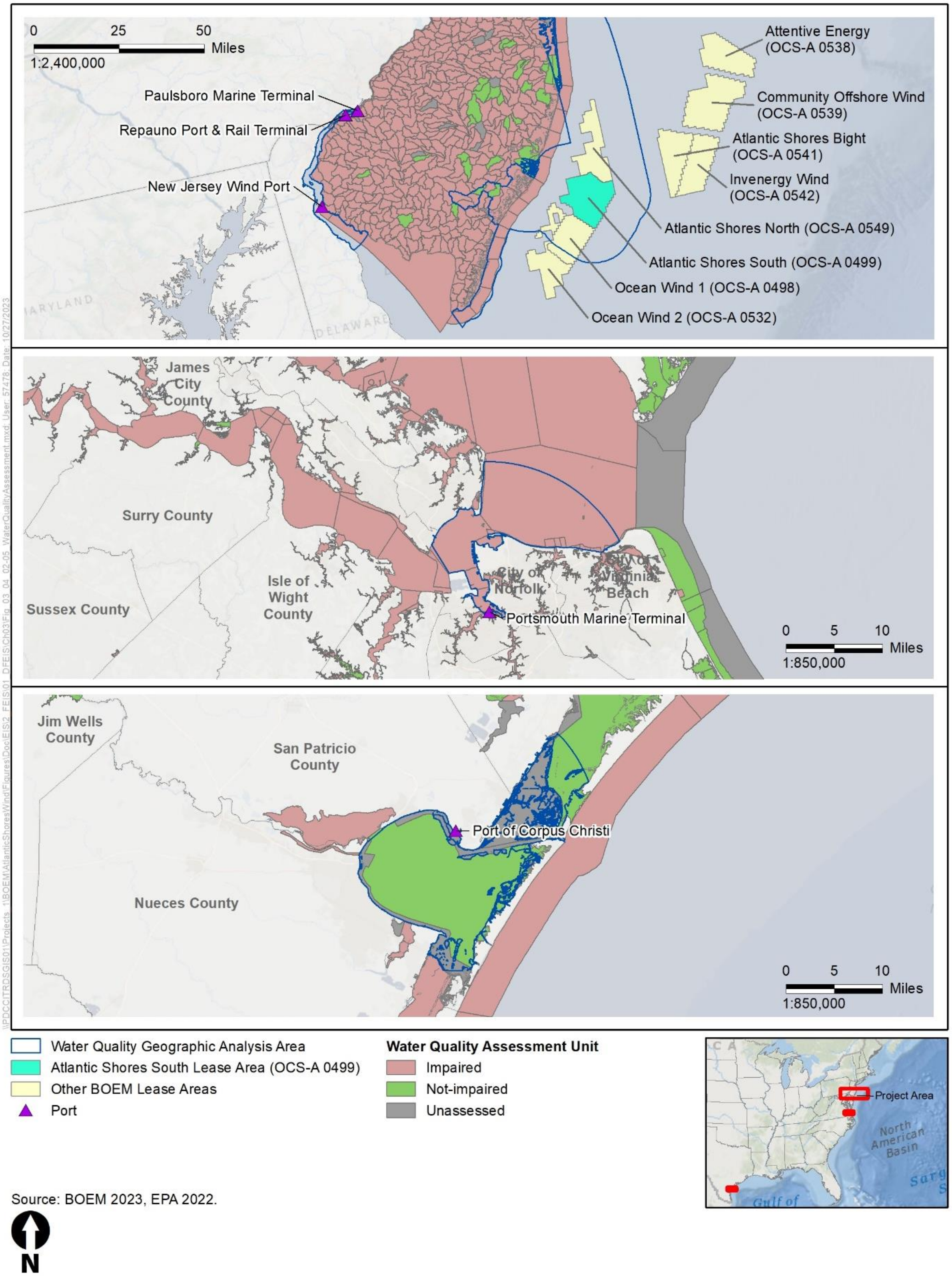


**Figure 3.4.2-5 Water quality assessments within the geographic analysis area**

### *Water Quality Specific to Proposed Ports*

Areas within the water quality analysis area of the Project generally include Silver Bay, Great Egg Harbor Bay, the Delaware River, Chesapeake Bay, James River, Nansemond River, Elizabeth River, and Corpus Christi Bay. Specifically, the existing ports of Repauno Port and Rail Terminal, Paulsboro Marine Terminal, Portsmouth Marine Terminal, and Port of Corpus Christi are to be used during construction and O&M of the Project; however, the Port of Corpus Christi would only be used during the construction phase. Additionally, a new port, the New Jersey Wind Port, is currently being constructed and is planned to be in operation by the start of construction of the Project (COP Volume II, Section 7.1.2.5, Table 7.1-17; Atlantic Shores 2024).

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

### *Water Quality Geographic Analysis Area: Coastal Onshore Waters*

Groundwater reservoirs underlie some areas of the Onshore geographic analysis area (COP Volume II, Section 3.2.1.2; Atlantic Shores 2024). Many of these groundwater resources are designated and monitored because they supply water to communities. There are various types of water supplies within the onshore portion of the geographic analysis area, and New Jersey has different types of public water supplies. These include both community public systems such as municipalities and communities with at least 15 year-round service connections and noncommunity transient or non-transient public systems such as schools, factories, and motels. Noncommunity systems typically obtain water from groundwater resources (NJDEP 2020). A third type of water supply is a private system, such as an individual well serving a household (COP Volume II, Section 3.2.1.2; Atlantic Shores 2024).

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

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

According to the New Jersey Department of Health, as of 2017, more than half of households within Monmouth County get their drinking water from private groundwater wells. Some of these private wells may be located at residences and businesses within the geographic analysis area. The municipalities within this area include the townships of Howell and Wall, and the boroughs of Manasquan and Sea Girt. Domestic water for these towns and boroughs is taken from groundwater or surface water reservoirs. Several wellhead protection areas are located within the geographic analysis area in Monmouth County (COP Volume II, Section 3.2.1.2; Atlantic Shores 2024). As shown on Figure 3.2-4 of the COP, no community wellhead protection areas or noncommunity water wellhead protection areas intersect the Onshore Project area (COP Volume II, Section 3.2.1.2; Atlantic Shores 2024).

The private New Jersey American Water company manages a public community water system that supplies Howell Township with drinkable water. Fourteen groundwater wells and one surface water source provide water for this system (New Jersey American Water 2020). Those groundwater wells and surface water are over 1 mile (1.6 kilometers) from the Onshore Project area and are not shown on COP Volume II, Figure 3.2-4, Section 3.2.1.2 (Atlantic Shores 2024).

Approximately 60 percent of the drinking water for the Monmouth County communities of Sea Girt Borough and Wall Township, as well as other communities, is sourced from the Manasquan Reservoir in Howell Township. This reservoir is managed by the New Jersey Water Supply Authority (New Jersey Water Supply Authority 2017) and is located over 1,000 feet (305 meters) to the northwest of the Onshore Project area at its nearest point (COP Volume II, Section 3.2.1.2; Atlantic Shores 2024).

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

Both groundwater and surface water sources are used to supply Atlantic City with its public potable water (Atlantic City Municipal Utilities Authority 2020). The Atlantic City Reservoir, formed by damming Absecon Creek in two locations, is the surface water that supplies drinkable water to Atlantic City. Up to 13 community and noncommunity groundwater wells also supply public potable water to Atlantic City. These wells range from 200 to 675 feet (60 to 206 meters) in depth and draw from the Cohansey-Kirkwood Aquifer, which covers much of the New Jersey Coastal Plain (NJDEP 2009). Access to these wellhead locations is restricted to protect the water supply. Water from these wells is transported to and treated at Atlantic City’s Water Treatment Plant (COP Volume II, Section 3.2.1.2; Atlantic Shores 2024).

As with Monmouth County, several wellhead protection areas are located within the geographic analysis area in Atlantic County (COP Volume II, Section 3.2.1.2, Figure 3.2-5; Atlantic Shores 2024). One public noncommunity wellhead protection area overlaps with an existing railroad ROW where the Cardiff onshore interconnection cable would be routed (COP Volume II, Section 3.2.1.2, Figure 3.2-5, Sheet 2; Atlantic Shores 2024). No community wellhead protection areas intersect with the proposed onshore substation site; however, the existing Cardiff Substation is located within the outermost Tier 3 (12-year source assessment) of a community wellhead protection area (COP Volume II, Section 3.2.1.2, Figure 3.2-5, Sheets 2–3; Atlantic Shores 2024).

### 3.4.2.2 Impact Level Definitions for Water Quality

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

**Table 3.4.2-3. Impact level definitions for water quality**

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

### 3.4.2.3 Impacts of Alternative A – No Action on Water Quality

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

#### *Impacts of Alternative A – No Action*

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

See Appendix D, Table D.A1-23 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for water quality. There is one ongoing offshore wind project within the geographic analysis area for water quality: Ocean Wind 1 in Lease Area OCS-A 0498.

### *Cumulative Impacts of Alternative A – No Action*

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

Other planned non-offshore wind activities that affect water quality include onshore development activities (including urbanization, forestry practices, municipal waste discharges, and agriculture); marine transportation-related discharges; dredging and port improvement projects; commercial fishing; military use; new submarine cables and pipelines; and climate change (see Section D.2 in Appendix D, for a description of planned activities). Water quality impacts from these activities, especially from dredging and harbor, port, and terminal operations, are expected to be localized and short term to permanent, depending on the nature of the activities and associated IPFs. Similar to under ongoing activities, the deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). State and federal water quality protection requirements and permitting would result in avoiding and minimizing these impacts. See Table D.A1-23 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for water quality.

The water quality geographic analysis area for the Proposed Action overlaps all of the Atlantic Shores North (OCS-A 0549) and most of the Ocean Wind 1 (OCS-A 0498) and part of Ocean Wind 2 (OCS-A 0532) Lease Areas. BOEM conservatively assumed in its analysis of water quality impacts that all 364 WTGs estimated for the ongoing Ocean Wind 1 Project and planned Atlantic Shores North and Ocean Wind 2 Projects would be sited within the water quality geographic analysis area (Appendix D, Table D.A2-1). Periods of construction overlap could occur between Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North. There would be a risk of greater cumulative impacts on water quality during these periods due to an increased risk of accidental releases, resuspension and deposition of sediments from offshore construction activities, and land disturbance due to construction of onshore components and use of ports for construction.

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

**Accidental releases:** Ongoing and planned offshore wind activities could expose surface waters to contaminants (such as fuel, solid waste, or chemicals, solvents, oils, or grease from equipment) in the event of a spill or release during routine vessel use. Ongoing and planned offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with construction is expected to occur regularly in the New York and New Jersey lease areas beginning in 2026 and continuing through 2030 and then lessen to near-baseline levels during operational activities. Increased vessel traffic would be localized near affected ports and offshore construction areas. Increased vessel traffic in the region associated with offshore wind construction could increase the probability of collisions and allisions, which could result in oil or chemical spills.

Based on the estimated construction schedules (Appendix D, Table D.A2-1), offshore wind projects could occur with some overlapping construction schedules between 2026 and 2030.

Based on Appendix D, Table D.A2-3, up to about 1,030,349 gallons (3.9 million liters) of coolants, 2,166,000 gallons (8.2 million liters) of oils and lubricants, and 366,763 gallons (1.4 million liters) of diesel fuel would be contained in the structures for the wind energy projects within the water quality geographic analysis area. If accidental releases occur, they would most likely occur during construction but could occur during operations and decommissioning of offshore wind facilities.

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

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

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

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

**Anchoring:** Offshore wind activities would contribute to changes in offshore water quality from resuspension and deposition of sediments from anchoring during construction, installation, maintenance, and decommissioning of offshore components. BOEM estimates that approximately 728 acres (295 hectares) of seabed could be affected by anchoring within the water quality geographic analysis area (Appendix D, Table D.A2-2). Disturbances to the seabed during anchoring would temporarily increase suspended sediment and turbidity levels in and immediately adjacent to the anchorage area. The intensity and extent of the additional sediment suspension effects would be less than that of new cable emplacement (see the *Cable emplacement and maintenance* IPF discussion below) and would therefore be unlikely to have an incremental impact beyond the immediate vicinity. If more than one project is being constructed during the same period, the impacts would be greater than for one project, and multiple areas would experience water quality impacts from anchoring, but, due to the localized area for sediment plumes, the impacts would likely not overlap each other geographically. The cumulative impact of increased sediment and turbidity from vessel anchoring is anticipated to be minor, localized, and short term, resulting in little change to ambient water quality. Anchoring would not be expected to appreciably contribute to overall impacts on water quality.

**Cable emplacement and maintenance:** Emplacement of submarine cables would result in increased suspended sediments and turbidity. Using the assumptions in Table D.A2-2 of Appendix D, ongoing and planned offshore wind development in the water quality geographic analysis area would result in approximately 10,397 acres (4,208 hectares) of seabed impact from offshore export and interarray cable emplacement. As described under the *Anchoring* IPF, these activities would contribute to changes in offshore water quality from the resuspension and deposition of sediment. The installation of interarray and offshore export cables, including site preparation activities, via jet plow, mechanical plow, or mechanical trenching, can cause temporary increases in turbidity and sediment resuspension. Due to the localized areas of disturbances and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance are anticipated to be localized, short term, and minor, resulting in little change to ambient water quality. Cable emplacement and maintenance activities would not be expected to appreciably contribute to cumulative impacts on water quality.

**Discharges/intakes:** Ongoing and planned offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with offshore wind project construction is expected to occur regularly in the New Jersey lease areas beginning in 2024 due to ongoing activities and continuing through 2030 due to planned activities, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. Planned offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be staggered over time and localized. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes such as treated deck drainage and sumps. BOEM assumes that all vessels operating in the same area will comply with federal and state regulations on effluent discharge. All offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of discharges and of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162. Furthermore, each project's vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151, and allowable vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids. Therefore, due to the minimal amount of allowable discharges from vessels associated with offshore wind projects, BOEM expects impacts on water quality resulting from vessel discharges to be minimal and to not exceed background levels over time.

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

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

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

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

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

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

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

**Presence of structures:** Using the assumptions in Tables D.A2-1 and D.A2-2 of Appendix D, planned offshore wind projects are estimated to result in 277 WTG and OSS structures by 2030 within the water quality geographic analysis area, in addition to the 101 WTG and OSS structures to be constructed as part of the ongoing Ocean Wind 1 (OCS-A 0498) Project. The construction of these structures (planned and ongoing) could disturb up to 404 acres (164 hectares) of seabed within the water quality geographic analysis area from foundation and scour protection installation and disrupt bottom current patterns, leading to increased movement, suspension, and deposition of sediments (Appendix D, Table D.A2-2). Scouring, which could lead to impacts on water quality through the formation of sediment plumes (Harris et al. 2011), would generally occur in shallow areas with tidally dominated currents.

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

The general understanding of offshore wind–related impacts on hydrodynamics is derived primarily from European based studies. A synthesis of European studies by Van Berkel et al. (2020) summarized the potential effects of wind turbines on hydrodynamics, the wind field, and fisheries. Local to a wind facility, the range of potential impacts include increased turbulence downstream, remobilization of sediments, reduced flow inside wind farms, downstream changes in stratification, redistribution of water temperature, and changes in nutrient upwelling and primary productivity. Human-made structures, especially tall vertical structures such as foundations, alter local water flow at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). When water flows around the structure, turbulence is introduced that influences local current speed and direction. Turbulent wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts on current speed and direction decrease rapidly around monopiles, there is a potential for hydrodynamic effects out to 0.6 mile (1 kilometer) from a monopile (Li et al. 2014). Direct observations of the influence of a monopile extended to at least 984 feet (300 meters); however, changes were indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to 3,281 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, and sensitivity of the analysis. In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing toward stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017; refer to Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, Section 3.5.6, *Marine Mammals*, and Section 3.5.7, *Sea Turtles*, regarding hydrodynamic and atmospheric wake effects on primary production).

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

The exposure of offshore wind structures, which are mainly made of steel, to the marine environment can result in corrosion without protective measures. Corrosion is a general problem for offshore infrastructures and corrosion protection systems are necessary to maintain structural integrity.

Protective measures for corrosion (e.g., coatings, cathodic protection systems) are often in direct contact with seawater and have different potentials for emissions, e.g., galvanic anodes emitting metals, such as aluminum, zinc, and indium, and organic coatings releasing organic compounds due to weathering and leaching. The current understanding of chemical emissions for offshore wind structures is that emissions appear to be low, suggesting a low environmental impact, especially if compared to other offshore activities, but these emissions may become more relevant for the marine environment with increased numbers of offshore wind projects and a better understanding of the potential long-term effects of corrosion protection systems (Kirchgeorg et al. 2018). Based on the current understanding of offshore wind structure corrosion effects on water quality, BOEM anticipates the potential impact to be minor.

Offshore aquifers containing brackish water are known to occur along the OCS of the Atlantic Ocean where wind development is taking place. Although these aquifers underlie areas where WTGs and OSSs would be installed, offshore aquifers are typically found at depths below the seafloor greater than 328 feet (100 meters). If piles were to penetrate an aquifer, they could potentially create a pathway for seawater to flow in or out of the aquifer if it was contained. Any water seepage would be very minor due to the skin friction along the pile. Foundation construction is not expected to reach depths that would impact the aquifers within the Project area. Due to the difference between the depth of the aquifers near the Project area and the possible foundation penetration depths, impacts on offshore aquifers are not anticipated.

#### *Conclusions*

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

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

BOEM anticipates the cumulative impacts of the No Action Alternative on water quality would be minor to moderate because water quality would continue to follow current regional trends and respond to current and future environmental and societal activities. Moderate impacts on water quality would primarily be driven by the unlikely event of a large-volume, catastrophic release.

#### 3.4.2.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The amount of vessel use during installation, operations, and decommissioning.
- The number of WTGs and OSSs and the amount of cable laid determines the area of seafloor and volume of sediment disturbed by installation. In the maximum-case scenario, there would be a maximum of 200 WTGs installed, up to 10 OSSs, 1 met tower, 4 temporary metocean buoys, 547 miles (880 kilometers) of interarray cable, and 37 miles (60 kilometers) of interlink cable. Approximately 342 miles (550 kilometers) of offshore export cable would be installed for the Monmouth ECC and approximately 99 miles (160 kilometers) for the Atlantic ECC (COP Volume I, Table E-1; Atlantic Shores 2024). These numbers represent Project 1 and Project 2 cumulatively.
- Installation methods chosen and the duration of installation.
- Proximity to sensitive water sources and mitigation measures used for onshore proposed Project activities.
- In the event of a non-routine event such as a spill, the quantity and type of oil, lubricants, or other chemicals contained in the WTGs, vessels, and other proposed Project equipment.

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

### 3.4.2.5 Impacts of Alternative B – Proposed Action on Water Quality

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

**Accidental releases:** Similar to other offshore wind projects, chemicals (e.g., coolants, oils, diesel fuel) would be used and stored in facilities, and black and gray water may be stored in sump tanks on facilities. Chemicals such as coolants, oils, and diesel fuels used during construction activities could have negative impacts on offshore water quality. The Proposed Action would have a maximum of 857,960 gallons (3,247,732 liters) of coolants, 1,356,220 gallons (5,133,851 liters) of oils and lubricants, and 360,000 gallons (1,362,748 liters) of diesel stored within WTG foundations and OSSs within the water quality geographic analysis area (Appendix D, Table D.A2-3). As discussed previously, the risk of a spill from any single offshore structure would be low, and any effects would likely be localized. Modeling conducted for an area near the Project (Maryland WEA) indicates that the most likely type of spill (i.e., non-routine event) to occur during the life of a project is 90 to 440 gallons (341 to 1,666 liters) at a rate of one time in 5 years, which would have brief, localized impacts on water quality (Bejarano et al. 2013). One difference between the Proposed Action and the Maryland WEA is that there would be more WTGs under the Proposed Action (up to 200 instead of 125), which could lead to an increased likelihood of spill events compared to the Bejarano et al. (2013) model. Overall, the probability of an oil or chemical spill occurring that is large enough to affect water quality is extremely low and the degree of impact on water quality would depend on the spill volume. The impacts of the Proposed Action alone on water quality from accidental releases would be localized, short term, and minor.

The use of HDD during installation of the export cables at the landfall locations will require HDD drilling fluid, usually made up of a water and bentonite mixture. The mixture is not anticipated to considerably affect water quality if released. Atlantic Shores would implement BMPs during construction to minimize potential release of the fluid. These methods may include returning the drilling fluid to surface pits and collecting it for reuse. The HDD also creates a potential for frac-out during drilling activities. A frac-out occurs when the drilling fluids migrate unpredictably to the surface through factures, fissures, or other conduits in the underlying rock or unconsolidated sediments. In the unlikely event of a frac-out, the inadvertent release of bentonite into the water column could result in short-term and localized impacts on water quality in the nearshore marine environment. However, design considerations, operational controls, and contingency planning would greatly diminish the likelihood of accidental releases. Furthermore, HDD activities would be managed by an HDD Contingency Plan for the Inadvertent Release of Drilling Fluid to ensure the protection of marine and inland surface waters from an accidental release of drilling fluid. All drilling fluids would be collected and recycled upon HDD completion (WAT-04, Appendix G, *Mitigation and Monitoring,* Table G-1). Therefore, with implementation of BMPs and the development and implementation of the contingency plan, potential impacts from chemical release would be localized, short term, and minor.

Increased vessel traffic in the region associated with the Proposed Action could increase the probability of collisions and allisions, which could possibly result in oil or chemical spills. However, collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Project: USCG requirement for lighting on vessels, NOAA vessel speed restrictions, the proposed spacing of WTGs and OSSs, the lighting and marking plan that would be implemented, and the inclusion of proposed Project components on navigation charts. Atlantic Shores would implement its OSRP that meets USCG and the BSEE requirements (COP Volume I, Appendix I-D; Atlantic Shores 2024), which would provide for rapid spill response, cleanup, and other measures to minimize any potential impact on affected resources from spills and accidental releases, including spills resulting from catastrophic events (WAT-03, Appendix G, Table G-1). In the unlikely event an allision or collision involving vessels or components associated with the Proposed Action resulted in a large spill, impacts from the Proposed Action alone on water quality would be short term to long term and minor to moderate depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill.

Onshore construction activities would require heavy equipment use or HDD activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. The Proposed Action would store onshore a maximum of 2,550 gallons (9,653 liters) of coolants, 545,020 gallons (2,063,125 liters) of oils and lubricants, and 3,000 gallons (11,356 liters) of diesel fuel for the two onshore substations and/or converter stations (one per POI) within the water quality geographic analysis area (Table 3.4.2-4). Atlantic Shores would develop and implement an SPCC Plan and OSRP to minimize impacts on water quality (prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act) (WAT-03, Appendix G, Table G-1). In addition, all wastes generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the U.S. Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates the Proposed Action alone would result in negligible, short-term, and long-term impacts on water quality as a result of releases from heavy equipment during construction and other cable installation activities.

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

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

Atlantic Shores would use a new onshore O&M facility in Atlantic City, New Jersey, sited on a parcel that was previously used for vessel docking and other port activities. The O&M facility would include offices, control rooms, warehouses, workshop space, and potentially an associated parking structure. The O&M facility may utilize the parking lot on South California Avenue at the Atlantic Landfall Site or other existing surface lots in Atlantic City supported by shuttles to and from the O&M facility. Construction and operation of the O&M facility could result in accidental fuel spills or sedimentation that could cause impacts on water quality. Construction would be separately reviewed and authorized by USACE and local authorities, as needed. Atlantic Shores would ensure that any action that would affect surface waters, including those listed as impaired under Section 303(d), would not result in exceedances of water quality standards, and would comply with any existing total maximum daily load requirements for any waters designated as impaired under CWA Section 303(d). BOEM anticipates negligible impacts on water quality in the event of a potential release at the facility because the terms and conditions of permits for construction and any in-water work would require measures to avoid and minimize sedimentation, turbidity, and accidental release impacts on surface waters.

**Anchoring:** There would be increased vessel anchoring during the construction and installation, O&M, and decommissioning of offshore components of the Proposed Action. Anchoring would cause increased turbidity levels from the positioning of anchors and anchor chain contact with the seafloor. Impacts on water quality from the Proposed Action alone due to anchoring would be localized, short term, and minor during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in reduced impacts. Atlantic Shores has not yet selected the specific vessels that would carry out construction activities. Because the number of vessels and the number of vessel trips depend on the specific vessels used, estimates were generated using sample vessels and preliminary Project plans. Currently, maximum estimates for the total number of vessels required for any single offshore construction activity range from 2 vessels for scour protection installation to up to 16 vessels for OSS installation. For export cable installation, it is estimated that up to 6 vessels could be operating at once. In the unlikely event that all Project 1 and Project 2 construction activities were to occur simultaneously, a total of 51 vessels could be present at any one time (COP

Volume II, Section 7.6.2.1; Atlantic Shores 2024). The number of vessels is anticipated to result in 714 acres (289 hectares) of impact from anchoring (Appendix D, Table D.A2-2). Atlantic Shores has proposed to use anchor midline buoys on anchored construction vessels, where feasible, to minimize disturbance to the seafloor and sediments (WAT-01, Appendix G, Table G-1).

**Cable emplacement and maintenance:** The installation of interarray cables and offshore export cables would include site preparation activities (e.g., sandwave clearance, boulder removal) and cable installation via jet plow, mechanical plow, or mechanical trenching, which can cause temporary increases in turbidity and sediment resuspension. Other projects using similar installation methods (e.g., jet plowing, pile driving) have been characterized as having minor impacts on water quality due to the short-term and localized nature of the disturbance (Latham et al. 2017). Additionally, Atlantic Shores proposes to use dynamically positioned vessels and jet plow embedment to the maximum extent practicable to minimize sediment disturbance and alteration during cable laying process (WAT-02, Appendix G, Table G-1).

Based on the Sediment Transport Modeling results, suspended sediment concentrations resulting from cable installation, HDD activities, and sandwave clearing are predicted to remain close to the route centerline or HDD pit, be constrained to the bottom of the water column, and occur for durations of less than 24 hours (COP Volume II, Appendix II-J3; Atlantic Shores 2024). Simulations of possible interarray cable or offshore export cable installation methods using jet trenching installation or mechanical trenching installation predicted above-ambient TSS of ≥10 mg/L stayed relatively close to the route centerline. According to Balthis et al. (2009), 10 mg/L is considered within the range of ambient TSS concentrations in the Mid-Atlantic Bight. TSS concentrations of ≥10 mg/L traveled a maximum distance of approximately 1.8 miles (2.9 kilometers), 1.6 miles (2.6 kilometers), and 1.1 miles (1.7 kilometers) for installation of interarray cables, Monmouth ECC cables, and Atlantic ECC cables, respectively. The use of an excavator without a cofferdam was assumed and sediment was assumed to be introduced at the surface for the landfall approaches. Results showed a maximum distance for the predicted above-ambient TSS concentrations ≥10 mg/L to be approximately 2.1 miles (3.3 kilometers) and 1.2 miles (1.9 kilometers) for the Monmouth and Atlantic HDD pits, respectively (COP Volume II, Section 3.2.2.1; Atlantic Shores 2024). The Atlantic ECC and interarray cable model scenarios showed above-ambient TSS concentrations significantly dissipated within 2 to 4 hours and fully dissipated in 6 or less hours. Above-ambient TSS concentrations substantially dissipated within 2 to 6 hours but required up to 13 hours to fully dissipate for the Monmouth ECC model scenarios. The landfall approach scenarios results showed that tails of sediment plumes, with concentrations of ≥10 mg/L, were transported away from the source and were brief, while concentrations around the HDD pits dissipated within 11 hours for the Atlantic HDD pit and 12 hours for the Monmouth HDD pit (COP Volume II, Section 3.2.2.1; Atlantic Shores 2024). Above-ambient TSS concentrations stemming from sandwave clearance activities were also predicted to be short lived and remain relatively close to the route centerline. The maximum distances for the predicted above-ambient TSS concentrations of ≥10 mg/L and 100 mg/L were approximately 2.0 miles (3.2 kilometers) and 1.3 miles (2.1 kilometers), respectively. The models showed that above-ambient TSS concentrations were projected to considerably dissipate within 4 to 6 hours and fully dissipate in less than 12 hours for most areas (COP Volume II, Section 3.2.2.1; Atlantic Shores 2024). These modeling results are similar to modeling predictions conducted for similar projects in similar conditions (COP Volume II, Section 3.2.2.1; Atlantic Shores 2024). Based on Elliot et al. (2017), actual suspended sediment concentrations and transport during installation may be even lower. Environmental monitoring surveys conducted during installation of the Block Island Wind Farm submarine cable found that suspended sediment levels during jet plow installation were measured to be up to 100 times lower than those predicted by the modeling (COP Volume II, Section 3.2.2.1; Atlantic Shores 2024).

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

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

During construction of the Proposed Action, vessel traffic would increase in and around the WTA, leading to potential discharges of uncontaminated water and treated liquid wastes. Tables 7.0-1 through 7.0-3 in COP Volume I list the types of wastes that could potentially be produced by the Proposed Action (Atlantic Shores 2024). The Project's solid and liquid wastes would be treated, released, stored, or disposed of in accordance with applicable federal, state, and local regulations. Vessels may discharge some liquid wastes such as domestic wastewater, uncontaminated bilge water and ballast water, treated deck drainage and sumps, and uncontaminated fresh or seawater from vessel air conditioning. Waste—such as sewage, solid waste, or chemicals, solvents, oils, and greases from equipment, vessels, or facilities—would be stored and properly disposed of onshore or incinerated offshore. All vessels for the Project would comply with USCG waste and ballast water management regulations and oil and hazardous material pollution prevention regulations, in addition to other regulations. Project vessels covered under the NPDES Vessel General Permit (VGP) are also subject to effluent limits contained in Section 2 of the VGP. Atlantic Shores would also require offshore contractors to participate in a marine trash and debris prevention training program. With implementation of these mitigation measures and the regulatory requirements described herein, the short-term impact of routine vessel discharge is expected to be minor.

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

Any onshore waste that could likely cause environmental harm would be stored in containers situated in designated, secure, and bermed locations away from depressions and drainage lines that carry surface water until collected by the selected waste contractor. Spill kits would be provided at all locations where hazardous materials are held to control foreseeable spills, and protocols would be in place to minimize the chance of such spills (see COP, Volume I, Section 1.5.3.2; Atlantic Shores 2024). Waste required to be removed for use away from storage areas would be kept in portable bunds (temporary spill berms), and waste oils would be recycled where appropriate. BMPs would be utilized to adequately contain excavated soils and sediments during onshore construction. Disturbed soil areas would be stabilized to avoid potential sedimentation and runoff into waterbodies or wetlands. See Appendix G, for proposed environmental protection measures that would be adhered to during construction of onshore components.

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

**Land disturbance:** Construction and installation of onshore components (e.g., substations, cable installation) would disturb ground and lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity. Two onshore interconnection cables (one per POI) would be installed underground primarily along existing roadways, bike paths, and utility ROWs from both the Monmouth and Atlantic Landfall Site(s) to their respective onshore substations. The Cardiff Onshore Interconnection Cable Route would be approximately 12.4 to 22.6 miles (20 to 36.4 kilometers), and the Larrabee Onshore Interconnection Cable Route would be approximately 9.8 to 23 miles (15.8 to 37 kilometers) in length. Utilizing existing roads, paths, and ROWs would minimize potential disturbance to onshore waterbodies and impacts on water quality. Atlantic Shores has also proposed to use trenchless technologies to install onshore cables in certain areas to avoid impacts on wetlands and water quality (WAT-08, Appendix G, Table G-1). These trenchless techniques would be used to install onshore cables under wetlands and waterbodies, minimizing soil disturbance in these sensitive areas. Atlantic Shores would implement appropriate BMPs such as silt fence, filter socks, inlet protection, dust abatement, and other approved BMPs in accordance with the approved Soil Erosion and Sediment Control Plan to properly contain excavated soils and sediments and stabilize disturbed land areas, to avoid erosion and sediment runoff into waterbodies and impacts on water quality (WAT-09, Appendix G, Table G-1). Additionally, the Project would be constructed in accordance with an approved New Jersey Division of Land Resource Protection Stormwater Management Control Plan (New Jersey Pollutant Discharge Elimination System [NJPDES] and SWPPP) and County Soil Conservation District BMPs to avoid and minimize Project-related water quality impacts on nearby aquatic habitats (WAT-09, WAT-11, Appendix G, Table G-1). The installation of onshore cables may require dewatering activities and road openings during construction. Atlantic Shores is aware of NJDEP water allocation requirements and would abide by all federal, state, and local laws related to ground and surface water quality standards by obtaining all applicable permits. Temporarily disturbed areas would be restored (i.e., reseeding or repaving) in accordance with an approved Soil Erosion and Sediment Control Plan and SWPPP within the Onshore Project area. Construction would lead to an increased potential for water quality impacts resulting from accidental fuel spills or sedimentation in waterbodies. The incremental increases in land disturbance from the Proposed Action would be small, and mitigation measures, such as the use of an SPCC Plan, Erosion and Sedimentation Control Plan, and SWPPP, would be implemented. As such, impacts from the Proposed Action alone on water quality from land disturbance would be short term and negligible to minor.

**Port utilization:** During construction the port facilities of Paulsboro Marine Terminal and the Repauno Port and Rail Terminal in New Jersey, the Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas would be used for construction staging of activities associated with the Project. The State of New Jersey is building a new offshore wind port in Salem County, approximately 7.5 miles (12.1 kilometers) southwest of Salem. The port is expected to be complete in late 2024 (New Jersey Wind Port 2021). The Virginia Department of Mines Minerals and Energy commissioned a study that was published in 2015 that evaluated ports in Virginia based on their readiness to supply offshore wind construction activities. The Portsmouth Marine Terminal was identified as having a high level of readiness to support offshore wind activities; however, the State of Virginia plans to upgrade this port to make it even more suitable for offshore wind manufacturing, handling, and transportation (Appendix D, Table D-8). The impacts on water quality could include accidental fuel spills or sedimentation during port use. The incremental increases in vessel traffic at the ports would be small; multiple authorities regulate water quality impacts from these operations (BOEM 2019). Therefore, the impacts of the Proposed Action alone on water quality from port utilization would be localized, short term, and negligible.

**Presence of structures:** Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area. Dock facilities and other structures are concentrated along the coastline. The Proposed Action would add up to 200 WTGs, 10 OSSs, 1 permanent met tower, 4 temporary metocean buoys and related Project elements, which would increase seabed disturbance and potential water quality impacts. As described in Section 3.4.2.3*,* results from a recent BOEM (2021) hydrodynamic model of four different WTG build-out scenarios of the offshore Rhode Island and Massachusetts lease areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification) via their influence on currents from WTG foundations and by extracting energy from the wind. Similarly, as described in Section 3.4.2.3, the presence of WTGs during an extreme weather event can affect oceanic processes (Chen et al. 2016). The presence of WTGs also has the potential to alter the spatial distribution and aggregation of Chlorophyll-*a* and dissolved inorganic nutrients in coastal waters. A recent study was conducted at 38 offshore wind farms in Europe and China with regards to offshore wind structures and Chlorophyll-*a* (Lu et al. 2022). The study found that offshore wind farms have the potential to alter the spatial distribution and aggregation of Chlorophyll-*a*. The study also concluded that for 10 of the 38 offshore wind farms studied, no significant trends in spatial distribution patterns of Chlorophyll-*a* were found after construction. The effects from offshore wind farms to Chlorophyl-*a* seems to be situationally dependent.

Two onshore substations or converter stations (one per POI) and one O&M facility are proposed for the Project. Onshore facilities locations would be in previously disturbed and developed areas away from surface waters and water supplies to minimize soil disturbance and risk of sediment deposition in nearby water resources. Atlantic Shores also proposes to use specialized cable installation technologies (e.g., trenchless technologies) in some areas to minimize environmental impacts. For example, HDD would be used to complete export cable landfall (i.e., offshore-to-onshore transition), which would minimize the amount of sediment and soil disturbance at the landfall sites, both offshore and onshore (WAT-04; Appendix G, Table G-1). Atlantic Shores would also use trenchless techniques (e.g., pipe jacking, jack-and-bore, and HDD) to install the onshore interconnection cables under wetlands, waterbodies, or roadways, which would minimize soil disturbances at these locations (WAT-08; Appendix G, Table G-1). See Figures 3.2-4 and 3.2-5 in Section 3.2.1.2 of COP Volume II for a depiction of the proposed routes of the onshore interconnection cables (Atlantic Shores 2024).

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

As previously mentioned, offshore aquifers containing brackish water are known to occur along the OCS of the Atlantic Ocean where wind development is taking place. Although these aquifers underlie areas where WTGs and OSSs would be installed, construction is not expected to reach depths that would impact the aquifers within the Project area. Due to the difference between the depth of the aquifers near the Project area and the possible foundation penetration depths, impacts on offshore aquifers are not anticipated.

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

### *Impacts of the Connected Action*

As described in Chapter 2, *Alternatives,* bulkhead repair or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). The existing bulkhead consists of multiple sections that are made from steel sheet piles, timbers, and concrete. It is missing sections, making it unstable and increasing the potential for erosion. Repair and/or replacement of the existing bulkhead would take place in order to stabilize the shoreline and prevent additional erosion. This activity would be necessary regardless of whether the Proposed Action is implemented. Independently of the Proposed Action, Atlantic Shores is pursuing a USACE Nationwide Permit 13 to install an approximately 541-foot (165-meter) bulkhead composed of corrugated steel sheet pile. The proposed design for new shoreline structures consisting of three floating docks, 9.0 feet (2.7 meters) wide and extending 92.7 feet (28.3 meters) from the shoreline. Each floating dock will be equipped with a 37.0-foot (11.3-meter) gangway and stabilized by two 4.0-foot (1.2-meter) diameter steel piles. This dock area will also include 16 dolphin structures each with seven 1.0-foot (0.3-meter) timber clusters. Impact pile driving may be required for installing each of the six 4.0-foot (1.2-meter) steel piles and 112 1.0-foot (0.3-meter) timber piles. The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the approved permit. Additionally, the City of Atlantic City obtained a USACE approval (CENAP-OPR-2021-00573-95) and a NJDEP Dredge Permit (No. 0102.20.0001.1 LUP 210001) to perform 10-year maintenance dredging of 13 city waterways, including the area associated with the proposed O&M facility. Dredging would reestablish a water depth of 15 feet (4.6 meters) below the plane of MLW plus 1.0 foot (0.3 meter) of allowable overdredge and 4:1 slide slopes within the site. Maintenance dredging activities would serve to maintain safe navigational depths for transiting vessels by re-establishing in-water depths consistent with depths historically maintained in collaboration with dredging activities of adjacent harbors and waterways. These activities would be implemented independently from the Proposed Action.

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

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

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

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

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

### *Cumulative Impacts of Alternative B – Proposed Action*

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

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

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

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

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

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

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

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

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

### *Conclusions*

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

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

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

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

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

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

### *Conclusions*

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

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

## 3.4.2.7 Proposed Mitigation Measures

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

## 3.4.2.8 Comparison of Alternatives

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

### 3.4.2.9 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical miles (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative would include up to 195 WTGs,[1] up to 10 OSSs, and up to 1 permanent met tower. All permanent structures must be located in the uniform grid spacing and the total number of permanent structures constructed (WTGs, OSSs, and met tower) would not exceed 197.

The quantities of coolants, oils and lubricants, and diesel fuel under the Preferred Alternative would be of lesser quantities than those anticipated for the Proposed Action due to the smaller number of WTGs. The reduced number of structures may slightly reduce localized water quality impacts during construction and installation, operations, and decommissioning, however, the anticipated impacts under the Preferred Alternative would not be measurably different from those anticipated under the Proposed Action. Therefore, the impacts of the Preferred Alternative would be **minor to moderate** for water quality.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and connected action, would result in similar impacts as the Proposed Action: **minor to moderate**.

[1] 195 WTGs assumes that 197 total positions are available, and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

## 3.5 Biological Resources

### 3.5.1 Bats

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

#### 3.5.1.1 Description of the Affected Environment and Future Baseline Conditions

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

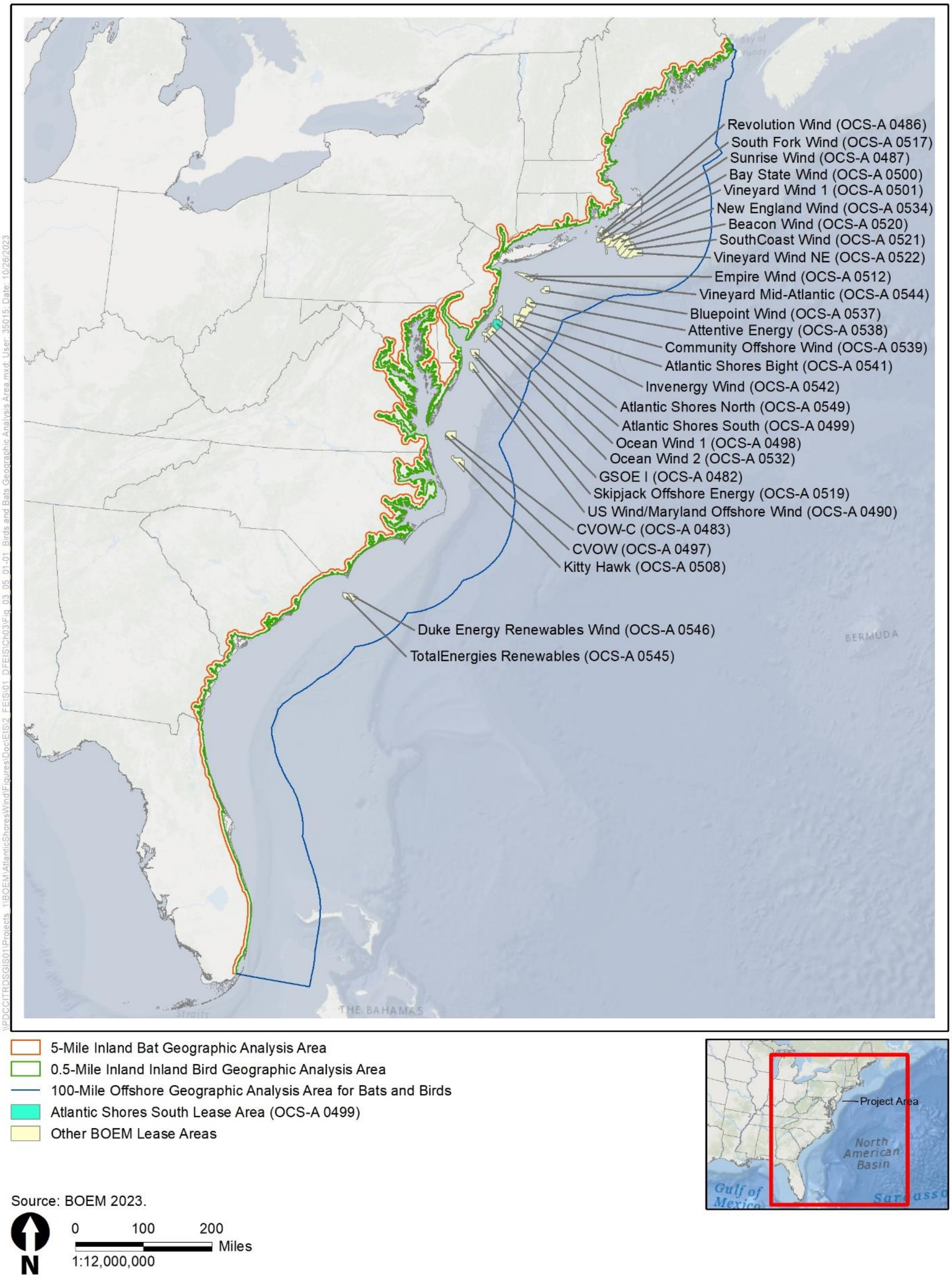


**Figure 3.5.1-1. Bats geographic analysis area**

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

| Common Name | Scientific Name | State Status [1] | Federal Status |
|---|---|---|---|
| **Cave-Hibernating Bats** | | | |
| Eastern small-footed bat | *Myotis leibii* | SC, PE[2] | -- |
| Little brown bat | *Myotis lucifugus* | PE[2] | Under Review[3] |
| Northern long-eared bat | *Myotis septentrionalis* | E[4] | E[4] |
| Indiana bat | *Myotis sodalis* | E | E |
| Tricolored bat | *Perimyotis subflavus* | PE[2] | PE[5] |
| Big brown bat | *Eptesicus fuscus* | PSC[2] | -- |
| **Migratory Tree Bats** | | | |
| Eastern red bat | *Lasiurus borealis* | PSC[2] | -- |
| Northern hoary bat | *Lasiurus cinereus* | PSC[2] | -- |
| Silver-haired bat | *Lasionycteris noctivagans* | PSC[2] | -- |

Source: CWFNJ 2008.
[1] All bats in Table 3.5.1-1 are classified as Species of Greatest Conservation Need (SGCN) in New Jersey.
[2] NJDEP has proposed to classify the eastern small-footed bat, little brown bat, and tricolored bat as endangered and anticipates a decision in 2024 (NJDEP 2013, 2023; Hall, pers. comm.).
[3] Currently under a USFWS discretionary status review. Results of the review may be to propose listing, make a species a candidate for listing, provide notice of a not warranted candidate assessment, or other action as appropriate. USFWS anticipates a decision in Fiscal Year 2024.
[4] USFWS elevated to endangered status, effective March 31, 2023, which gives the species automatic State Endangered species status.
[5] USFWS proposed to classify the tricolored bat as endangered on September 14, 2022, and a final determination is anticipated in Fiscal Year 2024.
E = Endangered; PE = Proposed Endangered; PSC = Proposed Special Concern; SC = Special Concern; SGCN = Species of Greatest Conservation Need; T = Threatened. All nine species are on NJDEP's list of Species of Greatest Conservation Need (NJDEP 2018).

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

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

Cave-hibernating bats overwinter in regional caves, mines, and other structures (e.g., buildings) and feed mostly on insects in terrestrial and freshwater habitats. These species generally display lower activity in the offshore environment than the migratory tree bats (Sjollema et al. 2014), with movements mainly during the fall months. The maximum distance *Myotis* bats were detected offshore in the mid-Atlantic was 7.2 miles (11.5 kilometers) (Sjollema et al. 2014). A recent nano-tracking investigation on Martha's Vineyard documented little brown bat movements off the island in late August and early September, with one individual traveling from Martha's Vineyard to Cape Cod (Dowling et al. 2017). Big brown bats were also recorded migrating from the island as late as October through November (Dowling et al. 2017). These findings are supported by an acoustic study conducted on islands and buoys off the Gulf of Maine that demonstrated the highest percentage of activity occurs during the months of July–October (Peterson et al. 2014). Offshore acoustic bat surveys were conducted in the Lease Area (OCS-A 0499) in 2020 and 2021 (Table 3.5.1-2). During these surveys, 26 big brown bats, 5 tricolored bats, and 3 bats belonging to *Myotis* spp. were detected. Due to insufficient information, which otherwise would allow for a species identification, 478 recordings were categorized into the big brown/silver bat group. Cave-hibernating bats were likely among those categorized in this group; however, based on the number of positively identified silver-haired bats (80) compared to the number of positively identified big brown bats (26), big brown bats likely only proportionally account for one-third (an estimated 157 recordings) of the recordings in this group. Given the use of coastlines as migratory routes by cave-hibernating bats is likely limited to their fall migration period, that acoustic studies indicate lower use of the offshore environment, and that cave-hibernating bats do not habitually feed on insects over the ocean, exposure to the proposed Project is likely low for cave-hibernating bats.

Tree bats migrate south to winter and have been recorded in the offshore environment (Hatch et al. 2013). Eastern red bats have been detected migrating from Martha's Vineyard in late fall, with one individual tracked as far south as Maryland. These outcomes are supported by past observations of eastern red bats offshore and recent acoustic and survey results (Hatch et al. 2013, Peterson et al. 2014, Sjollema et al. 2014, Normandeau 2022). During offshore acoustic bat surveys conducted in the Lease Area (OCS-A 0499) in 2020 and 2021 (Table 3.5.1-2), eastern red bat represented the most detections (495), followed by big brown/silver-haired bat group (478), silver-haired bat (80), northern hoary bat (37), big brown bat (26), tricolored bat (5), and *Myotis* spp. (3). As mentioned above, silver-haired bats likely accounted for the majority of detections in the big brown/silver-haired bat group observations. Detections occurred from July to October, with peak activity in August and September, and the latest detection occurring on November 1. These results suggest that tree bats, particularly eastern red and silver-haired bats, are more likely to pass through the Lease Area than cave-hibernating bats, and mostly during the fall migration period (late summer/early fall) (COP Volume II, Appendix II-F4; Atlantic Shores 2024). Overall, there were 1,124 total bat detections identified to species or species group across the 180 survey nights in the Lease Area. This averages to 6.2 bat detections per detector-night, which is a small fraction of bat passage rates typically found onshore during migration in eastern North America. For a nearby onshore comparison, Johnson et al. (2011) found bat activity along the coast of Maryland to average 25 passes per detector-night over the span of an entire year. During fall migration, the number of bat passes there commonly exceeded 500 per detector-night and peaked around 1,000 (Johnson et al. 2011), compared to an average of only 6.2 bat passes per night in the Lease Area during a similar time of year. As another comparison, a recent study farther inland, along Lake Erie, reported an average of 155 bat passes per detector-night during the fall migration period of 2020 (Haddaway and McGuire 2022). As such, while some individuals may take offshore routes during migration and can be present in the Lease Area, they appear to represent a very small percentage of their species' total population onshore.

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

| Species | Year | |
|---|---|---|
| | 2020 | 2021 |
| Northern hoary bat | 13 | 24 |
| Big brown bat | 17 | 9 |
| Silvered-hair bat | 26 | 54 |
| Big brown/Silver-haired bat | 163 | 315 |
| Eastern red bat | 148 | 347 |
| Evening bat | 0 | 0 |
| Tricolored bat | 3 | 2 |
| Little brown bat | 0 | 0 |
| Eastern small-footed bat | 0 | 0 |
| Indiana bat | 0 | 0 |
| Northern long-eared bat | 0 | 0 |
| *Myotis* species | 1 | 2 |
| **Total** | **371** | **753** |

Source: COP Volume II, Appendix F4, Table 3 (Atlantic Shores, 2024).
Note: Results show the number of files vetted for each category that were recorded in the study area.

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

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

There are acoustic records of northern long-eared bats in surrounding townships around the existing Cardiff and Larrabee substations and proposed new onshore substation and/or converter station sites (COP Volume II, Section 4.4.1.2; Atlantic Shores 2024). There are no known records of northern long-eared bat hibernacula, roost trees, or maternity colonies in Absecon, Pleasantville City, or Wall; however, records of roost trees, including maternity colonies, exist in Howell Township, but they are all within the grounds of the Earle Naval Weapon Station or farther north (COP Volume II, Section 4.4.1.2; Atlantic Shores 2024). 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 2024). The nearest maternity colony to Onshore Project structures associated with the Atlantic City Landfall to Cardiff POI route is approximately 2.88 miles (4.64 kilometers) from the Cardiff Onshore Interconnection Cable Route. The nearest maternity colonies to Onshore Project structures associated with the Monmouth Landfall to Larrabee POI route are approximately 6 miles (9.66 kilometers) from the Larrabee Onshore Interconnection Cable Route, approximately 8 miles (12.87 kilometers) from the existing Larrabee substation (POI), and approximately 7 miles (11.27 kilometers) from the three substation and/or converter station options. As such, northern long-eared bats are expected to be potentially present in wooded areas near the proposed Cardiff and Larrabee onshore substation and/or converter station sites. Occupancy modeling has suggested the occurrence of northern long-eared bats in coastal New Jersey and coastal areas of other mid-Atlantic and northeastern states is low relative to inland areas (USGS 2019). However, there is increasing recognition that northern long-eared bat occurrence in low-lying coastal areas may be much greater than previously expected and that coastal areas may be providing an important refuge from white-nose syndrome (WNS) because of their milder winter climate (e.g., Grider et al. 2016; Dowling and O'Dell 2018; Jordan 2020; Gorman et al. 2021). Because northern long-eared bats in coastal areas have been found to be overwintering there (Grider et al. 2016; Dowling and O'Dell 2018; Jordan 2020; Gorman et al. 2021), their potential to occur in the vicinity of the Cardiff and Larrabee onshore substation and/or converter station sites is year-round. Under the programmatic Biological Opinion that assists with Section 7 consultation for this ESA-listed species, the USFWS has determined that activities away from known roost trees and hibernacula are not likely to impact the species (USFWS 2018). Therefore, if the Project can avoid removing trees 0.5 mile (0.8 kilometer) from known hibernacula, or 150 feet (46 meters) around a known roost tree from June 1 to July 31, formal Section 7 consultation may be unnecessary (USFWS 2018). It should be noted, however, that USFWS elevated the listing of northern long-eared bat from threatened to endangered, effective March 31, 2023, and current regulations and mitigation requirements for the species may therefore be subject to change in the near future.

Northern long-eared bats are not likely to occur in the Offshore Project area given that none were detected there during acoustic surveys in 2020 and 2021 (COP Volume II, Appendix II-F4; Atlantic Shores 2024) and offshore records of northern long-eared bats elsewhere in the geographic analysis area are extremely rare (e.g., Dowling et al. 2017; Tetra Tech 2021,2022). For example, post-construction acoustic and video monitoring of bats at the CVOW pilot project from the spring of 2021 through winter of 2022 found no northern long-eared bats (or other *Myotis* species) among the 519 bats detected (Normandeau 2022). During acoustic surveys performed in support of the South Fork Wind Farm (SFWF), one northern long-eared bat call was detected at the southeastern edge of the SFWF and 33 calls were detected along the export cable route, which represents 3.8 percent of the 896 passes that were able to be identified to species level (Stantec 2018b).If northern long-eared bats were to migrate over water, movements would likely be close to the mainland. The related little brown bat has been documented to migrate from Martha's Vineyard to Cape Cod, and northern long-eared bats may likewise migrate to mainland hibernacula from these islands in August through September (Dowling et al. 2017). In addition, while in a different area, the Vineyard Wind 1 BA concluded that "it is extremely unlikely northern long-eared bats would traverse offshore portions" of that project (BOEM 2019). Additional, stationary acoustic detectors positioned on two WTGs within the operational BIWF in Rhode Island did not detect any northern long-eared bat calls over a 3-year period (Stantec 2020); similarly, acoustic detectors on WTGs in a CVOW-pilot off Virginia did not detect northern long-eared bat during a 1–year survey period (Tetra Tech 2021, Normandeau 2022). Given that there is little evidence of use of the offshore environment by northern long-eared bat, exposure to the offshore components of the Proposed Action is anticipated to be minimal. Consultation with USFWS pursuant to Section 7 of the ESA concluded with the issuance of a Biological Opinion from USFWS in December 2023 (USFWS 2023). In the Biological Opinion, USFWS concluded that the Proposed Action is not likely to adversely affect the northern long-eared bat and the tricolored bat.

Tricolored bat habitat is very similar to habitats used by the northern long-eared bat. The occurrence of tricolored bat in the vicinity of the Onshore Project area is predicted to be relatively low (USGS 2019). The USFWS' Species Status Assessment Report for the tricolored bat indicates that prior to WNS in 2000 there were several occupied hibernacula in northern New Jersey, with one estimated occupied hibernaculum in 2019 in New Jersey (USFWS 2021). More recent surveys during the winters of 2021–2022 and 2022–2023 in areas of historic tricolored bat presence found that five of eight surveyed hibernacula were occupied by tricolored bats (Hall, pers. comm.). None of the hibernacula are close to the Onshore Project area.

Although there were five detections of this species during offshore acoustic surveys conducted as part of the proposed Project in 2020 and 2021 (COP Volume II, Appendix II-F4; Atlantic Shores 2024), 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 bats in the nearshore portion of the New Jersey Coast, but none were identified as tricolored bat (Geo-Marine Inc. 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 BIWF, bats were monitored with acoustic detectors on boats; no tricolored bats were detected among the 1,546 bat passes (Stantec 2018a). Preliminary results of the first year of post-construction monitoring at BIWF indicated low numbers of tricolored bat calls (33 out of 1,086 calls) (Stantec 2018a). In addition, recent data from 3 years of post-construction monitoring around BIWF found relatively low numbers of bats present only during the fall (Stantec 2020); although 80 passes were labeled as tricolored bats, none had characteristics that were diagnostic of the species, and these were more likely to be eastern red bats (Stantec 2020). During acoustic surveys performed in support of the SFWF, 31 tricolored bat calls (of 896 total passes) were detected in the offshore project area (Stantec 2018b). Post-construction acoustic and video monitoring of bats at the Coastal Virginia Offshore Wind Pilot Project from the spring of 2021 through winter of 2022 similarly found no tricolored bats among the 519 bats detected (Normandeau 2022).

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

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

### 3.5.1.2 Impact Level Definitions for Bats

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

**Table 3.5.1-3. Impact level definitions for bats**

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

| | | |
|---|---|---|
| Major | Adverse | Impacts would result in severe, long-term habitat or population-level effects on species. |

### 3.5.1.3 Impacts of Alternative A – No Action on Bats

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

#### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for bats described in Section 3.5.1.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends, and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on bats are generally associated with onshore construction and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bat species through temporary and permanent habitat removal and temporary noise impacts, which could cause avoidance behavior and displacement. Mortality of individual bats could occur, but population-level effects would not be anticipated. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on bats (based on the scenario shown in Appendix D) include:

- Continued O&M of the BIWF (five WTGs) installed in Massachusetts state waters;
- Continued O&M of the CVOW pilot project (two WTGs) installed in OCS-A 0497 approximately 27 miles (44 kilometers) off the coast of Virginia Beach, Virginia; and
- Ongoing construction of six offshore wind projects: the Vineyard Wind 1 Project (62 WTGs and 1 OSS) in OCS-A 0501 approximately 14 miles (23 kilometers) offshore of Nantucket, Massachusetts, and approximately 14 miles (23 kilometers) offshore Martha's Vineyard, Massachusetts; the SFWF Project (12 WTGs and 1 OSS) in OCS-A 0517 approximately 19 miles (31 kilometers) southeast of Block Island, Rhode Island, and 35 miles east of Montauk Point, New York; the Ocean Wind 1 Project (98 WTGs and 3 OSSs) in OCS-A 0498 approximately 15 miles (24 kilometers) southeast of Atlantic City, New Jersey; the Revolution Wind Project (65 WTGs and 2 OSSs) in OCS-A 0486 approximately 18 miles (29 kilometers) southeast of Point Judith, Rhode Island and approximately 15 miles (24 kilometers) east of Block Island, Rhode Island; the Empire Wind Project (147 WTGs and 2 OSSs) in

OCS-A 512 approximately 14 miles (23 kilometers) south of Long Island, New York and 19.5 miles (31 kilometers) east of Long Branch, New Jersey; and the CVOW Commercial (CVOW-C) Project (202 WTGs and 3 OSSs) in OCS-A 0483 approximately 27 miles (44 kilometers) east of Virginia Beach, Virginia.

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

The northern long-eared bat and tricolored bat are the only ESA-listed or proposed threatened or endangered bat species that may occur within the proposed Project area. Planned onshore and offshore activities without the Proposed Action are not expected to significantly impact populations of the northern long-eared bat or tricolored bat. WNS remains the primary threat to these species, and summer habitat availability is not considered to be a factor regulating the species' population sizes (USFWS 2015, 2021). As such, coastal development and other onshore activities without the Proposed Action would not be expected to impact northern long-eared bat or tricolored bat populations. Future offshore wind development without the Proposed Action also would not be expected to impact northern long-eared bat or tricolored bat populations because offshore records of these species are rare and exposure to WTGs would be minimal (Dowling et al. 2017; BOEM 2019; Tetra Tech 2021, 2022,; Normandeau 2022; COP Volume II, Appendix II-F4; Atlantic Shores 2024).

### *Cumulative Impacts of Alternative A – No Action*

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

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

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

In addition to the eight ongoing offshore wind projects, 27 additional offshore wind projects are planned to be constructed in the geographic analysis area for bats. These 27 planned projects, along with the ongoing offshore wind projects, would result in an additional 2,940 WTGs and 41 OSSs/ESPs in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). The impacts of planned offshore wind projects are discussed in this section.

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

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

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

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

The 2,940 offshore WTGs and up to 41 OSSs or ESPs from ongoing and planned offshore wind projects would create noise and may temporarily affect some migrating tree bats, if conducted at night during spring or fall migration. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 7 to 9 hours per monopile and 2 monopiles per day, and 3 to 4 hours per pin pile and up to 4 pin piles per day over an 8-year period. Construction activity would be temporary and highly localized. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to temporary threshold shifts (TTS) than other terrestrial mammals (Simmons et al. 2016). Habitat-related impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior by individual migrating tree bats (Schaub et al. 2008). These impacts would likely be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). However, these impacts are highly unlikely to occur, as little use of the OCS is expected, and only during spring and fall migration.

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

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

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

**Presence of structures:** Ongoing and planned offshore wind-related activities would add up to 2,940 WTGs and up to 41 OSSs on the OCS (Appendix D, Tables D.A2-1 and D.A2-2), and the presence of these structures could result in potential long-term effects on bats. Cave bats (including the federally endangered northern long-eared bat and proposed endangered tricolored bat) do not tend to fly offshore (even during fall migration), and, therefore, exposure to construction vessels during construction or maintenance activities, or the RSZ of operating WTGs in the offshore wind lease areas, is expected to be negligible, if exposure occurs at all (BOEM 2015; Pelletier et al. 2013).

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

At onshore wind farms, bats have sometimes been observed to be attracted to WTGs, and several authors (e.g., Cryan and Barclay 2009, Cryan et al. 2014, and Kunz et al. 2007) have proposed hypotheses of why this may occur. Many, including the creation of linear corridors, altered habitat conditions, or thermal inversions, do not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009;

Cryan et al. 2014; Kunz et al. 2007). Other hypotheses regarding bat attraction to WTGs include bats perceiving the WTGs as potential roosts, potentially increased prey base, visual attraction, disorientation due to EMFs or decompression, or attraction due to mating strategies (Arnett et al. 2008; Cryan 2007; Kunz et al. 2007). However, no definitive answer as to why, if at all, bats are attracted to WTGs has been postulated, despite intensive studies at onshore wind facilities. As such, it is possible that some bats may encounter, or perhaps be attracted to, OSSs and non-operational WTG towers to opportunistically roost or forage. However, bats' echolocation abilities and agility make it unlikely that these stationary objects (OSSs and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the bases of onshore turbine towers (Choi et al. 2020).

Tree bat species that may encounter the operating WTGs in the offshore wind lease areas include the eastern red bat, northern hoary bat, and silver-haired bat. Offshore O&M would present a seasonal risk factor to migratory tree bats that may utilize the offshore habitats during fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during fall migration, the overall occurrence of bats on the OCS is very low (Stantec 2016). Acoustic surveys in the Lease Area found bat activity there to average only a small fraction of that which occurs onshore. Furthermore, unlike with terrestrial migration routes, there are no landscape features that would concentrate bats and thereby increase exposure to the offshore wind lease areas. Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would be expected to encounter operating WTGs or other structures associated with future offshore wind development. With the proposed up to 1-nautical-mile (1.9-kilometer) spacing between structures associated with future offshore wind development and the distribution of anticipated projects, individual bats migrating over the OCS within the RSZ of WTGs would likely pass through with only slight course corrections, if any, to avoid operating WTGs because, unlike with terrestrial migration routes, there are no landscape features that would concentrate migrating tree bats and increase exposure to offshore wind lease areas on the OCS (Baerwald and Barclay 2009; Cryan and Barclay 2009; Fiedler 2004; Hamilton 2012; Smith and McWilliams 2016 As seen with some birds (Masden et al. 2012, Peschko et al. 2021), it is reasonable to expect that wide spacing between WTG rows would provide bats ample space to fly through wind farms while staying far away from the nearest WTG. Additionally, the potential collision risk to migrating tree bats varies with climatic conditions; for example, bat activity both onshore and offshore is known to be associated with relatively low wind speeds and warm temperatures (COP Volume II, Appendix II-F4; Atlantic Shores 2024; Arnett et al. 2008; Brabant et al. 2021; Cryan and Brown 2007; Fiedler 2004; Kerns et al. 2005; Sjollema et al. 2014; Normandeau 2022). Post-construction acoustic and video monitoring of bats at the Coastal Virginia Offshore Wind Pilot Project from the spring of 2021 through winter of 2022 found bat activity to decline with increasing wind speed and no video evidence of collisions with the WTGs (Normandeau 2022). Given the relatively low numbers of tree bats in the offshore environment, the likelihood of collisions is expected to be low; therefore, impacts on bats would be expected to be negligible. Additionally, the likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bats onshore and offshore have been shown to suppress activity during periods of strong winds, low temperatures, and rain (COP Volume II, Appendix

II-F4; Atlantic Shores 2024; Arnett et al. 2008; Brabant et al. 2021; Erickson et al. 2002; Sjollema et al. 2014; Normandeau 2022).

### *Conclusions*

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

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

## 3.5.1.4 Relevant Design Parameters and Potential Variances in Impacts

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

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

- The time of year during which construction occurs.

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

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

#### 3.5.1.5 Impacts of Alternative B – Proposed Action on Bats

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

*Onshore Activities and Facilities*

**Land disturbance:** Land disturbance impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities took place during the active season of bats (generally April through October), and may result in injury or mortality of individuals, particularly juveniles who are unable to flush from a roost, if occupied by bats at the time of removal. The primary potential effect on bats from the Onshore Project components is localized and involves minor habitat modification. The majority of the proposed onshore export and interconnection cable routes are in disturbed areas (e.g., roadways) where there is no vegetated habitat suitable for bats, and anthropogenic sources of noise already exist (GEO-12, Appendix G, *Mitigation and Monitoring,* Table G-1). Tree clearing and other land disturbance for two of the proposed substations and/or converter stations would occur in an urbanized, fragmented landscape, have a small footprint, and would not eliminate high-quality roosting or foraging habitat for bats. This long-term but negligible effect on bat habitat would occur for the duration of the Project's operational lifetime. Approximately 18 acres (7.3 hectares) of permanent tree clearing could occur at the Fire Road Onshore Substation/Converter Station site. No more than 14 acres (5.7 hectares) of permanent tree clearing could occur at either the Lanes Pond Road Substation/Converter Station site or the Randolph Road Substation/Converter Station site. Tree clearing at the potential Brook Road parcel would be performed by the SAA-awardee (or the designated lead state or federal agency, as appropriate) as part of the development under the SAA and is thereby not included as part of the Proposed Action. Because tree clearing would be anticipated to occur during the winter period when bats are not active and present in the area (BAT-08, Appendix G, Table G-1), there would be no potential for direct impacts on bats that could result from the removal of an active roost tree. Other minimization measures include siting Onshore Project components in disturbed areas as much as practicable and minimizing tree clearing (BAT-07, Appendix G, Table G-1). With these measures in place and given the small area of marginal-quality bat habitat that would be affected, the fragmented and disturbed conditions in the surrounding landscape, and existing sources of anthropogenic activity in the area, BOEM anticipates that disturbance to bats from construction and installation of the Onshore Project facilities would not result in individual fitness or population-level effects.

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

**Noise:** Noise associated with the construction, O&M, and decommissioning of onshore elements of the Proposed Action is expected to result in short-term and highly localized impacts. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). Additionally, Atlantic Shores would implement reasonable efforts to minimize onshore construction noise (BAT-11, Appendix G, Table G-1). Noise from O&M operations at onshore facilities is not anticipated to have any adverse impacts on bats.

**Presence of structures:** There are no anticipated impacts associated with bats interacting with onshore structures such as substations during construction, O&M, and decommissioning. Atlantic Shores will employ the following applicant-proposed measures to further minimize disturbances to bats related to onshore structures: minimization of night-time activities (BAT-12, Appendix G, Table G-1), the use of down-shielding and down-lighting on onshore structures to the maximum extent practicable (BAT-04, Appendix G, Table G-1), the limiting of light during onshore O&M to the minimum required by regulation and for safety (BAT-02, Appendix G, Table G-1) and ensuring that onshore construction lighting is temporary and localized to the work area (BAT-09, Appendix G, Table G-1). In addition, the communication antennae at the O&M facility would be designed in accordance with USFWS guidelines, to the extent practicable, including lighting and support system characteristics (BAT-14, Appendix G, Table G-1). These measures would minimize the potential for any light-driven attraction of bats or their insect prey and therefore reduce the effects of light on potential collisions of bats at night.

### *Offshore Activities and Facilities*

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

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

**Presence of structures:** The various types of impacts on bats that could result from the presence of structures during the life of the Proposed Action, such as migration disturbance and turbine strikes, are described in detail under Section 3.5.1.3, *Impacts of Alternative A – No Action on Bats*. The up-to 200 WTG structures, along with one permanent met tower and up to 10 OSSs, associated with the Proposed Action would remain at least until decommissioning of the Project is complete. While the up to 200 WTGs would be aligned in a uniform grid with rows in an east-northeast to west-southwest direction spaced 1.0 nautical mile (1.9 kilometers) apart and rows in an approximately north to south direction spaced 0.6 nautical mile (1.1 kilometers) apart, the OSSs and met tower would be sited in off-grid positions within the Lease Area. These structures associated with the Proposed Action could pose long-term effects on bats. At this time, there is some uncertainty regarding the level of bat use of the OCS and the consequences to bats, if any, from operating offshore WTGs and associated offshore structures on the OCS. Migratory tree bats have the potential to pass through the Lease Area, but in low numbers because of its distance from shore (BOEM 2014). While there is evidence of bats visiting WTGs and other associated offshore wind structures close to shore (2.5 to 4.3 miles [4 to 7 kilometers]) in the Baltic Sea (enclosed by land) (Ahlén et al. 2009; Rydell and Wickman 2015), the individual bats would be expected to enter the Lease Area in low numbers during late summer/fall migration. As discussed above, acoustic surveys in the Lease Area found bat activity levels to be only a small fraction of those typically found onshore. In addition, recent data from 3 years of post-construction monitoring around BIWF found relatively low numbers of bats and only during the fall, and none of the bats were the ESA-listed northern long-eared bat (Stantec 2020). Atlantic Shores would implement measures to avoid and minimize bat impacts, including implementing a monitoring program (COP Volume II, Section 4.4.2.5; Atlantic Shores 2024; BAT-13, Appendix G, Table G-1) and reporting dead and injured bats to NJDEP and USFWS to further understand the long-term effects of structures. Additional measures include the use of red flashing FAA lights and yellow flashing marine navigation lights on WTGs rather than constant white lights to reduce eastern red bat fatality rates (BAT-03, Appendix G, Table G-1), the use of an ADLS system to reduce the number of hours that FAA lighting would be illuminated (BAT-03, Appendix G, Table G-1), limiting lighting during offshore O&M activities to minimize the potential for any light-driven attraction of bats and their insect prey (BAT-02, Appendix G, Table G-1), and the use of down-shielding and down-lighting (BAT-04, Appendix G, Table G-1) to the maximum extent practicable. Therefore, population-level impacts are unlikely given the small numbers of bats offshore relative to onshore and the measures that would be implemented to avoid and minimize bat impacts.

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

As discussed in Section 3.5.1.1, northern long-eared bats and tricolored bats are not likely to occur in the Offshore Project area given that, respectively, zero and five were detected there during acoustic surveys in 2020 and 2021 (COP Appendix II-F4; Atlantic Shores 2024) and offshore records of these species elsewhere in the geographic analysis area are rare (e.g., Dowling et al. 2017;, Tetra Tech 2021, 2022; Normandeau 2022). If northern long-eared bats or tricolored bats were to migrate over water, movements would likely be in proximity to the mainland. Northern long-eared bats have the potential to occur in the vicinity of the Onshore Project facilities, but there are no known hibernacula nearby and tree removal during construction would be limited to periods outside of the species' active season to avoid potential for direct impacts that could result from the removal of an active roost tree. BOEM prepared a BA for the potential effects on USFWS federally listed species, which concluded that the Proposed Action *may affect, but is not likely to adversely affect* ESA-listed bat species (BOEM 2023). There is no critical habitat designated for this species. Consultation with USFWS pursuant to Section 7 of the ESA concluded with the issuance of a Biological Opinion from USFWS in December 2023 (USFWS 2023). In the Biological Opinion, USFWS concluded that the Proposed Action is not likely to adversely affect the northern long-eared bat and the tricolored bat.

### *Impacts of the Connected Action*

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

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

Impacts, if any, are expected to be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

#### *Cumulative Impacts of Alternative B – Proposed Action*

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities related to submarine cables and pipelines, oil and gas activities, marine minerals extraction, onshore development, and port expansions would contribute to impacts on bats through the primary IPFs of noise, presence of structures, and land disturbance. Construction related to the connected action would generate temporary and localized noise impacts on bats. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of noise, presence of structures, and land disturbance. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration and given that cave bats do not typically occur on the OCS, offshore wind activities would not appreciably contribute to impacts on bats. Temporary disturbance and permanent loss of onshore habitat may occur as a result of constructing onshore infrastructure such as onshore substations and onshore export cables for offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. Ongoing and planned offshore wind activities in combination with the Proposed Action would result in an estimated 3,140 WTGs (Appendix D, Table D.A2-1), of which the Proposed Action would contribute 200, or about 6.3 percent.

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

#### *Conclusions*

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

**Cumulative Impacts of Alternative B - Proposed Action.** The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action at the Inlet Marina in Atlantic City, New Jersey. The contribution of the Proposed Action to the cumulative impacts of individual IPFs resulting from ongoing and planned activities would be expected to be negligible. The primary IPFs are noise, presence of structures, and land disturbance. Considering all the IPFs together, due to limited anticipated bat presence on the OCS and minimal expected onshore bat habitat impacts, BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Proposed Action, would result in **negligible** impacts on bats in the geographic analysis area because any impacts on bats would be too small to be measurable.

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

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

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

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

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

##### *Conclusions*

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

**Cumulative Impacts of Alternatives C, D, E, and F.** The incremental impacts contributed by Alternative C, D, E, or F to the cumulative impacts on bats would be undetectable. Because the impacts of the Proposed Action would not change under Alternatives C, D, E, and F, BOEM anticipates that the cumulative impacts of Alternatives C, D, E, and F would be the same as described for the Proposed Action: **negligible** due to limited anticipated bat presence on the OCS and minimal expected onshore bat habitat impacts, and because any impacts on bats would be too small to be measurable.

### 3.5.1.7 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Tables G-2 through G-4 and summarized and assessed in Table 3.5.1-4. If one or more of the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts on bats could be further reduced.

**Table 3.5.1-4. Proposed mitigation measures – bats**

| Mitigation Measure | Description | Effect |
| --- | --- | --- |
| Tree clearing restrictions | Because many wildlife species overwinter in cavities and nests, any mature trees slated for removal should be checked (including for vacant raptor nests) and avoided if possible. If the tree must be taken down, the Lessee will coordinate with USFWS and clearing would occur between October 1 and March 31. Mature trees are defined as live trees and/or snags ≥3 inches diameter at breast height (dbh). | While this mitigation measure would reduce impacts on roosting bats located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Bird and Bat Monitoring Plan (BBMP) | A BBMP will be implemented that will include monitoring, annual monitoring reports, post-construction quarterly progress reports, monitoring plan revisions, operational reporting, and raw data sharing. | The monitoring plan will determine if revisions are needed, including technical refinements and/or additional monitoring in order to reduce impacts incurred on bird and bat resources. |
| Light impact reduction | The Lessee must use lighting technology that minimizes impacts on avian species to the extent practicable including lighting designed to minimize upward illumination and will use an FAA-approved vendor for the ADLS, which will | While this mitigation measure would reduce Project-related offshore illumination in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs due to the already low presence of bats in the offshore Project area. |

| Mitigation Measure | Description | Effect |
|---|---|---|
| | activate the FAA hazard lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night. The Lessee must provide USFWS with a courtesy copy of the final Lighting, Marking, and Signaling Plan, and the Lessee's approved application to USCG to establish Private Aids to Navigation and will confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the FDR. | |
| Pre-construction surveys | The Lessee will conduct pre-construction surveys for ESA-listed bats and implement avoidance and minimization measures in coordination with USFWS and NJDEP. | The pre-construction surveys would determine the presence of bats in the onshore and offshore Project areas and aid in avoiding and minimizing impacts on bats. |
| Replanting Plan | The Lessee must develop and implement a replanting plan in areas of temporary deforestation. The replanting plan must include the identification of specific tree species and densities, timing of planting, protection of saplings from herbivory, monitoring, and invasive species control in order to provide high-quality bat habitat and must be provided to USFWS for approval prior to commencing onshore construction activities. | While this mitigation measure would reduce impacts on bats located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Structure demolition | The Lessee must contact USFWS to assess the potential risk to ESA-listed bat species should any onshore structures require demolition during the O&M or decommissioning phase. If USFWS determines that adverse effects exist, the Lessee must coordinate with USFWS to develop appropriate mitigation measures that the Lessee is required to implement to avoid adverse effects on listed bat species. | While this mitigation measure would reduce impacts on roosting bats located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Bat mortality reporting | Any occurrence of a dead or injured 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 72 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state. The Lessee must provide an annual report to BOEM, BSEE, and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and | This mitigation would help inform future collision and impact estimates for bats; however, it would not reduce the impact rating for any of the Proposed Action's IPFs. |

| Mitigation Measure | Description | Effect |
|---|---|---|
| | decommissioning. Carcasses with federal or research bands must be reported to the USGS Bird Band Laboratory. | |

### *Measures Incorporated in the Preferred Alternative*

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.5.1-4 and Tables G-2 through G-4 in Appendix G are incorporated in the Preferred Alternative. These measures would further define how the effectiveness and enforcement of EPMs would be ensured and improve accountability for compliance with EPMs by requiring monitoring, reporting, and adaptive management of potential bat impacts on the OCS. However, given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, offshore wind activities are unlikely to appreciably contribute to impacts on bats regardless of measures intended to address potential offshore bat impacts. In the onshore environment, tree clearing restrictions and post-construction monitoring and reporting would ensure impacts on bats and their habitats would be avoided and minimized to the extent practicable. Because these measures ensure the effectiveness of and compliance with EPMs that are already analyzed as part of the Proposed Action, these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.1.5.

### 3.5.1.8 Comparison of Alternatives

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

### 3.5.1.9 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500 meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical miles (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative would include up to 195[1] WTGs, representing a decrease of 5 WTGs as compared to the Proposed Action. Impacts associated with WTG installation, O&M, and decommissioning, including pile driving and vessel noise and the presence of offshore structures, would be reduced by approximately 3 percent, decreasing the overall impacts on bats in the Lease Area. In addition to fewer WTGs, the Preferred Alternative would result in uniform grid spacing of offshore structures, and this potential for wider and uniform space between offshore structures may allow greater opportunity for migrating tree bats (if present) to avoid WTGs, OSSs, and the met tower. Changes to WTG hub height and the micrositing of WTGs and interarray cables within AOC 1 and AOC 2 under the Preferred Alternative would not materially change the analyses of any IPF as compared to the Proposed Action.

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

Due to limited anticipated bat presence on the OCS and minimal expected onshore bat habitat impacts, BOEM anticipates cumulative impacts of the Preferred Alternative would likely be **negligible** because any impacts on bats would be too small to be measurable.

[1] 195 WTGs assumes that 197 total positions are available, and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

### 3.5.2 Benthic Resources

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

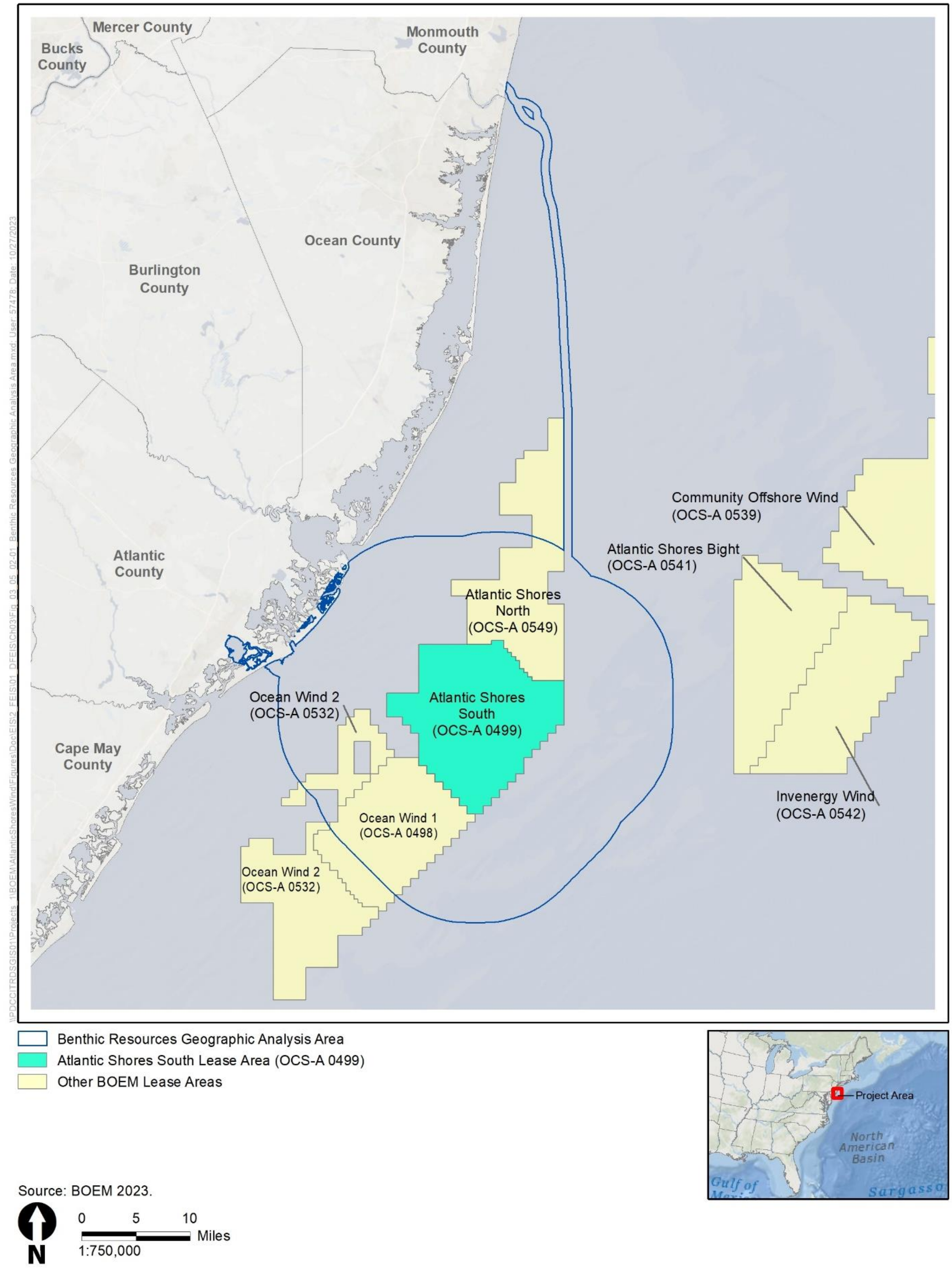


**Figure 3.5.2-1. Benthic resources geographic analysis area**

### 3.5.2.1 Description of the Affected Environment and Future Baseline Conditions

*Regional Setting*

The geographic analysis area for benthic resources includes the WTA plus a 10-mile (16.1-kilometer) buffer area and a 330-foot-wide (100-meter-wide) buffer around the ECCs. The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. Although sediment transport beyond 10 miles (16.1 kilometers) is possible, sediment transport related to proposed Project activities would likely be on a smaller spatial scale than 10 miles (16.1 kilometers). Detailed baseline descriptions of the affected environment within the Project area are provided in COP Volume II, Appendix II-G and Section 4.5 (Atlantic Shores 2024) and summarized in this section.

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

Within the Mid-Atlantic Bight, the WTA is located in a smaller sub-region referred to as the New York Bight (Guida et al. 2017; Grothues et al. 2021), with the export cable routes extending from the WTA to coastal and back-bay areas. The WTA is relatively flat and composed mainly of soft sediments, with low-degree seaward slopes and depth contours generally paralleling the shoreline. Predominant bottom features include a series of ridges and troughs that are closely oriented in a northeast-southwest direction, although side slopes are typically less than 1 degree (Guida et al. 2017). Troughs are characterized by finer sediments and higher organic matter, while ridges are characterized by relatively coarser sediments. Differences in benthic invertebrate assemblages, likely driven by differences in sediment characteristics, have been observed that include increased diversity and biomass within troughs (Rutecki at al. 2014). This may subsequently influence distribution of fish and shellfish. Ridge and trough habitat features are common in the mid-Atlantic OCS and are not unique to the Project area. Surface sediments of the New York/New Jersey shelf region are dominated by medium to coarse sands, with sediment grain sizes generally diminishing with distance from shore (Williams et al. 2006). As indicated by side scan sonar, the seabed across the WTA and ECCs is largely level and consistent, with sand bedforms of varying sizes and swales (COP Volume II, Section 2.1.1.2.2; Atlantic Shores 2024). According to regional surficial sediment mapping, surface sediments are predominantly sandy to the south across the Lease Area, with increased gravel and gravelly deposits present in the north and western parts (MARCO 2020). Hard, structured, elevated relief (i.e., reef habitat) is scattered among the relatively flat, sandy, shelf seafloor of the Mid-Atlantic Bight and Southern New England but is scarce (Steimle and Zetlin 2000).

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

An important oceanographic feature of the Mid-Atlantic Bight is the cold pool, a large area of cold-bottom (generally less than 50°F [10°C]) water resulting from strong seasonal stratification that extends from Cape Hatteras to Georges Bank (Houghton et al. 1982; Miles et al. 2021). The presence of these colder waters allows boreal fauna to extend their range farther south along the Atlantic coast, and the seasonal development, presence, and breakdown of the Cold Pool plays an important role in structuring the ecosystems of the Mid-Atlantic Bight. Productivity in the area is high, and the cold pool supports many ecologically, commercially, and recreationally important fish and invertebrate species. Changes to the timing of the development and breakdown of the cold pool, its seasonal duration, and areal extent could affect the behavior and reproduction of these species (Miles et al. 2021). The cold pool has been described by Chen et al. (2018) and Lentz (2017), but its year-to-year dynamics are yet to be fully understood. Additionally, predicted warming sea temperatures in the geographic analysis area add to long-term uncertainty associated with the dynamics and presence of the mid-Atlantic cold pool (Miles et al. 2021).

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

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

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

### *Offshore Project Area*

The Project area is in the southern New England ecoregion, with its southern border close to the Mid-Atlantic Bight ecoregion. There is considerable overlap among the dominant species in the two ecoregions, with dominant species from both ecoregions either resident in, or transient through, the Project area. Descriptions of benthic resources in the Project area are based on site-specific high resolution geophysical (HRG), geophysical, and benthic surveys conducted by Atlantic Shores in 2019,2020, and 2022 within the Project area including side-scan sonar, backscatter, and bathymetry surveys, benthic grabs and drop-down video (COP Volume II, Appendix II-G1 and Appendix II-G2; Atlantic Shores 2024), sediment profile and plan view surveys conducted in 2020 and 2022 (COP Volume II, Appendix II-G4; Atlantic Shores 2024), and towed video surveys conducted in 2021 (COP Volume II, Appendix II-G3; Atlantic Shores 2024).

Sediment grab samples taken during 2019,2020, and 2022 surveys in the Lease Area and ECCs indicated predominately medium-grained sands (0.01–0.02 inch [0.25–0.5 millimeter]), with grain sizes ranging from very fine (0.002– 0.005 inch [0.06– 0.125 millimeter]) to very coarse sands (0.04–0.08 inch [1.0–2.0 millimeters]). Medium-grained sands are predominant in the WTA, with some gravelly sands along the northern and western portions (Table 3.5.2-1, Figure 3.5.2-2). Gravelly sands are predominant along the Monmouth ECC, and fine/very fine sands and medium sands to gravelly sands are predominant along the Atlantic ECC (Table 3.5.2-2, Figure 3.5.2-2). Of the 57 sediment grab samples taken in the WTA, only 8 had gravel proportions greater than or equal to 5 percent, and no samples had a gravel content greater than or equal to 30 percent. Of the 37 sediment grab samples taken along the Monmouth ECC, only 4 samples had a gravel proportion that was greater than or equal to 30 percent. None of the 10 sediment grab samples taken along the Atlantic ECC had gravel proportions greater than or equal to 30 percent, and only 1 sample had a gravel proportion equal to or greater than 5 percent. Towed video surveys conducted in 2021 confirmed that the dominant Coastal and Marine Ecological Classification Standard (CMECS) Sediment Group within the WTA and ECCs was Sand/Mud, with some sampling stations in the Monmouth ECC having higher percentages of gravelly sand (COP Volume II, Appendix II-G3, Figures 4-7 and 4-17; Atlantic Shores 2024; note that Appendix II-G3 also includes the results from sampling conducted in the Atlantic Shores North WTA [OCS-A 0549]). Sediments with greater than 5 percent and less than 80 percent gravel are considered coarse sediments as per the CMECS and as complex habitat under NMFS EFH recommendations. Heterogeneous complex habitats are defined as transitional areas between soft and complex sediments, and as areas where surficial sand coverage and benthic features intersect. Soft sediments compose 60,224 acres (24,372 hectares), 7,936 acres (3,212 hectares), and 4,800 acres (1,943 hectares) of the WTA, Monmouth ECC, and Atlantic ECC, respectively. Heterogeneous complex habitats compose 9,024 acres (3,652 hectares) within the WTA, less than 64 acres (less than 26 hectares) within the Monmouth ECC, and 64 acres (25 hectares) within the Atlantic ECC. Within the WTA, 17,472 acres (7,071 hectares) are classified as complex habitat. The Monmouth ECC and Atlantic ECC contain 17,536 acres (7,097 hectares) and 448 acres (181 hectares) of complex habitat, respectively (COP Volume II, Appendix II-J2, Table 3; Atlantic Shores 2024). Other complex hard bottom habitat in the Project area is provided by multiple shipwrecks that are located in and along its borders, and three artificial reefs (the Atlantic City reef located near the southwest corner of the WTA, and the Manasquan Inlet and Axel Carlson reefs located along the outer borders of the Monmouth ECC) (COP Volume II, Appendix II-G2; Atlantic Shores 2024).

Although most of the Offshore Project area is considered to be flat, smaller soft-bottom topographic features such as sand waves, ripples, mega ripples, depressional areas, sand bedforms, textured seafloor, and sand ridges are present in the WTA and ECCs (Steimle and Zetlin 2000; Stevenson et al. 2004; COP Volume II, Atlantic Shores 2024). Two NMFS Areas of Concern (AOCs) are located within the WTA. The “Lobster Hole” designated recreational fishing area (AOC 1) is a broad swale/depression that extends roughly from the middle of the eastern edge of the WTA towards its center. AOC 2 is part of a larger sand ridge and trough complex and is located at the southern tip of the WTA. Both NMFS AOCs have pronounced bottom features and produce habitat value. Swale, trough, and ridge habitats provide complex physical structures, which are often associated with greater species diversity, abundance, overall function, and productivity. In the mid-Atlantic, sand ridges and troughs are areas of biological significance for migration and spawning of mid-Atlantic fish species, many of which are recreationally targeted in those specific areas.

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

| Sample Location | NMFS CMECS Substrate Category | Sample Location | NMFS CMECS Substrate Category | Sample Location | NMFS CMECS Substrate Category |
|---|---|---|---|---|---|
| OCS-20-071 | Medium Sand | OCS-20-101 | Medium Sand | OCS-20-160 | Medium Sand |
| OCS-20-073 | Medium Sand | OCS-20-103 | Medium Sand | OCS-20-161 | Medium Sand |
| OCS-20-077 | Medium Sand | OCS-20-105 | Gravelly Sand | OCS-20-163 | Fine/Very Fine Sand |
| OCS-20-079 | Medium Sand | OCS-20-107 | Medium Sand | OCS-20-165 | Medium Sand |
| OCS-20-081 | Medium Sand | OCS-20-109 | Medium Sand | OCS-20-167 | Medium Sand |
| OCS-20-083 | Gravelly Sand | OCS-20-136 | Medium Sand | OCS-20-169 | Gravelly Sand |
| OCS-20-085 | Medium Sand | OCS-20-137 | Gravelly Sand | OCS-20-171 | Medium Sand |
| OCS-20-086 | Very Coarse/ Coarse Sand | OCS-20-139 | Gravelly Sand | OCS-20-172 | Muddy Sand |
| OCS-20-087 | Medium Sand | OCS-20-145 | Gravelly Sand | OCS-20-173 | Medium Sand |
| OCS-20-089 | Medium Sand | OCS-20-147 | Medium Sand | OCS-20-175 | Medium Sand |
| OCS-20-091 | Medium Sand | OCS-20-148 | Medium Sand | OCS-20-177 | Medium Sand |
| OCS-20-092 | Medium Sand | OCS-20-153 | Medium Sand | OCS-20-179 | Medium Sand |
| OCS-20-093 | Medium Sand | OCS-20-155 | Gravelly Sand | OCS-20-180 | Medium Sand |
| OCS-20-095 | Medium Sand | OCS-20-157 | Medium Sand | OCS-20-181 | Fine/Very Fine Sand |
| OCS-20-097 | Gravelly Muddy Sand | OCS-20-159 | Medium Sand | OCS-20-500 | Gravelly Sand |
| OCS-20-099 | Medium Sand | | | | |

Source: COP Volume II, Appendix A to Appendix G-2, Table A-1; Atlantic Shores 2024.

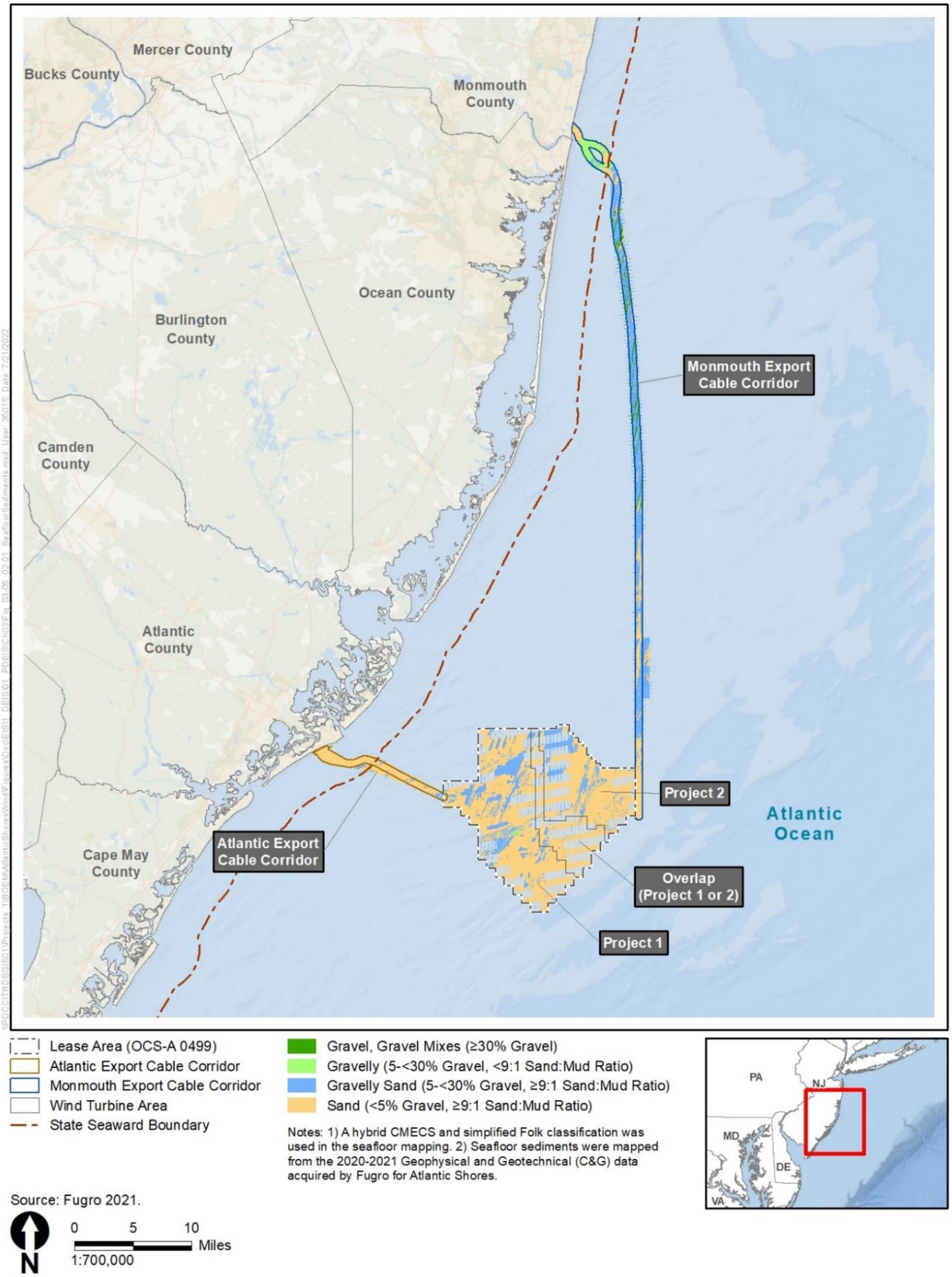


**Figure 3.5.2-2. Seafloor sediments in the Offshore Project area**

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

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

Source: COP Volume II, Appendix A to Appendix G-2; Table A-1; Atlantic Shores 2024.

Data obtained from video surveys conducted from 2003 to 2012 by the University of Dartmouth School of Marine Sciences and Technology and mapped by the Northeast Regional Ocean Council showed low to moderate average presence of bryozoans, hydrozoans, and sponges, and moderate to high average presence of sand dollars in the WTA and Monmouth ECC (NROC 2009; SMAST 2016). Moon snails, hermit crabs, and sea stars had low abundance in the WTA and Monmouth ECC (NROC 2009). These datasets did not include data from the Atlantic ECC. Site-specific benthic grab surveys were conducted by Atlantic Shores in 2019 and 2020 throughout the WTA and ECCs, and the survey data were used to analyze species diversity, richness, and evenness across the WTA, Atlantic ECC, and Monmouth ECC. Overall, the site-specific benthic surveys showed that nematodes and arthropods were the most common organisms collected and were present in the highest densities across the survey area compared to other collected phyla in 2019 and 2020, although nematodes were present in lesser quantities during the 2019 surveys. Nematodes were excluded from the analysis of the 2022 samples because, as meiofanua, they are not included in recent BOEM (2019) and NMFS (2021a) guidance for benthic community assessments. In 2022, annelids were the most common organisms collected and were present in the highest densities across the survey area compared to other collected phyla. The highest average species diversity and evenness occurred in the Atlantic ECC, and the highest average species richness occurred in the WTA. The most commonly collected species in NEFSC and NJDEP federal and state trawl and dredge surveys conducted in the Offshore Project area between 2009 and 2019 (NEFSC Multi-Species Bottom Trawl [2009–2019]; NJDEP Ocean Stock Assessment Program [OSAP] [2009–2019];NEFSC Atlantic Surfclam and Ocean Quahog dredge survey [2011–2015]) included sand dollars (Echinoidae spp.), lady crab (*Ovalipes ocellatus*), gulf shrimp *(Penaeus* spp.), Atlantic rock crab (*Cancer irroratus*), and Atlantic surfclam (*Spisula solidissima*) (COP Volume II, Appendix II-G2; Atlantic Shores 2024). In the 2021 towed video transect survey contracted by Atlantic Shores (COP Volume II, Appendix II-G3; Atlantic Shores 2024), Sand Dollar Bed was the most common CMECS biotic component classification in the WTA and the Monmouth ECC. *Diopatra* Bed, and the broader biotic group, Larger Tube-building Fauna were the most common CMECS classification observed in the towed video transect surveys in the Atlantic ECC (COP Volume II, Appendix II-G3; Atlantic Shores 2024).

No coral species were observed in any of the site-specific surveys in the Project area, including inshore areas of the ECCs (COP Volume II, Appendices II-G2 and II-G3; Atlantic Shores 2024). Additionally, no observations of coral have been made within the Project area (NOAA 2017). In addition to lacking observational data, coral habitat suitability is low throughout the Project area according to NOAA's Deep Sea Coral Research and Technology modeling (Kinlan et al. 2016). The Monmouth ECC is the only portion of the Project area that could provide some habitat for non-gorgonian coral species; however, habitat suitability in this area is classified as low to medium (Kinlan et al. 2016). During towed video surveys, an encrusting sponge was identified in one transect in the WTA; however, unidentified encrusting organisms (defined as "unidentified sponge/tunicate/other feature") were observed in 6 video transects in the WTA, 19 video transects in the Monmouth ECC, and 1 video transect in the Atlantic ECC. Analysis of images taken during grab sampling surveys showed the presence of "algae or plantlike animals," defined as "macroalgae, sea grass, or hydrozoans," at four stations in the Offshore Project area (one station in the WTA and three stations along the Monmouth ECC). Video reviewer notes identify these organisms as "seaweed" at all four stations, and at one of these stations, the "seaweed" was noted as only being present on the shell of a single bivalve. No seagrass was observed during site-specific surveys in the Offshore Project area (COP Volume II, Appendices II-G2 and II-G3; Atlantic Shores 2024).

#### *Inshore Project Area*

The Atlantic Landfall Site for the Atlantic ECC is located in Atlantic City, New Jersey, and is comprised of South Iowa Avenue and a parcel of land that is currently used as a public parking lot and located at the eastern terminus of South California Avenue adjacent to the Atlantic City Boardwalk. The site is bounded by Pacific, South Belmont, and South California Avenues. The Atlantic Landfall location is shown on Figure 2.1-2 in Chapter 2, Section 2.1.2, *Alternative B – Proposed Action*. The landfall would be connected to the approximately 12.4- to 22.6-mile (20.0- to 36.4-kilometer) Cardiff Onshore Interconnection Cable Route, which continues northwest under urban residential, commercial, and industrial areas to the potential site for the Cardiff Substation and/or Converter Station and would terminate at the Cardiff Substation POI owned by ACE. The potential substation and/or converter station site, as shown on Figure 2.1-2, is a vacant lot located in Egg Harbor Township, covering approximately 20 acres (8 hectares) and bordered by Fire Road (County Road 651) to the north and Hingston Avenue to the south. On this route, the Atlantic ECC passes through portions of Inner and Great Thorofares located inshore of the Atlantic Landfall Site near the former Atlantic City Municipal Airport (Bader Field).

Although resources in this area have not been recently surveyed, a 1979 NJDEP map of seagrass resources near Atlantic City shows the presence of seagrass (NJDEP 2022a) and a 1963 NJDEP survey of shellfish resources shows this area mapped as "Hard Clam – High Value Commercial" (NJDEP 2022b).

The Monmouth Landfall Site for the Monmouth ECC is located in Sea Girt, New Jersey, at the U.S. Army NGTC. The landfall is connected to the approximately 9.8- to 23.0-mile (15.8- to 37.0-kilometer) Larrabee Onshore Interconnection Cable Route, which continues west to one of three potential sites for the Larrabee Substation and/or Converter Station and terminates at the Larrabee Substation POI. Interbedded surficial sediments, which are characterized by terraced seafloor with steep slopes, and scarps were identified in nearshore areas of the Monmouth ECC near the Monmouth Landfall Site (COP Volume II; Atlantic Shores 2024) and add complexity to the seafloor habitat in this area.

Both the Monmouth and Atlantic ECC landfall sites occur on sandy ocean beaches. Impacts on the coastal and upland portions of the landfall sites are analyzed in Section 3.5.4, *Coastal Habitat and Fauna*. Wetlands and streams do not occur at the Monmouth or Atlantic ECC landfall sites, and all delineated wetlands and waterbodies present along the onshore cable routes are located adjacent to roadways, railroads, electric utility lines, and other developed areas (COP Volume II, Appendices II-D1, II-D2, II-E1, and II-E2; Atlantic Shores 2024). For a more detailed description of impacts on wetlands and freshwater waterbodies, please see Section 3.5.8, *Wetlands and Other Waters of the United States*.

### 3.5.2.2 Impact Level Definitions for Benthic Resources

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

**Table 3.5.2-3 Impact level definitions for benthic resources**

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

| Impact Level | Impact Type | Definition |
|---|---|---|
| Major | Adverse | Adverse impacts would affect the viability of the population and would not be fully recoverable. Adverse impacts on habitats would result in population-level impacts on species that rely on them. |
| | Beneficial | Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them. |

### 3.5.2.3 Impacts of Alternative A – No Action on Benthic Resources

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

#### *Impacts of Alternative A – No Action*

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

See Appendix D, Table D.A1-3 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for benthic resources. There is one ongoing offshore wind activity within the geographic analysis area for benthic resources: Ocean Wind 1 in Lease Area OCS-A 0498.

### *Cumulative Impacts of Alternative A – No Action*

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

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

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

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

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

Ongoing and planned offshore wind activities, not including the Proposed Action, are expected to gradually increase vessel traffic over the next 34 years, increasing the risk of accidental releases of fuels/fluids/hazardous materials. There would also be a low risk of fuel/fluid/hazardous material leaks from any of the up to 364 WTGs and up to 14 OSSs/ESPs and met towers (Appendix D, Tables D.A2-1 and D.A2-2) anticipated from planned offshore wind activities in the geographic analysis area other than the Proposed Action. The total volume of WTG fuels, fluids and hazardous materials (including oils and lubricants, coolant, and diesel fuel) from planned offshore wind activities other than the Proposed Action in the geographic analysis area is estimated at 2,335,637 gallons (8.8 million liters) (Appendix D, Table D.A2-3). OSSs are expected to hold an additional 1,227,475 gallons (4.6 million liters) of fuels, fluids and hazardous materials (Appendix D, Table D.A2-3). BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons (484,533 liters) is likely to occur no more frequently than once every 1,000 years and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). Diesel floats on the water's surface briefly before volatilizing; it does not sink to the bottom and would not affect benthic habitat or species. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to nontoxic levels before they reach benthic resources (BOEM 2021). In most cases, the corresponding impacts on benthic resources are unlikely to be detectable unless there is a catastrophic spill (e.g., an accident involving a tanker ship). Large-scale spills may be accompanied by the use of chemical dispersants during post-spill response. Crude oil treated with dispersants (specifically Corexit 9500A) has been shown to have higher toxicity to marine zooplankton and meroplankton than either the crude oil or dispersant alone (Rico-Martinez et al. 2013; Almeda et al. 2014a, 2014b). Benthic resources with planktonic larval stages may be susceptible to this toxicity, which may affect subsequent recruitment. Given the volumes of fuels, fluids, and hazardous materials potentially involved and the low likelihood of release occurrence, the increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

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

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

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

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

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

Planned offshore wind activities may increase accidental releases of invasive species due to increased vessel traffic and installation of WTGs and other offshore structures. Invasive species are periodically released accidentally during nearshore and offshore activities, including from the discharge of ballast and bilge water from marine vessels. Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction when the number of project-related vessels would be greatest. This includes invasive species that could compete with, prey on, or introduce pathogens that negatively affect benthic species. Offshore wind farms have been reported to host nonindigenous invasive species, particularly through their provision of hard substrate and intertidal habitat (on foundation piles) where none previously existed (Adams et al. 2014; Kerckhof et al. 2010; Lindeboom et al. 2011). Although sub-tidal invasive species found in offshore wind farms have, in general, been noted elsewhere in their respective regions, invasive intertidal hard-substrate organisms have been previously absent from offshore waters (De Mesel et al. 2015; Kerckhof et al. 2011, 2016). It is possible that offshore wind farms could serve as "stepping-stones" and facilitate the spread and establishment of invasive species new to the region, as well as native species, in the offshore environment (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2020). Invasive species releases may or may not lead to the establishment and persistence of invasive species. Although the likelihood of invasive species becoming established as a result of offshore wind activities is very low, their impacts on benthic resources could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna; however, such an outcome is considered highly unlikely. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities (e.g., trans-oceanic shipping).

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

**Anchoring:** Vessel anchoring from planned wind-related activities would predominantly occur outside of the benthic resource geographic analysis area for the Project; however, biological monitoring efforts related to other wind-related projects may increase anchoring within or near the geographic analysis area. Vessel anchoring from these activities may be minimized by the use of dynamic positioning systems. Anchor/chain contact with the seafloor may cause injury to and mortality of benthic resources, as well as physical damage to their habitats. Direct impacts on seafloor habitat and benthic organisms from anchor contact from offshore wind activities other than the Proposed Action in the geographic analysis area would be limited to an approximate area of 728 acres (295 hectares) (Appendix D, Table D.A2-2). Mortality of organisms may occur due to anchor contact but affected areas are expected to be recolonized in the short term; however, impacts on seafloor habitats may be permanent if they occur in sensitive or limited habitats such as eelgrass beds or hard-bottom areas. Indirect impacts from anchoring include resuspension of sediments and burial from sediment deposition. Dispersal of resuspended sediments is dependent on bottom currents, and burial of hard-bottom habitat and organisms is possible. Mobile organisms may avoid burial by repositioning in the sediments or moving away. Recovery from non-permanent impacts is expected to occur rapidly.

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

**Cable emplacement and maintenance:** Planned offshore wind activities other than the Proposed Action would install buried or armored export and interarray cables, some of which may traverse the geographic analysis area. The width of the disturbed bottom along cable routes, however, would likely be less than 58 feet (17.7 meters). More than 10,397 acres (4,208 hectares) of seafloor habitat would be disturbed by export and interarray cable installation in planned offshore wind development other than the Proposed Action in the geographic analysis area between 2024 and 2030 (Appendix D, Tables D.A2-1, D.A2-2). Cable installation would require trenching, laying, then burial. Trenching can be done using a cutting wheel in hard-bottom habitat or ploughing or water jetting in soft-bottom habitat (Taormina et al. 2018). Ploughing is designed to minimize resuspension of sediments by trenching, laying, and burying all in successive steps. Dredging and mechanical trenching used during cable installation activities can cause localized, short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through sediment deposition. Additionally, water jetting would entrain and possibly injure or kill larvae of some benthic organisms. The level of impact may vary seasonally, particularly in nearshore locations, and spatially with the greatest impact occurring if the activities overlap spatially and temporally with areas of high benthic organism abundance. Locations, amounts, and timing of dredging for planned offshore wind projects are not known at this time.

Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and recover fairly quickly from disturbance, although recovery time varies by region, species, and type of disturbance. The mechanical trenching process, which is used in sediments with larger grain size (e.g., gravel, cobble), causes immediate seabed profile alterations; however, the seabed profile is usually restored to its original condition after cable installation in the trench. Therefore, seabed profile alterations, while locally intense, have little impact on benthic resources in the greater geographic analysis area.

Cables may also be armored with hard material for protection in areas where the desired cable burial depth cannot be achieved. Impacts from habitat conversion associated with cable armoring are discussed in the *Presence of structures* IPF in this section. Cable armoring impacts are likely permanent, but some re-sedimentation may occur.

Following cable installation and armoring activities associated with the construction of offshore wind facilities, suspended sediments would settle in and adjacent to the submarine cable routes. The height of the suspended sediment above the bottom would be influenced by particle size and bottom currents. Adult and juvenile individuals, demersal eggs, and larvae could be buried by deposited sediments during construction; however, measurable sediment deposition would be limited to the installation trench and the areas immediately adjacent. Currents, storms, and other oceanographic processes frequently disturb soft-bottom habitats, and native invertebrates are adapted to respond to such disturbances (Guida et al. 2017). Evidence of recovery following sand mining in the United States Atlantic and Gulf of Mexico indicates that soft-bottom benthic habitat in the geographic analysis area would fully recover within 3 months to 2.5 years (Brooks et al. 2006; BOEM 2015; Kraus and Carter 2018; Rutecki et al. 2014). Studies on benthic community recovery at European offshore wind farms after cable emplacement have found recovery times in the range of months to less than 5 years. For example, a study by Daan et al. (2006) found that, 6 months after construction of a wind farm in the Dutch North Sea, the benthic community in sandy areas between monopile foundations was not significantly different in terms of species composition, diversity, density, and biomass from five of six reference locations. Another study by Leonhard and Pedersen (2006) documenting the recovery of the soft-sediment benthic community after the construction of a wind farm in the Dutch North Sea found no significant differences in the infaunal community between pre-construction and 3-year post-construction sampling. Although the post-construction recovery of benthic communities along export and interarray cable routes was not monitored for Block Island Wind Farm in Massachusetts, BOEM documented the recovery of seafloor sediments and found that approximately 62 percent of the export cable scar had recovered within 4 months of cable-laying activities, with the remainder of the export cable scar being partially recovered. Forty-one percent of the interarray cable scar had completely recovered 2 years after cable-laying activities (HDR 2020). NMFS estimated that recovery of the soft-bottom benthic community at Block Island Wind Farm occurred within 3 years (NMFS 2015). Although estimates of recovery time following disturbance vary by region, species, and type of disturbance, a one-time disturbance associated with the construction of offshore wind facilities would not prevent natural recovery of benthic communities. Therefore, such impacts, while locally intense, would have little impact on benthic resources in the greater geographic analysis area.

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

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

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

**Electric and magnetic fields and cable heat:** The marine environment continuously generates a variable ambient EMF. Export and interarray cables from planned offshore wind development, not including the Proposed Action, would add an estimated 1,554 miles (2,501 kilometers) of buried cable to the geographic analysis area, producing EMFs in the immediate vicinity of each cable during operation (Appendix D, Table D.A2-1). BOEM would require these planned submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. Cable shielding would block electric fields emitted by the cables; however, these measures would not eliminate the magnetic fields emitted by the cables (CSA Ocean Sciences, Inc. and Exponent 2019; Hutchison et al. 2021). The variable magnetic field produced by HVAC cables induces a weak electric field in the surrounding marine environment, regardless of the presence of cable shielding. This induced electric field increases and decreases correspondingly with the electric current flow in the cables (CSA Ocean Sciences, Inc. and Exponent 2019; Exponent 2022). EMF effects from these planned projects on benthic habitats would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). EMF strength diminishes rapidly with distance, and EMFs that could elicit a behavioral response in an organism would likely extend less than 50 feet (15.2 meters) from each cable. The strength of the EMFs generated by power cables is a factor of cable voltage, current, and type of cable. HVDC cables generate static EMFs, which have greater intensities than the variable EMFs generated by HVAC cables, and thus can have a more prominent influence on local geomagnetic fields than HVAC cables (Bilinski 2021; Snoek et al. 2016). In general, HVAC cables are used for interarray cables, but either HVAC or HVDC can be used for export cables. Although HVAC export cables do not necessitate the need for converter stations and thus have lower initial costs, HVDC export cables are usually used for projects with longer distances (I.e., greater than 62.14 miles [100 kilometers]) between the WTA and the onshore substations because of greater voltage stability and more efficient transmission of power (Snoek et al. 2016). The intensity of the magnetic fields generated by export cables can be reduced through cable bundling (e.g., bundled AC three-phase cables) and thoughtful positioning of multiple export cables (e.g., close placement of direct current (DC) cables with equal currents) (Snoek et al. 2016).

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

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

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

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

Offshore cables would emit heat along cable routes. The amount of heat generated by electric transmission cables is variable and is influenced by factors such as by the temperature of overlying waters, cable type, voltage, and capacity, and by cable length (BOEM 2023). Alternating current cables generate higher heat than direct current cables (OSPAR 2009; Taormina et al. 2018) when transmission rates are equal (OSPAR 2009; Taormina et al. 2018), and the amount of heat generated by both HVAC and HVDC increases as energy transmission increases (Sharples 2011). Colder overlying waters will dissipate heat more readily than warmer waters (BOEM 2023). Based on controlled experiments with a heat source buried at a depth of 39.3 inches (100 centimeters) meant to simulate buried cables, Emeana and others (2016) measured greater than 50°F (10°C) increases in sediment temperature at distances ranging from 16 inches (40 centimeters) to over 3.3 feet (1 meter) from a heat source that varied depending on sediment substrate type and source temperature. In these experiments, the mode of heat transmission and extent varied by sediment permeability. Heat transmission occurred primarily via conduction in low permeability clays to coarse silts, and sediment temperature increases of 50°F (10°C) or greater only occurred within a 16-inch (40-centimeter) radius of the heat source. In fine sands with medium permeability, heat was transmitted via conduction at lower heat source temperatures but transitioned to convective heat transfer with increasing heat source temperature. In the medium permeability sediments, temperature increases of greater than 50°F (10°C) were observed up to 3.3 feet (1 meter) from a 131°F (55°C) heat source. Heat transmission in very coarse sands with high permeability occurred via convection and thus was more efficient than heat transfer occurring via conduction. As a result, heat transmission in very coarse sands extended up to 4.6 feet (1.4 meters) from the heat source, even at a low heat source temperature of 45°F (7°C), and sediment temperatures up to 64°F (18°C) above ambient were observed 1 meter from a 64°F (18°C) heat source (Emeana et al. 2016). These results suggest that benthic organisms living on or in coarser sediments within 6.6 feet (2 meters) or less of cables may experience greater impacts from heat emitted from export and interarray cables than those living in finer sediments having less permeability.

Impacts on most epibenthic organisms would be negligible considering that most cables from offshore wind development are expected to be buried, and heat from above-sediment cables would be cooled by water, limiting the heated area at short distances from cables (Taormina et al. 2018). Infaunal fishes (e.g., sand lances) and invertebrates, however, may be impacted by cable heat. Increased sediment temperatures may alter physical and chemical profiles of the sediments, as well as the growth rates, reproduction, physiology, mortality, distributions, and behaviors of some infaunal organisms (OSPAR 2009; Taormina et al. 2018). Infaunal responses to heated sediments would likely vary by species and differences in their tolerances and behaviors, as described in Meissner and others' (2006) review in which a tube-dwelling polychaete species (*Marenzelleria viridis*) that burrows deeper and is relatively more stationary avoided warmer sediments, whereas a tube-dwelling crustacean species (*Corophium volutator*) that does not burrow as deeply and is relatively mobile did not. Unfortunately, field studies that examine the biological impacts of these temperature increases caused by buried electric cables are lacking (OSPAR 2009; Taormina et al. 2018). Cable burial depth could mitigate impacts of heat emission from cables.

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

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

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

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

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

328 feet (100 meters) for particle motion-sensitive species, including invertebrates. Because most HRG sources are typically "on" for short periods with silence in between, only a few "pings" emitted from a moving vessel towing an active acoustic source would reach fish or invertebrates below, so behavioral effects would be intermittent and temporary. Overall, the level of disturbance from geophysical and geotechnical surveys is expected to be negligible for invertebrates due to the frequency range, the small spatial extent of sound propagation, and the short duration of exposure.

Operating WTGs generate non-impulsive underwater noise that may be detectable by some benthic invertebrates. Monitoring data indicate that root-mean-square sound pressure levels ($SPL_{RMS}$) produced by operating 0.2 to 6.15 MW WTGs are relatively low, generally ranging from 110 to 125 dB re 1 μPa (Tougaard et al. 2020). WTGs associated with planned offshore activities are expected to be larger than WTGs currently operating and may therefore produce higher noise levels; however, possible increased noise levels due to larger WTGs is not expected to significantly impact benthic organisms. Noise levels produced by WTGs are expected to decrease to ambient levels within a relatively short distance (less than 0.6 mile [1 kilometer]) from the turbine foundations (HDR 2019; Thomsen et al. 2015; Miller et al. 2017), and underwater vibrations would attenuate rapidly with increasing distance from a sound source (Morley et al. 2014). Given that noise levels generated by WTGs are relatively low and that underwater vibrations would attenuate rapidly, the low levels of elevated noise associated with operating WTGs are likely to have little to no impact on benthic invertebrates.

Planned offshore wind activities in the geographic analysis area, not including the Proposed Action, could generate impulsive pile-driving noise during foundation installation. Pile driving is expected to occur for 4 to 69 hours at a time as 364 WTGs and 14 OSSs are constructed between 2024 and 2030 (Appendix D, Tables D-3, D.A2-1, and D.A2-2) for planned offshore wind activities other than the Proposed Action in the geographic analysis area. Pile driving can cause injury and mortality to invertebrates in a small area around each pile. Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not likely to experience barotrauma from pile driving. Very few studies have examined the effects of substrate vibrations from pile driving, yet many have recently acknowledged that this is a field of urgently needed research (Hawkins et al. 2021; Popper et al. 2022b; Wale et al. 2021). Most of the research thus far has focused on water-borne particle motion, or even acoustic pressure, and is discussed briefly below.

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

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

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

Some planned offshore wind projects may encounter unexploded ordnance (UXO) within lease areas or along cable installation corridors requiring removal or relocation. Relocation of UXOs could be performed using “lift-and-shift” methods. Removal of UXOs may require detonation, which would generate high pressure levels that could injure or kill benthic invertebrates. Impact distances of explosive detonations depend on impulse intensity and are shorter at the bottom than at surface waters (Govoni et al. 2008). Studies suggest that marine invertebrates are insensitive to explosions; however, those findings are disputed as the methods used in those studies have been deemed inadequate (Keevin et al. 1999; Keevin and Hempen 1997). Further research is needed to carefully evaluate the impacts of explosive detonations on invertebrates.

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

**Presence of structures:** Planned offshore wind development, not including the Proposed Action, would construct up to 364 WTGs and 14 OSSs in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). These structures may impact benthic resources by increasing the risk of fishing gear entanglement and loss, alterations to local hydrodynamics, and habitat conversion. The nature of these sub-IPFs and their impacts are discussed below.

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

The presence of tall, vertical structures, such as WTGs, can alter wind fields, water turbulence, and water column mixing and stratification (reviewed by van Berkel et al. 2020). WTGs can alter hydrodynamics and local water stratification characteristics in two main ways: through the potential reduction of wind-driven mixing of surface waters due to atmospheric wakes occurring downstream of WTGs (e.g., Christiansen et al. 2022) or through an increase in turbulent vertical mixing due to water flow around WTG foundation structures (e.g., Carpenter et al. 2016; Dorrell et al. 2022). Seasonal stratification cycles on continental shelf seas play an important role in carbon and nutrient cycling, phytoplankton production, and secondary production; and large-scale changes in seasonal stratification may impact these natural processes and cycles (Dorrell et al. 2022). Additionally, variation in the depth of the mixing layer could impact larval distribution of species with pelagic larvae (e.g., van Berkel et al. 2020; Chen et al. 2021). Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. Finfish aggregate trends along the mid-Atlantic shelf have been shifting northeast into deeper waters (NOAA 2022); the presence of structures may reinforce these trends. Based on earlier hydrodynamic modeling studies, foundation array structures would potentially disrupt water flow at a fine scale within the interarray area and immediately downstream, but flows would return to normal at short distances from the array (Cazenave et al. 2016; Miles et al. 2017). Modeled disturbances in flow from those studies ranged from 65.6 to 164 feet (20 to 50 meters) and are proportional to foundation pile diameter. In a separate shelf-scale model based on wind-related structures in the Irish Sea, a 5 percent reduction in peak water velocities was estimated based on arrays totaling 297 turbines (Cazenave et al. 2016). Reductions in peak velocities from that study were modeled to extend up to approximately 0.5 nautical mile (1 kilometer) downstream of monopiles.

Offshore wind facilities have the potential to impact atmospheric and oceanographic processes through the presence of structures and the extraction of energy from the wind. The atmospheric wakes from the operating turbines could potentially reduce wind-driven mixing of surface waters (e.g., Christiansen et al. 2022). Thus far, studies have largely relied on modeling rather than field measurement campaigns and have largely been focused on Europe. A synthesis of European studies by van Berkel and others (2020) summarized the potential effects local to a wind facility to include increased downstream turbulence, remobilization of sediments, reduced flow inside wind farms, downstream changes in stratification, redistribution of water temperature, and changes in nutrient upwelling and primary productivity. Golbazi and others (2022) showed smaller surface effects from the wind wakes of turbines of the size being proposed and built in U.S. waters (10–15 MW) than other modeling efforts using smaller turbines (5 MW) in the North Sea (Akhtar et al. 2022; Daewel et al. 2022). Furthermore, Golbazi et al. 2022 states that the higher wind turbine heights are “key” to this difference and concludes that “the results of this study indicate that, on average, meteorological changes at the surface induced by next-generation extreme-scale offshore wind turbines will be nearly imperceptible,” where next-generation extreme-scale turbines are those with a rotor diameter greater than 492 feet (150 meters) and hub height above 328 feet (100 meters). This introduces uncertainty in the scale of potential impacts at the sea surface and on stratification and regional hydrodynamics due to the higher hub heights (427–492 feet [130–150 meters]) planned for use in U.S. projects than those studied in Europe (295 feet [90 meters]; Akhtar et al. 2022; Christiansen et al. 2022; Daewel et al. 2022). Modeling performed by Johnson et al. (2021) showed a relative deepening in the thermocline of approximately 3.3 to 6.6 feet (1 to 2 meters) and a retention of colder water inside offshore wind areas off of New England during the summer months, compared to a model run without wind turbines. This is somewhat contrary to results in European studies that suggest a loss of stratification due to additional turbulence in the atmospheric wakes (e.g., Carpenter et al. 2016; Dorrell et al. 2022).

Research on the potential disruptions to the Cold Pool from offshore wind structures is ongoing (BOEM 2021). A recent review by Miles and others (2021) proposed that offshore foundation effects on the Cold Pool, where seasonal stratification is strong and tidal currents are weaker, may not be as pronounced as those in Northern Europe, where seasonal stratification is weaker, tidal currents are stronger, and turbulence is greater. Due to these differences in oceanographic characteristics, previous models of impacts on stratification in European waters may be more indicative of impacts on Cold Pool stratification during spring and fall when stratification is weaker, and structure-induced mixing may not be substantial enough to significantly affect the stronger stratification present in the Cold Pool during the summer; however, the presence of WTGs may influence the setup or breakdown of the Cold Pool (Miles et al. 2021). Although future research is needed, current available information suggests that the consequences for benthic resources of hydrodynamic disturbances due to the presence of offshore structures are anticipated to be undetectable to small, to be localized, and to vary seasonally.

The addition of planned offshore structures (WTG, OSS, and met tower foundations and associated scour protection and cable scour protection) would likely convert soft-bottom habitat to complex structured habitat. This habitat conversion would occur within wind farm footprints and along cable routes. Soft-bottom habitat is the most extensive habitat in the Mid-Atlantic Bight subregion of the Large Marine Ecosystem (LME); therefore, wind-related structures would not significantly reduce this habitat and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). Due to the low availability of complex structured habitat in the Mid-Atlantic Bight subregion of the LME, planned offshore structures would present new habitat opportunities for communities associated with this habitat type in much the same way that artificial reefs function (Glarou et al. 2020). The physical structures would initially increase local diversity as they are colonized by biofouling invertebrates (e.g., barnacles, anemones) and introduce new feeding opportunities to new fish assemblages that typically occur in association with complex structure (e.g., black sea bass, tautog) (Degraer et al. 2018; Fayram and de Risi 2007; Griffin et al. 2016; Hooper et al. 2017a, 2017b), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). WTG foundations may also provide habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Coates et al. 2013; Goddard and Love 2008). Fish communities, especially species associated with structure, would aggregate around foundations, scour protection, and cable protection. Some of the newly attracted species may increase predation pressure on nearby undisturbed benthic habitats, resulting in adverse impacts on benthic communities in the immediate vicinity of the structure. These impacts are expected to be local and to persist as long as the structures remain. Depending on the balance of attraction and production, newly placed structures may affect the distribution of fish and shellfish among existing natural habitat, artificial reef sites, and newly emplaced structures.

New structures can be colonized by invasive species and also have the potential to facilitate range expansion of both native and nonnative aquatic species through the stepping-stone effect (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2020). Due to the pre-existing network of artificial reefs in the mid-Atlantic OCS, however, it is unlikely that additional structures would measurably increase the potential for this effect. Further discussion on invasive species can be found in the *Accidental releases* IPF of this section.

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

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

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

### *Conclusions*

**Impacts of Alternative A – No Action.** Under the No Action Alternative, benthic resources would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing short-term, long-term, and permanent impacts (e.g., disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources primarily through regular maritime activity, offshore construction impacts, and emplacement and presence of structures. There are currently no ongoing offshore wind activities in the benthic resources geographic analysis area. BOEM anticipates individual IPFs from ongoing activities associated with the No Action Alternative, including seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, to result in a range of negligible to moderate impacts on benthic resources; however, overall impacts are expected to be **moderate,** as adverse impacts would not result in population-level effects.

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

Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and benthic resources would continue to be affected by the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, discharges/intakes, EMF, noise, presence of structures, and port utilization. Planned non-offshore wind activities including increasing vessel traffic and associated accidental releases and discharges, increasing construction, marine surveys, port expansion, and channel maintenance activities would also contribute to impacts on benthic resources. BOEM expects individual IPFs from the combination of ongoing and planned activities other than offshore wind development, such as increasing vessel traffic; increasing construction; marine surveys; port expansion; channel deepening activities; and installing new towers, buoys, and piers to result in a range of negligible to moderate impacts on benthic resources. however, overall impacts, primarily due to accidental releases, anchoring, cable emplacement and maintenance, discharges/intakes, EMF, noise, presence of structures, and port utilization, are expected to be moderate, as adverse impacts would be unavoidable but would not result in population-level effects.

Planned offshore wind activities are expected to contribute considerably to several IPFs, primarily cable emplacement and maintenance and the presence of structures, namely foundations and scour/cable protection. Planned offshore wind activities would increase vessel activity, which could lead to an increased risk of accidental releases and discharges. In addition, the planned construction and operation of Ocean Wind 2 in Lease Area OCS-A 0532 and Atlantic Shores North in Lease Area OCS-A 0549 would add an estimated 364 WTGs and up to 14 OSSs into an area where no such structures exist (Appendix D, Tables D.A2-1 and D.A2-2), increasing the conversion of soft-bottom habitat to hard-bottom habitat, the amount of benthic habitat disturbed by cable emplacement and maintenance and anchoring, noise and EMF in the marine environment, and the risk of invasive species. BOEM anticipates individual IPFs resulting from the cumulative impact of the No Action Alternative would result in a range of negligible to moderate adverse impacts on benthic resources; however, overall impacts are expected to be **moderate**, primarily due to habitat disturbance and conversion, as adverse impacts would be unavoidable but would not result in population-level effects. Beneficial impacts could result from emplacement of structures (habitat conversion to hard substrate), but these impacts would be **moderate beneficial** because they would not result in population-level effects.

### 3.5.2.4 Relevant Design Parameters and Potential Variances in Impacts

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

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

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

- The total amount of scour protection: The amount of scour protection installed for the foundations, interarray cables, and offshore export cables relates directly to the amount of soft-bottom habitat converted to hard-bottom habitat. This conversion would result in the displacement of soft-bottom species and possible habitat provision for hard-bottom species.

- The number and type of WTG and OSS foundations: The number and type of WTG and OSS foundations directly affects the magnitude of several of the most impactful IPFs on benthic resources, including pile-driving noise, the presence of structures and associated conversion of soft-bottom habitats to hard-bottom habitats, and the amount of sediment resuspended and deposited. More WTG and OSS foundations would result in a longer duration of pile driving, and larger WTG and OSS foundations would result in a larger ensonified area. More WTG and OSS foundations would result in greater impacts associated with the presence of structures, including risk of entanglement of commercial fishing gear, fish aggregation, hydrodynamic disturbances, and habitat conversion.

- The installation method of export cables, interarray cables, and interlink cables: Methods of cable installation have differing effects on sediments and benthic organisms. For example, the ploughing method minimizes resuspension of sediments by trenching, laying, and burying all in successive steps, and the water-jetting method would entrain and possibly injure or kill larvae of some benthic organisms.

- The amount of pre-cable laying dredging and the amount of anchoring: Pre-cable laying dredging and anchoring directly affect the amount of sediment disturbed and the level of risk of injury and mortality to benthic organisms.

- The time of year when foundation and cable installations occur: Migratory benthic and demersal organisms exhibit seasonal variation in migration patterns, such that certain species and life stages are present in the Project area at certain times of the year. The time of year during which construction occurs may influence the magnitude of impacts (e.g., noise, sediment resuspension and burial) on these species.

- The number of temporary metocean buoys: Metocean buoy anchors directly affect the amount of sediment disturbed and the level of risk of injury and mortality to benthic organisms.

#### 3.5.2.5 Impacts of Alternative B – Proposed Action on Benthic Resources

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

### *Onshore Activities and Facilities*

**Accidental releases:** The Proposed Action could increase accidental releases of fuels/fluids/hazardous materials, trash, and debris during construction and installation, O&M, and decommissioning activities at the export cable landfall sites. Additionally, components of anti-fouling paints and anti-corrosives may leach into surface waters. However, the Proposed Action is not anticipated to significantly increase the risk of accidental releases in the Project area. Additionally, the Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste and Atlantic Shores would implement a SPCC Plan, further reducing the likelihood of an accidental release. Atlantic Shores has developed an OSRP with measures to avoid accidental releases and a protocol to respond to such a release (BEN-06; Appendix G, Table G-1). Atlantic Shores would also implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at the export cable landfall sites and estuarine portions of the export cable routes (BEN-02; Appendix G, Table G-1). Therefore, accidental releases are considered unlikely and would be quickly mitigated if one occurred. Construction and installation, O&M, and decommissioning activities at the export cable landfall sites are not expected to increase the risk of accidental releases of invasive species.

**Cable emplacement and maintenance:** The landfalls of the export cables would occur at Monmouth and Atlantic ECC landfall sites. The offshore-to-onshore transition is proposed to be accomplished using HDD, a trenchless method that would avoid nearshore impacts as well as impacts directly along the shoreline. HDD, in comparison to trenching, also results in a deeper burial depth for cables in the nearshore environment, facilitating sufficient burial over the life of the Project and decreasing the likelihood that cables would become exposed over time. An HDD bore would be completed for each of the export cables coming ashore, so each cable would be contained within its own HDD conduit. Up to two additional spare HDD conduits may be installed at each landfall site for a total of six HDD conduits at each landfall site. To support HDD activities, Atlantic Shores would establish an onshore staging area at each landfall site. At both sites, HDD would either be initiated or exit landward of the beach to avoid impacts on the beach. Onshore, each HDD path would originate or terminate in an excavated pit that is approximately 10 by 13 feet (3 by 4 meters) located at the landfall site's onshore staging area. The excavated pit would also serve to contain drilling fluid, which is a slurry of bentonite (an inert, nontoxic natural clay that poses little to no risk to the marine environment) and water that lubricates the drill head and extracts excavated material from the bore hole. Atlantic Shores would implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at the export cable landfall sites (BEN-02; Appendix G, Table G-1). HDD would also be used for cable installation at inshore portions of the export cable routes where necessary to avoid impacts on wetlands located along the Atlantic and Monmouth export cable routes and on seagrass resources located along the estuarine portion of the Atlantic export cable route. Although the detailed design of HDD activities has not yet been finalized, the HDD activities would be designed in coordination with USACE to minimize any conflicts with USACE projects. The estimated average burial depth of HDD-installed cables at export cable landfalls is approximately 16 to 131 feet (5 to 40 meters) below the seabed (COP Volume I, Section 4.7.1; Atlantic Shores 2024). The depth of other HDD-installed cables under channels and wetlands would depend on the length of the HDD and other site-specific considerations. Atlantic Shores would design each HDD activity using site-specific geotechnical data to ensure adequate clearance from the channel or wetland and to minimize the risk of unintended interaction between the HDD and the environment. Special consideration would be given to any dredged channels to minimize the risk associated with future dredge maintenance activities.

At decommissioning, export cables at the Monmouth and Atlantic landfalls and along the inshore cable routes would be removed. When underwater cables are removed, any overlying cable protection would need to be removed first, then the cables would be extracted from the seabed. Where these cables are buried in dense sediments, it may be necessary to fluidize overlying sediments before extracting the cables, resulting in suspended sediments in the vicinity of the Proposed Action. As discussed in Section 3.5.2.3, *Impacts of Alternative A – No Action on Benthic Resources*, impacts on benthic resources related to resuspension and deposition of sediments are expected to be minor. The one-time disturbance associated with the decommissioning and removal of export cables at the Monmouth or Atlantic ECC landfall sites and in estuarine portions of the export cable routes would not prevent natural recovery of benthic communities.

### *Offshore Activities and Facilities*

**Accidental Releases:** The Proposed Action would result in increased vessel activity, which in turn could increase accidental releases of fuels/fluids/hazardous materials, trash and debris, and invasive species during construction and installation, O&M, and decommissioning activities. The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste (BEN-05; Appendix G, Table G-1) and Atlantic Shores would implement an SPCC plan (GEO-16; Appendix G, Table G-1), further reducing the likelihood of an accidental release. Atlantic Shores has developed an OSRP with measures to avoid accidental releases and a protocol to respond to such a release (BEN-06; Appendix G, Table G-1). Atlantic Shores would also implement an HDD Contingency Plan to minimize potential releases and inadvertent return of HDD fluid at export cable landfall sites (BEN-02; Appendix G, Table G-1). Therefore, accidental releases are considered unlikely and would be quickly mitigated if one occurred. The increased vessel traffic associated with the Proposed Action, especially traffic from foreign ports, would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on benthic resources depend on many factors but could be widespread and permanent. The increase in the risk of accidental releases of invasive species attributable to the Proposed Action would be moderate.

**Anchoring:** Increased Project-related vessel activity would result in increased anchoring activity within the geographic analysis area. Project-related anchoring activity would be highest during the construction and decommissioning phases of the met tower, up to 200 WTGs, and up to 10 OSSs. The use of dynamic positioning systems could minimize the need for anchoring in some cases. Anchor contact with the seafloor would result in direct impacts on habitat and benthic organisms but would be limited to an approximate area of 714 acres (289 hectares) (Appendix D, Table D.A2-2). Direct impacts include temporary disturbance of bottom habitat and injury or mortality of organisms including benthic invertebrates. The severity of impacts for each event would depend on the specific location and habitat type, with greater effects expected when seafloor-disturbing activities interact with sensitive habitats, early life stages (e.g., egg and larvae), and sessile species such as Atlantic surfclam and ocean quahog (see Section 3.5.5 for a discussion of potential impacts on commercially important benthic invertebrate species). Immobile and early life stages of benthic invertebrate species in the direct path of anchor or jack-up vessel disturbance may be subject to injury or mortality; however, as described in Section 3.5.2.3, the benthic community is expected to recover, and benthic infauna and epifauna are expected to recolonize the area after physical disturbance ceases. Atlantic Shores would employ an anchoring plan for areas where anchoring is required to avoid direct impacts on sensitive, hard-bottom, and structurally complex habitats to the maximum extent practicable (BEN-07; Appendix G, Table G-1). Indirect impacts include increased turbidity from resuspension of sediments and burial of habitats or organisms from redeposition. Dispersal distances of resuspended sediments would depend on bottom currents. Burial of hard-bottom habitat is possible, but this habitat type is limited within the geographic analysis area. The impacts from anchoring within the geographic analysis area are expected to be minor to moderate. The expected minor to moderate impacts from anchoring are not expected to influence the current trends in benthic habitat and organisms.

**Cable emplacement and maintenance:** The Proposed Action would install up to 988 miles (1,590 kilometers) of export and interarray cables (Appendix D, Table D.A2-1). Emplacement of offshore interarray and export cables would result in the disturbance of up to 576 acres (233 hectares) of the seafloor (Appendix D, Table D.A2-2) (for a description of the range of impacts associated with the different methods of cable installation, see COP Volume I, Section 4.5.10.2, Table 4.5-2, and Section 4.11, Table 4.11-1; Atlantic Shores 2024). Much of the Project area is characterized as being mainly level and consistent, with sand bedforms of varying sizes and swales (COP Volume II, Section 2.1.1.2.2; Atlantic Shores 2024). The pre-lay grapnel runs and installation of interarray cables would cause short-term disturbance of sand bedforms, but tidal and wind-forced bottom currents would likely reform most areas within days to weeks. Areas that are more strongly influenced by extreme weather events would reform in response to Nor'easters and tropical systems. It is anticipated that the natural pattern of sand bedforms would return to pre-construction conditions within a few months. The submarine export cable routes were selected to minimize overlap with sensitive benthic habitats. Additionally, the Proposed Action is committed to a target cable burial depth of 5 to 6.6 feet (1.5 to 2 meters) (BEN-03; Appendix G, Table G-1), although burial to this depth would not be possible in certain areas and cable protection may be required (see the *Presence of structures* IPF in this section for a further discussion of cable protection). Given the influence of natural currents, as well as construction-related avoidance and conservation measures, adverse impacts on benthic resources due to construction activities associated with the Proposed Action would be short term and minor.

In addition to pre-lay grapnel runs and sand form bed removal, cable pre-installation activities may include boulder removal. Boulders less than 8 feet (2.5 meters) in diameter can usually be relocated using standard methods and equipment such as subsea grabs. This method limits the impact of boulder removal to the original footprint of the boulder and the sediments upon which the boulder is relocated. If an area with many boulders is encountered, a displacement plow may be used to clear the area. The plow would clear a path approximately 33 feet (10 meters) wide and would clear boulders to a depth of 2.6 feet (0.8 meter). It is anticipated that the displacement plow would be utilized on up to 10 percent of each export cable corridor.

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

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

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

As discussed in Section 3.5.2.3, impacts on benthic resources related to cable emplacement are expected to be minor. Although adult and juvenile individuals, demersal eggs, and larvae could be buried by deposited sediments during construction, measurable sediment deposition would be limited to the cable installation trench and the areas immediately adjacent. Currents, storms, and other oceanographic processes frequently disturb soft-bottom habitats, and native invertebrates are adapted to respond to such disturbances (Guida et al. 2017). Indirect impacts on benthic invertebrate resources from sediment suspension and deposition would be short term and minimal. Evidence of recovery following sand mining in the U.S. Atlantic and Gulf of Mexico indicates that soft-bottom benthic habitat in the Project area would fully recover within 3 months to 2.5 years (Brooks et al. 2006; BOEM 2015; Kraus and Carter 2018; Rutecki et al. 2014). NMFS estimated that recovery of the soft-bottom benthic community at Block Island Wind Farm occurred within 3 years (NMFS 2015). The one-time disturbance associated with the construction of the proposed Project would not prevent natural recovery of benthic communities. Additionally, Atlantic Shores would minimize impacts on benthic resources by siting structures to avoid sensitive habitat and through the use of jet plow cable embedment to reduce sediment disturbance during the cable laying process (GEO-02, BEN-04; Appendix G, Table G-1). Therefore, impacts of sediment resuspension and deposition resulting from the Proposed Action would be short term, localized, and range from minor to moderate for benthic resources in the Project area.

Complex habitat in the form of gravelly sands is predominant along the Monmouth ECC and is also present along the Atlantic ECC. Post-disturbance recovery times for coarser sediments are typically longer than those of finer sediments and are estimated to range from 2 to 3 years for sand and gravel communities as compared to 6 to 8 months for estuarine mud communities (Newell et al. 1998; Wilbur and Clarke 2007). The recovery time of these coarser sediment communities is partially dependent on the proportion of sand versus gravel, with sediments containing larger proportions of gravel taking longer to recover than those with greater proportions of sand (Newell et al. 1998). Generally, when coarse sediments are removed or displaced finer sediments will settle in their place, often resulting in a recolonizing faunal community that is different from the pre-disturbance faunal community (Cooper et al. 2011; Hill et al. 2011; Desprez 2020). Depending on the degree of fineness of the sediments that settle in the areas disturbed by cable laying, the resultant post-construction invertebrate assemblages may or may not differ significantly from the pre-construction community. For example, there was a high degree of overlap between the invertebrate assemblages present in samples collected in gravelly sand and medium sand substrates in the Offshore Project area; however, there was a great degree of dissimilarity between samples collected in fine/very fine sand as compared to those collected in gravelly sand (COP Volume II, Appendix II-G2, Section 3.3; Atlantic Shores 2024).

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

Cable terminations and hang-offs would be inspected and maintained during scheduled maintenance of foundations, OSSs, or WTGs. Scheduled maintenance of offshore facilities would be performed annually, with 20 percent of the foundations inspected each year, and all foundations inspected at least once every 5 years. Scheduled cable survey and maintenance activities could result in increased vessel noise, anchoring impacts, and accidental releases of fuels/fluids/hazardous materials and trash and debris (see these IPFs for a description of their impacts). If portions of buried offshore cables require maintenance, the sediment cover may need to be removed for inspection and possible replacement of a portion of the cable. These activities would temporarily disturb the seafloor, but effects would be negligible, short term, and extremely localized.

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

**Discharges/intakes:** There would be increased potential for discharges from vessels during construction and installation, O&M, and decommissioning activities related to the Proposed Action, and it is expected that these discharges would be staggered over time and localized. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. Impacts on benthic resources from vessel discharges, if any, would be localized, short term, and negligible. Atlantic Shores is exploring the use of closed-loop cooling technologies for HVDC converters located on offshore OSSs. If HVDC technology is selected, it is anticipated that a closed-loop cooling system would be utilized, pending technical suitability and commercial availability of the technology. There would be no discharges or intakes associated with these Project elements if this closed-loop system is used.

**Electric and magnetic fields and cable heat:** The Proposed Action would install up to 441 miles (710 kilometers) of 230–275 kV HVAC or 320–525 kV HVDC offshore export cables, as well as up to 547 miles (880 kilometers) 66–150 kV HVAC interarray cables (Appendix D, Table D.A2-1). Up to four HVAC export cables and one HVDC export cable would be installed per Project, with a maximum of eight export cables for Project 1 and Project 2 combined. During operation, powered alternating current transmission cables would produce EMFs (Taormina et al. 2018) and heat. The strength of the EMF increases with electrical current, but rapidly decreases with distance from the cable (Taormina et al. 2018). BOEM would require these planned submarine power cables to have appropriate shielding to minimize potential EMF effects from cable operation. Cable shielding would block electric fields emitted by the cables; however, as mentioned in Section 3.5.2.3, these measures would not eliminate the magnetic fields emitted by the cables (CSA Ocean Sciences, Inc. and Exponent 2019; Hutchinson et al. 2021). The variable magnetic field produced by HVAC cables induces a weak electric field in the surrounding marine environment, regardless of the presence of cable shielding. This induced electric field increases and decreases correspondingly with the electric current flow in the cables (CSA Ocean Sciences, Inc. and Exponent 2019; Exponent 2022). Atlantic Shores would bury cables to a minimum target burial depth of 5 to 6.6 feet (1.5 to 2 meters) below the surface to minimize detectible EMFs, well below the aerobic sediment layer where most benthic infauna live (BEN-03; Appendix G, Table G-1).

The scientific literature provides some evidence of faunal responses to EMFs by marine invertebrates, including crustaceans and mollusks (Hutchison et al. 2018; Normandeau et al. 2011; Taormina et al. 2018), although some reviews (Albert et al. 2020; Gill and Desender 2020) indicate the relatively low intensity of EMFs associated with marine renewable projects would not result in impacts. Effects of EMFs may include interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018). Studies on the effects of EMFs on marine animals have mostly been restricted to commercially important species. The consequences of anthropogenic EMFs have not been well studied in benthic resources (Albert et al. 2020; Gill and Desender 2020; CSA Ocean Sciences, Inc. and Exponent 2019). However, the available information suggests that benthic invertebrates with limited mobility would not be affected by Project-associated EMF (Exponent 2018). In the case of mobile species, an individual exposed to EMFs would cease to be affected when it leaves the affected area. An individual may be affected more than once during long-distance movements; however, there is no information on whether previous exposure to EMFs would influence the impacts of future exposure. Therefore, BOEM expects localized and long-term, though not measurable, impacts on benthic resources from EMFs from the Proposed Action. See Section 3.5.5 for a discussion of the impacts of EMF on elasmobranchs.

Heat emission would occur along the planned 988 miles (1,590 kilometers) of Project cables. Heat emission from above-sediment cables would be minimized by cooling from bottom water and mitigated by cable sheathing or armoring. However, heat from buried cables may radiate at considerable distances relative to burial depths, depending on cable source heat and sediment substrate (Emeana et al. 2016). Based on controlled laboratory experiments, cable emitted heat was transmitted less than 6.6 feet (2 meters) for cable heat 66°F (19°C) or less above ambient temperature, and at source heat 109°F (43°C) and higher, heat transmission distances approach 6.6 feet (2 meters) (Emeana et al. 2016). In these experiments, the mode of heat transmission and extent varied by sediment permeability, with heat transmission being greatest in very coarse sands (Emeana et al. 2016). These results suggest that benthic organisms living on or in coarser sediments within 6.6 feet (2 meters) or less of cables may experience greater impacts from heat emitted from export and interarray cables than those living in finer sediments having less permeability. These results suggest that benthic organisms within 6.6 feet (2 meters) or less of cables on or in the coarser sediments and gravelly sands that are predominant along the Monmouth ECC and also present along the Atlantic ECC may experience greater impacts from heat emitted from export and interarray cables than those living in finer sediments having less permeability.

As mentioned in Section 3.5.2.3, increased sediment temperatures may alter physical and chemical profiles of the sediments, as well as the growth rates, reproduction, physiology, mortality, distributions, and behaviors of some infaunal organisms (OSPAR 2009; Taormina et al. 2018). Project cables would be buried to a target depth of 5 to 6.6 feet (1.5 to 2 meters) where possible, providing some measure of mitigation depending on actual cable temperatures (BEN-03; Appendix G, Table G-1). Additionally, Atlantic Shores would institute a cable monitoring system that would monitor for sufficient buried cable depth and include acoustic sensing and monitoring of distributed temperature and discharge (OCE-05, PUB-13; Appendix G, Table G-1).

**Gear utilization:** Atlantic Shores would implement benthic monitoring surveys in the Offshore Project area to establish pre-construction baselines, measure disturbances, and monitor recovery of habitats and biological communities (BEN-01, BEN-08; Appendix G, Table G-1). Atlantic Shores has also proposed to implement fisheries monitoring surveys (FIN-11; Appendix G, Table G-1). Benthic survey gear types include benthic grab samplers, multibeam echosounders, and underwater video cameras. Proposed fisheries survey gear types include clam dredges, demersal fish trawls, and fish pots.

Impacts from gear utilization related to benthic and fisheries monitoring surveys performed in support of the Proposed Action would likely range from negligible to minor. Impacts from the surveys are expected to be localized, and soft-bottom habitats would be expected to recover fairly quickly from the disturbance in the short term; however, disturbance to hard-bottom habitat would take longer to recover from. The time period for recovery would depend on the mobility and life stage of each species, with sessile organisms less able to avoid impacts and mobile organisms more able to avoid impacts.

**Noise:** The Proposed Action would result in noise from vessels, G&G surveys, pile driving, operational WTGs, and cable burial or trenching. The natures of these sub-IPFs and of their impacts on benthic resources are described in Section 3.5.2.3. Benthic habitat is composed of various types of sediment, structural features that are formed by that sediment (e.g., interstitial spaces between boulders, sand waves), and organisms that reside in and on the sediment. Substrates and associated structural features are unaffected by underwater noise. Benthic invertebrates are sensitive only to the particle motion component of noise. Invertebrates may experience a range of impacts from underwater sound depending on physical qualities of the sound source and the environment, as well as the physiological characteristics and the behavioral context of the species of interest. Detectable particle motion effects on invertebrates include startle responses, valve closure, and changes to respiration or oxygen consumption rates (Carroll et al. 2017; Edmonds et al. 2016; Hawkins and Popper 2014).

Vessel noise includes non-impulsive sounds that arise from a vessel's engines, propellers, and thrusters. Sound levels emitted from vessels depend on the vessel's operational state (e.g., idling, in-transit) and are strongly weather dependent. Zykov et al. (2013) and McPherson et al. (2019) report a maximum broadband source level of 192 dB re 1 µPa for numerous vessels with varying propulsion power. Noise from the Project's vessels is likely to be similar in frequency characteristics and sound levels to existing commercial traffic in the region, and Project vessels would only represent a small fraction of the large volume of existing traffic in the geographic analysis area. Moreover, given the rapid attenuation of underwater vibrations with increasing distance from a sound source (Morley et al. 2014), it is unlikely that these stimuli would cause more than short-term behavioral effects (e.g., flight or retraction) or physiological (e.g., stress) responses. Overall, effects on benthic invertebrates from vessel noise are expected to be short term and localized and are not anticipated to pose a risk to benthic invertebrates.

The most impactful noise is expected to be produced by pile-driving activities during construction, and specifically during impact pile driving to install turbine foundations. The Proposed Action would produce noise from pile driving during installation of up to 200 WTG foundations, 10 OSS foundations, and 1 met tower foundation for 4 to 6 hours per day. Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not likely to experience barotrauma from pile-driving. Vibration from impact pile driving can be transmitted through sediments. Sessile marine invertebrates like bivalves are sensitive to substrate-borne vibrations and may be affected by pile-driving noise (Day et al. 2017; Roberts et al. 2015; Spiga et al. 2016). Additionally, recent research (Jones et al. 2020, 2021) indicates that longfin squid, an EFH species, can sense and respond to vibrations from impact pile driving at a greater distance based on sound exposure experiments. The research thus far indicates that marine crustaceans may alter their natural behaviors in response to pile-driving sounds, but further work is required to understand the biological significance of these changes, and whether substrate-borne or water-borne particle motion has a greater influence on their behavior. Infaunal organisms may also exhibit short-term stress and behavioral responses over a smaller area due to the vibrations created by vibratory pile driving used for cofferdam installation. Given that most benthic species in the region are either mobile as adults or planktonic as larvae, disturbed areas would likely be recolonized naturally and in the short term, and the overall impact on benthic resources would be minor. Behavioral effects of pile driving on fish and commercially important invertebrates are discussed in *Section 3.5.5*.

As discussed in Section 3.5.2.3, operating WTGs generate non-impulsive underwater noise that may be detectable to some benthic invertebrates. However, maximum noise levels anticipated from operating WTGs would be below levels thought to cause injury and behavioral effects, and vibrations would dissipate rapidly with distance from turbine foundations. Noise impacts on benthic invertebrates from operating WTGs are expected to be negligible, localized, and long term.

As described in Section 3.5.2.3, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and cable protection installation. The Proposed Action includes the laying of 988 miles (1,490 kilometers) of export and interarray cables; however, the impacts of related noise-producing activities would be insignificant, and are not expected to result in adverse effects on benthic resources.

G&G surveys would be conducted in support of Project-associated site assessment and characterization activities. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration, and detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources, but may overlap with behavioral impacts of pile-driving noise. Overlapping sound sources are not anticipated to result in a greater, more-intense sound; rather, the louder sound prevents the softer sound from being detected (Hawkins and Popper 2014). Impacts of G&G surveys on benthic resources are expected to be short term and negligible.

Although the offshore Project area is considered a low hazard zone for munitions and explosives of concern (MEC), it is possible that MECs (inclusive of UXOs) may be present. If any are identified prior to construction, Atlantic Shores would attempt to mitigate through avoidance. In the event avoidance is not possible, Atlantic Shores would adhere to the U.S. Committee on the Marine Transportation System Proposed National Guidance for Industry on responding to Munitions and Explosives of Concern in U.S. Federal Waters (U.S. Committee on the Marine Transportation System 2023).

The negligible (for most noises) to minor (for pile-driving noise) impacts (disturbance, injury, and mortality) of the Proposed Action on benthic resources would be in addition to the noise that would occur under the No Action Alternative, which is expected to result in similar short-term and local impacts.

**Port utilization:** Because the Proposed Action would cause no appreciable change in port utilization, the impacts of this IPF on benthic resources attributed to the Proposed Action would be negligible.

**Presence of structures:** Under the Proposed Action, the presence of structures could result in various impacts. The nature of these sub-IPFs and their impacts on benthic resources are described in Section 3.5.2.3**.** The Proposed Action would construct up to 200 WTGs, 10 OSSs, and 1 met tower, and 289 acres (117 hectares) of scour protection around the foundations (Appendix D, Table D.A2-2). While up to 200 WTGs would be aligned in a uniform grid with rows in an east-northeast to west-southwest direction spaced 1.0 nautical mile (1.9 kilometers) apart and rows in an approximately north to south direction spaced 0.6 nautical mile (1.1 kilometers) apart, the OSSs and met tower would be sited in off-grid positions in the Lease Area. Based on the Cable Burial Risk Assessment (CBRA) developed for the Proposed Action (Atlantic Shores 2024, Appendix II-A5), the entirety of the Atlantic ECC would be suitable for jet trenching, whereas 11 out of 28 segments of the Monmouth ECC contained localized regions that would not be suitable for jet trenching. These results suggest that a greater percentage of the Monmouth ECC would require cable protection compared to the Atlantic ECC but do not provide a basis for estimating the amount of cable protection that would be required along each ECC. Although 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 in areas where sufficient burial depth is not achieved. Atlantic Shores is considering the use of one or more of five types of cable protection: (1) rock placement, (2) concrete mattresses, (3) rock bags, (4) grout-filled bags, and (5) half-shell pipes (COP Volume I, Section 4.5.7; Atlantic Shores 2024). Each of these forms of protective cable armor would create hard-bottom habitat up to 16 feet (5 meters) wide along cable corridors, resulting in an estimated 596 acres (241 hectares) of cable protection. The continuous hard-bottom habitat may fragment soft-bottom habitat communities, especially benthic infaunal communities, while presenting habitat opportunities for complex-bottom communities (e.g., biofouling communities that include anemones and barnacles).

The presence of the Offshore Project structures would convert soft-bottom habitat to hard-bottom habitat. This would result in permanent losses of soft-bottom habitat, including ecologically important complex sand ridge habitat that is present at some proposed WTG locations within the Project area. Loss of soft-bottom habitat would displace soft-bottom associated species (e.g., Atlantic surfclam, squid, and winter flounder) (Greene et al. 2010; Guida et al. 2017). New complex habitat communities that would inhabit the created hard-bottom habitat would include fouling/encrusting organisms, creating an array of biogenic reefs (Degraer et al. 2018; Fayram and de Risi 2007; Griffin et al. 2016; Hooper et al. 2017a, 2017b). Abundances and densities of new species assemblages at WTG foundations and cable scour protection would be influenced by the amount of surface area and seasonal availability of larval recruits. Areas surrounding WTG foundations would accumulate remains of fouling and attached organisms, which may provide habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Coates et al. 2013; Goddard and Love 2008). Colonization of new species could result in local increases (i.e., around wind -related structures) in biomass and diversity (Causon and Gill 2018), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). Impacts due to habitat conversion would be relatively local (extending up to 820 feet [250 meters] from foundation structures) (Lefaible et al. 2019, 2023) and range from moderate adverse to moderate beneficial and would persist for the operating life of each structure (i.e., until decommissioning and removal of the structures). Complex habitat communities that had formed on these hard structures would be destroyed when the hard structures are removed during decommissioning. Soft-bottom associated species (e.g., Atlantic surfclam, squid, and winter flounder) (Greene et al. 2010; Guida et al. 2017) could recolonize the newly restored soft sediments. Impacts due to the removal of structures and subsequent conversion of hard-bottom habitat back to soft-bottom habitat would be local and permanent but moderate. It is possible that, pending environmental assessment and regulatory approval, some foundations may be left in place as artificial reefs. In addition, scour protection and armoring associated with foundations and cables may be removed or left in place pending future environmental assessment. Although the removal of structures associated with the Proposed Action would greatly impact the organisms that utilize them, the removal would not result in population-level effects due to the presence of other hard structures in the geographic analysis area, including those associated with offshore wind.

Fishing gear including mesh from trawls or other similar nets, traps, and angling gear (e.g., fishing line, hooks, lures with hooks) could potentially become entangled or lost on structures associated with the Proposed Action. Lost gear actively continues to fish and may drift with currents. Marine organisms may become trapped or ensnared in lost or drifting gear, also known as “ghost” fishing gear, leading to injury or mortality. Crabs and lobsters are particularly vulnerable to entrapment in lost traps. Lost hooks, sometimes baited, and lures may be ingested by marine organisms, possibly causing harm. The increased risk of gear loss would persist for the operating life of the Project (i.e., until decommissioning/removal of structures). Atlantic Shores would regularly visually monitor all offshore structures as part of their normal O&M activities. If fishing gear is found to be entangled in wind farm structures, Atlantic Shores would assess potential safety risks as well as potential risks to marine life and navigation to inform a path forward (SEA-02; Appendix G, Table G-1). Impacts of gear loss due to the presence of Project-related structures on benthic resources are expected to be negligible.

As discussed in Section 3.5.2.3, once Project construction is complete, the presence of the WTG, OSS, and met tower foundations could result in some alteration of local water currents, which could alter local seasonal stratification of the water column, produce sediment scouring, and alter benthic habitat. Variation in the depth of the mixing layer due to hydrodynamic alterations could impact larval distribution of species with pelagic larvae (e.g., Chen et al. 2021). Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. Finfish aggregate trends along the Mid-Atlantic shelf have been shifting northeast into deeper waters (NOAA 2022); the presence of structures may reinforce these trends. The Proposed Action is located in the Cold Pool region of the Mid-Atlantic Bight described in Section 3.5.2.3, and its presence and water column structure play an important role in structuring regional ecosystems. Changes to the timing of the development and breakdown of the Cold Pool, its seasonal duration, and areal extent could affect the behavior and reproduction of fish and invertebrate species in the region (Miles et al. 2021); however, a recent review by Miles and others (2021) proposed that offshore foundation effects on the Cold Pool, where seasonal stratification is strong and tidal currents are weaker, may not be as pronounced as those in Northern Europe, where seasonal stratification is weaker, tidal currents are stronger, and turbulence is greater. Due to these differences in oceanographic characteristics, previous models of impacts on stratification in European waters may be more indicative of impacts on Cold Pool stratification during spring and fall when stratification is weaker, and structure-induced mixing may not be substantial enough to significantly affect the stronger stratification present in the Cold Pool during the summer (Miles et al. 2021).

Local changes in scour and sediment transport close to a foundation may alter sediment grain sizes and benthic community structure (Lefaible et al. 2019), though this impact is expected to be minimal due to the use of scour protection for each foundation. These effects, if present, would exist for the duration of the Proposed Action and would be reversed only after the Project has been decommissioned, although they may be permanent if scour protection is left in place.

New structures can be colonized by invasive species and also have the potential to facilitate range expansion of both native and nonnative aquatic species through the stepping-stone effect (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2020). Due to the pre-existing network of artificial reefs in the mid-Atlantic OCS, however, it is unlikely that the additional structures associated with the Proposed Action would measurably increase the potential for this effect. Further discussion on invasive species can be found in the *Accidental releases* IPF of Section 3.5.2.3. Although considered unlikely, the establishment of invasive species as a result of the Proposed Action could have strongly adverse, widespread, and permanent impacts on benthic resources if the species were to become established and out-compete native fauna.

Impacts due to fishing gear entanglement/loss and hydrodynamic disturbances are anticipated to be negligible, localized, and long term. Impacts due to habitat conversion and provision of hard structures are anticipated to range from moderate adverse to moderate beneficial, and be relatively localized and long term.

### *Impacts of the Connected Action*

As described in Chapter 2, as part of the Proposed Action, an O&M facility would be constructed in Atlantic City, New Jersey, on a site within the Inlet Marina area that was previously used for vessel docking or other port activities. The O&M facility would involve construction of a new building and potentially an associated parking structure, repairs to the existing docks, and installation of new dock facilities. Independently of the Proposed Action, Atlantic Shores is pursuing a USACE Nationwide Permit 13 to install an approximately 541-foot (165-meter) bulkhead composed of corrugated steel sheet pile. The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the approved permit. Bulkhead repair and/or installation, as well as maintenance dredging in coordination with Atlantic City's dredging of the adjacent basins, would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead and dredging activities are considered to be a connected action and are evaluated in this section.

The City's maintenance dredging program would reestablish a water depth of 15 feet (4.6 meters) below the plane of MLW plus 1.0 foot (0.3 meter) of allowable overdredge and 4:1 slide slopes within the site. Up to 142,823 cubic yards (109,196 cubic meters) of sediment within Clam Creek and Farley's Marina may be dredged as part of the connected action. Dredging would be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. The hydraulic cutterhead dredge would be the primary dredge method, with the mechanical dredge utilized to access small marina, canal, or lagoon areas. All resultant dredged material at the site would be removed and disposed of at Dredged Hole (DH) #86, a 14.4-acre (5.8-hectare) subaqueous borrow pit restoration site with degraded habitat, in Beach Thorofare in Atlantic City, New Jersey, and in accordance with Department of the Army Permit Number NAP-2020-00059-95. DH #86 is owned and maintained by NJDOT-OMR. Placement of dredged material into DH #86 is contingent upon execution of a use agreement between Atlantic City and NJDOT-OMR.

The connected action would affect benthic resources in the geographic analysis area through the following IPFs: accidental releases, anchoring, discharges/intakes, noise, and port utilization.

**Accidental releases:** The connected action could increase accidental releases of fuels/fluids/hazardous materials, trash and debris, and invasive species during bulkhead construction and dredging activities at the O&M facility. BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Therefore, impacts of the connected action would not significantly increase the risk of accidental releases. In the event of a release, it would be an accidental, localized event in the vicinity of the O&M facility, and therefore Project-related accidental releases would only have a localized, negligible, short-term effect on benthic resources.

**Anchoring:** The connected action could cause impacts due to increased anchoring of vessels associated with construction activities at the Inlet Marina area. Anchor/chain contact with the seafloor could cause injury to and mortality of benthic resources, as well as physical damage to their habitats. Impacts on seafloor habitats could be long term if they occur on hard-bottom habitat; however, sediments in the area of the connected action are primarily fine (sandy silt/clay). Mortality of organisms may occur, but affected areas are expected to be recolonized quickly. Resuspension of sediments and burial from redeposition are indirect impacts from anchoring. Dispersal of resuspended sediments is dependent on bottom currents, and burial of benthic organisms is possible. Mobile organisms may avoid burial by repositioning in the sediments or moving away. Recovery from non-permanent impacts in the silty sediments of the area of the connected action is expected to occur rapidly; therefore, impacts from anchoring activities associated with the connected action are expected to be negligible, localized, and short term.

**Discharges/intakes:** There would be increased potential for discharges from vessels during construction and operational activities related to the connected action, and it is expected that these discharges would be staggered over time and localized. At least three vessels (dredge vessel, tug, and scow) would be required to conduct dredging operations associated with the connected action. Dredging operations would not result in a permanent increase in vessel traffic because the vessels would only be present during dredging. Vessel traffic associated with construction activities for the connected action would not be permanent. Furthermore, use of the Inlet Marina following construction would not result in a net increase in commercial vessel traffic and is not expected to exceed an increase of two non-commercial vessels. All vessels associated with the connected action are expected to comply with environmental permitting standards for discharged materials. Additionally, most permitted discharges, including uncontaminated bilge water and treated liquid wastes, occur offshore from ports. Impacts on benthic resources from vessel discharges associated with the connected action, if any, would be localized, short term, and negligible.

**Noise:** The connected action would result in elevated levels of underwater noise due to construction and installation activities, vessels, pile driving, and dredging (see Section 3.5.2.3 for a detailed description of the impacts of these activities on benthic resources). Construction vessels would include at least three vessel types (dredge vessel, tug, and scow) during a temporary construction window. Additionally, in-water construction activities, including the installation of sheet piles, are only expected to create a small amount of noise. Impacts from increased vessel noise and in-water construction activities are expected to be negligible, localized, and short term.

Little is known about the effects of noise on benthic invertebrates. Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not likely to experience barotrauma from pile driving. Vibration from impact pile driving can be transmitted through sediments. As described in Section 3.5.2.3, benthic invertebrates are sensitive to the particle motion component of noise.

Detectable particle motion effects on invertebrates are typically limited to within 7 feet (2 meters) of the source or less (Carroll et al. 2017; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007). The research thus far indicates that marine crustaceans may alter their natural behaviors in response to pile-driving sounds, but further work is required to understand the biological significance of these changes, and whether substrate-borne or water-borne particle motion has a greater influence on their behavior. The overall impacts of noise from pile installation activities would be minor, temporary, and localized.

**Port utilization:** The connected action includes the repair/replacement of a bulkhead and maintenance dredging. Up to 142,823 cubic yards (109,196 cubic meters) of sediment within Clam Creek and Farley's Marina may be dredged as part of the connected action. All dredging work conducted within the small marina area of the connected action would be performed using a mechanical dredge. Sediments within the area of the connected action are primarily sandy silt/clay. Dredging and bulkhead replacement conducted during construction as part of the connected action would also result in increased total suspended sediment concentrations in the area. Mechanical dredging activities could result in total suspended sediment concentrations of up to 445 mg/L above ambient conditions (NMFS 2021b). Pile driving could result in total suspended sediment concentrations of approximately 5 to 10 mg/L above ambient conditions within approximately 300 feet (91 meters) of the point of origin (FHWA 2012). However, these elevated total suspended sediment concentrations are below the short-term (1 to 2 days) concentrations shown to have adverse effects on benthic communities (390 mg/L) (USEPA 1986). Elevated suspended sediment levels would be temporary, and most fish and invertebrates are capable of mediating temporary increases in suspended sediment by expelling filtered sediments or reducing filtration rates (NYSERDA 2017; Bergstrom et al. 2013; Clarke and Wilber 2000). Disturbed sediments that are resuspended into the water column may drift or disperse to nearby locations before settling. Resuspended sediments may include resuspension of chemical contaminants, especially in coastal and inland waters. Redeposition of disturbed sediments may temporarily or permanently alter nearby complex hard-bottom habitats and may bury benthic organisms. possibly resulting in mortality of benthic organisms and benthic and demersal life stages (e.g., eggs and larvae). In response to moderate sediment deposition, infaunal organisms (e.g., marine worms) may reposition in the sediments to avoid smothering (Hinchey et al. 2006), while mobile organisms (e.g., fishes, crustaceans) may actively avoid areas of deposition. However, some demersal eggs and larvae (e.g., longfin squid, winter flounder, ocean pout) could be buried by suspended sediment that settles in following dredging. Impacts from sediment suspension and deposition on benthic invertebrates would be temporary and localized to the 20.6-acre (8.3-hectare) dredge footprint. Habitat disturbance and modification associated with dredging could result in short-term habitat disturbance and modification within the dredge footprint, where all benthic organisms would be removed and the post-dredging surface substrates would consist of unconsolidated sediments. It is anticipated that sediments within the dredge footprint would quickly be recolonized by benthic organisms from surrounding, undisturbed sediments. Sandy or silty habitats, which are abundant in the geographic analysis area and in the vicinity of the connected action, recover fairly quickly from disturbance, although recovery time varies by region, species, and type of disturbance. For a more detailed discussion on the recovery of soft sediment benthic communities after disturbance, see the *Cable emplacement and maintenance* IPF in Section 3.5.2.3. Dredging may increase water depths by up to 21 feet (6.4 meters), which is not expected to have a significant impact on benthic community composition following recolonization of the dredged area. Dredging is not expected to alter the sediment composition compared to the existing substrate in the dredge area. Given there would be no change in sediment composition, subsequent changes in benthic community composition would not be expected. However, the surface sediments following dredging may contain increased concentrations of contaminants, which may affect recolonizing benthic invertebrates. Impacts from habitat disturbance and modification on benthic invertebrates would be short term and localized to the 20.6-acre (8.3-hectare) dredge footprint.

All dredged material would be mechanically and hydraulically placed at DH #86 in Beach Thorofare. The volume of dredged material from the connected action would represent a small fraction of the total dredged material placed within DH #86. Within DH #86, the depth below the surrounding natural seabed ranges from approximately 5 feet (1.52 meters) below MLW to 57 feet (17.37 meters) below MLW. DH #86 is approximately 14 acres (5.7 hectares) in size and is characterized by a rapidly changing and uneven bathymetry and steep sides (McKenna et al. 2018). Sediment, benthic infauna and epifauna, fish, and water quality field surveys were conducted from 2016 to 2018 to characterize the existing habitat in DH #86 and other dredged holes in the area (McKenna et al. 2018). Sediments within DH #86 were finer (silts and clays) and had a higher total organic content (TOC) (ranging from 8.34 percent to 10.77 percent) than the surrounding seabed, which was composed of very fine sand and a much lower organic content (TOC ranging from 2.8 percent to 6.92 percent). Elevated levels of arsenic, copper, and chromium, and slightly elevated levels of carbon disulfide and methylene chloride were detected in composite sediment samples taken from DH #86. Hypoxic conditions (2 mg/L) were observed during spring and summer surveys, but not during the winter survey. Water column total suspended sediment levels (ranging from 26 to 59 mg/L) greatly exceeded the desirable submerged aquatic vegetation (SAV) habitat limit of <15 mg/L as defined by Batiuk and others (2000). Although NJDEP SAV surveys conducted in 1979 noted the presence of SAV in the vicinity of DH #86 (NJDEP 2022a), no SAV was observed within or surrounding DH #86 during the 2016–2018 surveys. Large patches of drift macroalgae, which provided habitat for summer and winter flounder and invertebrates, were present in areas less than 25 feet (7.62 meters) deep in DH #86 and in the nearby control area. Crustaceans and polychaetes were the most abundant benthic invertebrates collected in the surveys. Both the diversity and abundance of benthic organisms were low within DH #86 and the surrounding seabed, particularly so at depths greater than 15 feet (4.57 meters), and numbers of fish collected within DH #86 were also low. Based on these surveys, DH #86 provides generally poor-quality benthic habitat. The addition of dredge material of DH #86 to bring the bottom depth in line with that of the surrounding seabed (6 feet [1.83 meters]) would benefit the DH #86 area. The filling of DH #86 may help increase current flow over the area, minimize accumulation of detritus and decaying macroalgae, and alleviate seasonal anoxia, all of which would improve the habitat quality of the area (McKenna et al. 2018).

As part of the bulkhead repair/replacement, 212 cubic yards of imported granular clean fill would be placed in the water and would cover a surface area of 1,082 square feet.[1] Any benthic organisms present in this footprint would be buried and likely experience mortality. Additionally, placement of fill may increase the level of suspended sediments in the vicinity of construction activities; however, these elevated suspended sediment levels would be temporary, and as mentioned previously, most fish and invertebrates are capable of mediating temporary increases in suspended sediment. Suspended fill sediments in the water column may drift or disperse to nearby locations before settling. Redeposition of these suspended fill sediments may temporarily or permanently alter nearby complex hard-bottom habitats and may bury benthic organisms, possibly resulting in mortality of benthic organisms and benthic and demersal life stages (e.g., eggs, larvae). Because the fill is clean and free from contaminants, resultant suspended sediments will not introduce chemical contaminants to surrounding areas. Impacts from fill sediment suspension and deposition on benthic invertebrates would be temporary and localized.

#### 3.5.2.6 Cumulative Impacts of Alternative B – Proposed Action

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities that affect benthic resources in the geographic analysis area include development activities for undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; onshore development activities; and global climate change. The connected action involves the repair/replacement of an existing bulkhead to stabilize the shoreline and prevent additional erosion and maintenance dredging to maintain safe navigational depths for vessels. Planned offshore wind activities in the geographic analysis area for benthic resources include the construction, O&M, and decommissioning of the Ocean Wind 1 project in Lease Area OCS-A 0498, the Ocean Wind 2 project in Lease Area OCS-A 0532, and the Atlantic Shores North project in Lease Area OCS-A 0549.

**Accidental releases:** The cumulative impacts of onshore and offshore accidental releases from ongoing and planned activities on benthic resources would likely range from negligible, localized, short term (for fuels/fluids/hazardous materials, trash, and debris) to moderate, possibly widespread, and long term (for invasive species). BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, large-scale releases are unlikely, and impacts from small-scale releases would be localized and short term, resulting in little change to benthic resources. The risk of accidental release and possible

[1] The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the respective approved permits.

establishment of invasive species in the geographic analysis area would be greater due to increased vessel traffic.

**Anchoring:** Anchoring impacts from ongoing and planned activities would be localized, and negligible to minor due to the relatively small size of the affected areas compared to the remaining area of the open ocean within the geographic analysis area and short-term nature of the impacts. Additionally, Project-related anchoring activity would be limited, as the use of vessel dynamic positioning systems is likely, and the construction and decommissioning phases would occur over a relatively short window.

**Cable emplacement and maintenance:** Ongoing and planned cable emplacement and maintenance for other offshore wind activities would generate comparable types of impacts to those of the Proposed Action for each offshore export cable route and interarray cable system. Offshore export cable and interarray cables for up to three other offshore wind projects could be under construction simultaneously while the Proposed Action is in operation. The Proposed Action in combination with the other planned offshore wind development within the geographic analysis area is estimated to result in 6,757 acres (2,734.5 hectares) of seabed disturbance in the geographic analysis area (Appendix D, Table D.A2-2), of which the Proposed Action represents 8.81 percent. Simultaneous construction of export and interarray cables for the three adjacent projects would have an additive effect, although it is assumed that only a portion of a project's cable system would be undergoing installation or maintenance at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export and interarray cable installation activities for other offshore wind projects outside of the geographic analysis area. As a result, the contribution of the Proposed Action to the impacts on benthic resources from cable installation from ongoing and planned activities would be localized, temporary, and intermittent. BOEM expects that the cumulative impacts of cable emplacement and maintenance on benthic resources would be minor to moderate. Overall impacts from cable emplacement and maintenance activities at the cable landfall at the Monmouth or Atlantic ECC landfall sites related to sediment resuspension and deposition would be short term, localized, and minor due to the relatively quick recovery time associated with soft-bottom communities in the area. Removal of cable scour protection during decommissioning activities may result in localized, moderate, and permanent impacts.

**Discharges/intakes:** There would be increased potential for discharges from vessels during construction, operations, and decommissioning activities related to the Proposed Action, connected action, and the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects; however, it is expected that these discharges would be staggered over time and localized. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Cumulative impacts of discharges resulting from ongoing and planned activities would be short term, localized, and minor.

**Electric and magnetic fields and cable heat:** Export and interarray cables from the Proposed Action and planned offshore wind development would add an estimated 2,604 miles (4,191 kilometers) of buried cable to the geographic analysis area (Appendix D, Table D.A2-1), producing EMF and cable heat in the immediate vicinity of each cable during operation. EMF effects on benthic habitats could be behavioral or physiological and would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). BOEM would require these future submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. Cumulative impacts of EMF and cable heat from ongoing and planned activities in the geographic analysis area would likely be minor and localized, based on current research; however, more research is needed to better understand the effects of EMF on benthic organisms.

**Gear utilization:** Cumulative impacts of gear utilization from ongoing and planned activities would likely be negligible, given the small amount of area that would be surveyed in comparison to the larger geographic analysis area.

**Noise:** Planned offshore wind activities and the connected action would generate comparable types of noise impacts to those of the Proposed Action. The most significant sources of noise are expected to be pile driving followed by vessels. If multiple piles are driven simultaneously, the areas of potential injury or mortality would not overlap. Project vessels would only represent a small fraction of the large volume of existing traffic in the geographic analysis area. The areas of behavioral impacts may overlap; although the noises from driving multiple piles are unlikely to overlap at any one time, individuals may be affected by noise from sequential events before they have fully recovered from previous exposures (Hawkins and Popper 2014). Cumulative noise impacts on benthic resources from ongoing and planned activities would likely range from negligible to moderate and would be short term and localized to somewhat widespread.

**Port utilization:** Increases in port utilization due to the Proposed Action, connected action, and planned offshore wind development would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a period of 4 years (2026–2030) and would decrease during operations but increase again during decommissioning. Increased port utilization and expansion results in increased vessel noise and increased suspended sediment concentrations during port expansion activities. Any port expansion and construction activities related to planned offshore wind projects would add to the total amount of disturbed benthic area, resulting in disturbance and mortality of individuals and short-term to permanent habitat alteration. Existing ports are heavily modified or impaired benthic environments, and future port projects would likely implement BMPs to minimize impacts (e.g., stormwater management, turbidity curtains). The degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of the port expansion activities. Cumulative impacts of port utilization associated with ongoing and planned activities would be localized and range from short term and negligible (for water quality and vessel noise impacts) to permanent and major (for port expansion activities that heavily modify benthic environments).

**Presence of structures:** The Proposed Action, in combination with the planned offshore wind activity, would add up to 566 WTGs and 22 OSSs and met towers (Appendix D, Tables D.A2-1 and D.A2-2), as well as hard scour protection around the WTG foundations and export and interarray cables in the geographic analysis area. The presence of these structures could impact local hydrodynamics, increase the risk of gear entanglement and loss, convert soft-bottom habitat to hard-bottom habitat, and increase the risk of establishment of invasive species. Cumulative impacts of the presence of structures from ongoing and planned activities would be moderate, localized, and long term. Fish and invertebrate aggregations from the addition of structurally complex hard-bottom habitat within the geographic analysis area, where such habitat is limited, may have a moderate beneficial impact. Although considered unlikely, the establishment of invasive species could have strongly adverse, widespread, and permanent impacts on benthic resources if the species were to become established and out-compete native fauna.

### *Conclusions*

I**mpacts of Alternative B – Proposed Action.** IPFs associated with the Planned Action would result in a range of negligible to moderate adverse impacts, with some moderate beneficial impacts on benthic resources in the geographic analysis area. IPFs generating negligible impacts during the construction and installation phase include accidental spills of fuels, fluids, hazardous materials, trash, and debris; discharges/intakes; noise generated from cable burial/trenching and G&G surveys; port utilization; and gear loss related to the presence of structures. Impacts from anchoring may be minor to moderate within the geographic analysis area. Other IPFs producing minor impacts include pile-driving noise, seabed profile alterations, and sediment resuspension and deposition from cable emplacement and maintenance. Moderate adverse to moderate beneficial impacts are possible from habitat conversion due to the presence of structures. IPFs producing moderate impacts include the risk of introduction of invasive species from ballast/bilge water.

IPFs generating negligible impacts during the O&M phase include accidental spills of fuels, fluids, hazardous materials, trash, and debris; anchoring; cable maintenance activities; discharges/intakes; EMF and cable heat; noise generated during O&M activities; port utilization; and gear loss related to the presence of structures. IPFs generating negligible impacts during the decommissioning phase include accidental spills of fuels, fluids, hazardous materials, trash, and debris; discharges; noise generated from vessels; port utilization; and gear loss related to the presence of structures. Impacts from anchoring may be minor to moderate within the geographic analysis area. The removal of WTG foundations would result in moderate adverse impacts on benthic resources due to the loss of hard-bottom habitat associated with these structures and the noise associated with their removal. These disturbances to the sediment profile and the resuspension and deposition of sediments as a result of cable and scour protection removal activities would result in minor adverse impacts. The Proposed Action would result in overall **moderate adverse** impacts on benthic resources; despite benthic resource mortality and short-term or permanent habitat alteration, the resources would likely recover naturally over time. The Proposed Action would also result in **moderate beneficial** impacts associated with the presence of structures and associated addition of structurally complex hard-bottom habitat.

BOEM expects that individual IPFs associated with the connected action alone would have a range of negligible to minor impacts on benthic resources due to noise from pile installation activities and habitat disturbance related to dredging activities; however, overall impacts from the connected action alone would be minor as adverse impacts that do occur would be temporary or short term in nature.

**Cumulative Impacts of Alternative B – Proposed Action.** Cumulative impacts of the Proposed Action in combination with the connected action and other ongoing and planned activities would vary by individual IPF and would range from negligible to moderate adverse and moderate beneficial. The primary IPFs are noise from pile driving, accidental releases of invasive species, cable emplacement and maintenance, and the presence of structures. Considering all the IPFs together (accidental releases, anchoring, cable emplacement and maintenance, discharges, EMF and heat, gear utilization, noise, and port utilization), BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Proposed Action would result in individual IPFs with a range of negligible to moderate adverse and moderate beneficial impacts on benthic resources; however, overall impacts would be **moderate adverse**, primarily due to habitat disturbance and conversion, as adverse impacts would be unavoidable but would not result in population-level effects. Beneficial impacts could result from emplacement of structures (habitat conversion to hard substrate), but these impacts would be **moderate beneficial** because they would not result in population-level effects.

#### 3.5.2.7 Impacts of Alternatives C, D, and E

**Impacts of Alternatives C, D, and E.** Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) involves the removal, or micrositing of up to 29 WTGs, 1 OSS, and associated interarray cables within the NMFS AOCs to avoid and minimize impacts on important sensitive habitats. Under Alternative C1, up to 16 WTGs, 1 OSS, and associated interarray cables within the Lobster Hole designated area (AOC 1) as identified by NMFS would be removed. Under Alternative C2, up to 13 WTGs and associated interarray cables within the NMFS-identified sand ridge complex in the southernmost portion of the Lease Area (AOC 2) would be removed. Under Alternative C3, up to six WTGs located within 1,000 feet (305 meters) of the sand ridge complex area identified by NMFS and further demarcated using NOAA’s Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores would be removed. Alternative C4 would involve the micrositing of up to 29 WTGs, 1 OSS, and associated interarray cables outside of the 1,000-foot (305-meter) buffer of the ridge and swale features within both AOC 1 and AOC 2. The “Lobster Hole” designated recreational fishing area (AOC 1) is a broad swale/depression that extends roughly from the middle of the eastern edge of the WTA towards its center. AOC 2 and the demarcated sand ridge complex are parts of a larger sand ridge and trough complex that crosses the WTA. The installation of WTGs and their associated scour protection and interarray cables within AOC 1, AOC 2, and/or the demarcated sand ridge complex would result in impacts on these important habitats through sediment resuspension and deposition and sediment profile alterations. Additionally, the presence of wind farm structures could alter hydrodynamics and predator-prey interactions in these habitats. The NMFS AOCs and the demarcated sand ridge complex all have pronounced bottom features and produce habitat value. Swale, trough, and ridge habitats provide complex physical structures, which are often associated with greater species diversity, abundance, overall function, and productivity. In the mid-Atlantic, sand ridges and troughs are areas of biological significance for migration and spawning of mid-Atlantic fish species, many of which are recreationally targeted in those specific areas. Alternative C1 would avoid or minimize impacts on AOC 1, and Alternative C2 would avoid or minimize impacts on AOC 2. A combination of Alternatives C1 and C2 would allow for the removal of up to 29 WTGs, 1 OSS, and associated interarray cables from both the

AOC 1 and AOC 2 areas, thus avoiding or minimizing impacts on both NMFS AOCs and the valuable habitat contained within. Alternative C3 would avoid or minimize impacts on the valuable habitat located within the demarcated sand ridge complex. Alternative C4 would microsite 29 WTGs, 1 OSS, and associated interarray cables outside of the 1,000-foot (305-meter) buffer of the ridge and swale features within AOC 1 and AOC 2, serving to minimize impacts on the important habitat features located within these areas. Through one or more of the sub-alternatives of Alternative C and the associated removal or micrositing of up to 29 WTGs, impacts on the valuable habitats present in AOC 1, AOC 2, and/or the demarcated sand ridge complex could be avoided or minimized, which would have beneficial impacts on benthic communities as well as fish species who utilize these areas.

Under Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), the layout and maximum number of WTGs would be adjusted to reduce visual impacts, which could result in the removal of up to 31 WTGs. The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters). Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) involves the removal or micrositing of up to 5 WTGs to establish a setback between the Atlantic Shores South and Ocean Wind 1 WTGs. All of these alternatives would be within the range of the design parameters outlined in the Atlantic Shores COP, and subject to applicable mitigation measures.

Construction and installation, O&M, and decommissioning of Alternatives C, D, and E would only differ from the Proposed Action for offshore activities and facilities. Onshore activities and facilities would be the same as those described under the Proposed Action (Section 3.5.2.5). Offshore construction and installation, O&M, and decommissioning activities under Alternatives C, D, and E would have potential impacts on benthic resources from IPFs similar to those of the Proposed Action. Alternatives C, D, and E would potentially benefit benthic resources through reduced effects on benthic habitats (see Table 3.5.2-5). The removal or micrositing of up to 29 WTGs and 1 OSS under Alternative C, removal of up to 31 WTGs under Alternative D, or removal or micrositing of up to 5 WTGs under Alternative E would result in a proportional decrease in the amount of EMF and noise impacts and benthic habitat disturbance and conversion related to the installation of foundations, interarray cables, and scour protection. Although impacts on benthic resources would be reduced under Alternatives C, D, and E, overall impacts on benthic resources would be similar to those under the Proposed Action.

**Cumulative Impacts of Alternatives C, D, and E.** The cumulative impacts of Alternatives C, D, and E would be similar to those for the Proposed Action. This determination is driven mostly by the effects of climate change, new cable emplacement and pile-driving activities, the presence of new offshore wind structures, and seafloor disturbances caused by dredging and bottom-tending fishing gear.

### *Conclusions*

**Impacts of Alternatives C, D, and E.** The impacts on benthic resources resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives C, D, and E would be the same as or substantially similar to those described under the

Proposed Action. None of the differences between these alternatives and the Proposed Action would have the potential to significantly reduce or increase overall impacts on benthic resources from the analyzed IPFs; however, Alternative C would reduce the impacts on the valuable habitat in AOC 1, AOC 2, and/or the demarcated sand ridge complex. All conclusions reached for the Proposed Action also apply to Alternatives C, D, and E, with impacts from individual IPFs on benthic resources ranging from negligible to moderate adverse, with some moderate beneficial impacts, depending on Project stage and location (onshore, offshore). Overall impacts for Alternatives C, D, and E would be the same as for the Proposed Action, **moderate adverse** and **moderate beneficial**.

**Cumulative Impacts of Alternatives C, D, and E.** The cumulative impacts of Alternatives C, D, and E would result in impacts from individual IPFs that range from negligible to moderate adverse and moderate beneficial; however, overall impacts would be **moderate adverse**, primarily due to habitat disturbance and conversion, as adverse impacts would be unavoidable but would not result in population-level effects. Beneficial impacts could result from emplacement of structures (habitat conversion to hard substrate), but these impacts would be **moderate beneficial** because they would not result in population-level effects.

### 3.5.2.8 Impacts of Alternative F on Benthic Resources

**Impacts of Alternative F.** Alternative F (Foundation Structures) analyzes the use of piled (Alternative F1), suction bucket (Alternative F2), and gravity-based (Alternative F3) foundations for WTGs, OSSs, and the met tower. Different foundation types could be used for different components (e.g., WTGs and OSSs) of the Project. The foundation type selected for the WTGs may be different from the foundation type selected for OSSs or the permanent met tower. A combination of foundation types could also be used for WTGs within the Project.

Construction and installation, O&M, and decommissioning of Alternative F would only differ from the Proposed Action in offshore activities. Onshore activities and facilities and offshore facilities would be the same as those described under the Proposed Action (Section 3.5.2.5).

Though all potential offshore activities under Alternative F were evaluated under the Proposed Action, sub-alternatives of Alternative F may exclude some activities evaluated under the Proposed Action. Activities would not differ between the Proposed Action and Alternative F1. Under Alternatives F2 and F3, no impact pile driving would be conducted; therefore, there would be no underwater noise impacts on benthic resources due to impact pile driving. The avoidance of impact pile-driving noise impacts would reduce overall construction and installation impacts on benthic resources under Alternatives F2 and F3 compared to the Proposed Action.

Though offshore construction activities would not differ between Alternative F and the Proposed Action, offshore impacts under some sub-alternatives may be reduced due to reductions in habitat conversion associated with some foundation types (see Table 3.5.2-5). Suction bucket foundations (Alternative F2) would result in the greatest area of habitat conversion due to scour protection, and the impacts were evaluated under the Proposed Action. Alternatives F1 and F3 would result in a reduction in scour protection compared to the Proposed Action and Alternative F2. Less scour protection would result in loss of less soft-bottom habitat. It would also result in a lower artificial reef effect compared to the Proposed Action and Alternative F2 but may also reduce risk of lost recreational fishing gear. Given that Alternatives F1 and F3 would result in reductions in both adverse and beneficial impacts, impacts on benthic resources under these alternatives are not expected to be measurably different from those anticipated under the Proposed Action.

**Cumulative Impacts of Alternative F.** The cumulative impacts of Alternative F would be similar to those proposed for the Proposed Action. This determination is driven mostly by the effects of new cable emplacement and pile-driving activities, the presence of new offshore wind structures, and seafloor disturbances caused by dredging and bottom-tending fishing gear.

*Conclusions*

**Impacts of Alternative F.** Impacts of Alternative F1 would not be measurably different from the impacts of the Proposed Action. Therefore, construction and installation, O&M, and decommissioning of Alternative F1 would result in individual IPFs with impacts ranging from negligible to moderate adverse due to sediment resuspension and deposition related to cable-laying activities, anchoring, and accidental releases of fuels, fluids, hazardous materials, trash, and debris and could include moderate beneficial impacts due to habitat conversion by the presence of hard structures. Overall impacts of Alternative F1 would be **moderate adverse** and **moderate beneficial**.

Impacts of Alternatives F2 and F3 would be measurably different from the impacts of the Proposed Action due to the avoidance of impact pile-driving noise impacts. Construction and installation, O&M, and decommissioning of Alternatives F2 and F3 would result in individual IPFs with negligible to minor adverse impacts on benthic resources. Due to the reduction in scour protection and the beneficial hard-bottom habitat it provides, Alternative F could include only minor beneficial impacts. Overall impacts of Alternatives F2 and F3 would be **minor adverse** and **minor beneficial**.

**Cumulative Impacts of Alternative F.** The cumulative impacts of Alternative F would be **moderate,** primarily due to habitat disturbance and conversion, as adverse impacts would be unavoidable but would not result in population-level effects. Beneficial impacts could result from emplacement of structures (habitat conversion to hard substrate), but these impacts would be **moderate beneficial** because they would not result in population-level effects.

### 3.5.2.9 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Tables G-2 through G-4 and summarized and assessed in Table 3.5.2-4. After publication of the Draft EIS, BOEM conducted consultation with NMFS pursuant to Section 305(b) of the MSA (i.e., EFH consultation), which resulted in NMFS issuing EFH Conservation Recommendations. EFH Conservation Recommendations are analyzed collectively in Table 3.5.2-4. If one or more of the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts on benthic resources could be further reduced.

**Table 3.5.2-4 Proposed mitigation measures – benthic resources**

| Measure | Description | Effect |
|---|---|---|
| Marine debris awareness training | Vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP must complete marine trash and debris awareness training annually. The Lessee must submit an annual report describing its marine trash and debris awareness training process and certifies that the training process was followed for the previous calendar year. | Marine debris and trash awareness training would minimize the risk of marine debris settling on the seafloor. While adoption of this measure would decrease risk to benthic resources under the Proposed Action, it would not alter the impact determination of negligible for accidental spills and releases. |
| Artificial reef buffer for turbines | The Lessee must remove a single turbine approximately 150–200 feet (45.8–61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site). | This measure would reduce impacts on benthic resources by removing the footprint of one foundation. While adoption of this measure would reduce risk to benthic resources under the Proposed Action, it would not alter the impact determination of minor associated with the presence of structures. |
| Cable Maintenance Plan | In conjunction with cable monitoring, the Lessee will develop and implement a Cable Maintenance Plan that requires prompt remedial burial of exposed and shallow-buried cable segments, review to address repeat exposures, and a process for identifying when cable burial depths reach unacceptable risk levels. | This measure would reduce the risk of EMF exposure to organisms by ensuring proper burial depth. While adoption of this measure would reduce risk to benthic resources and invertebrates under the Proposed Action, it would not alter the impact determination of minor associated with EMF. |
| Fishing-gear friendly cable protection measures | Use mobile fishing gear-friendly cable protection measures to better reflect pre-existing conditions along seafloor cable routes consistent with N.J.A.C. 7:7-16.2, to the maximum extent practicable. | This measure would reduce potential impacts on benthic resources by reducing hangs for mobile fishing gear, which would disturb benthic habitat. While adoption of this measure would reduce impacts on benthic resources, it would not alter the impact determination of moderate for cable emplacement and maintenance. |
| EFH Conservation Recommendations | EFH Conservation Recommendations from NMFS were transmitted by letter dated October 16, 2023. EFH Conservation Recommendations for activities under BOEM's jurisdiction were provided for WTG and cable installation and relocation (micrositing), anchoring, artificial reef avoidance, spill prevention, anti-corrosion measures, habitat alteration minimization, boulder relocation, marine debris removal, scour protection, noise mitigation, contents | Implementation of Conservation Recommendations, including micrositing WTGs, scour protection material and avoidance, anchoring avoidance and practices, reduced distance in boulder/cobble relocation, sand bedform removal avoidance, conservation of submarine topography and benthic features, over-trenching and sufficient cable burial depth, cable cross-mapping, and seafloor |

| Measure | Description | Effect |
|---|---|---|
| | of the Benthic Habitat Monitoring Plan, and development of a Project-specific *in situ* Monitoring Plan. EFH Conservation Recommendations for activities under USACE's jurisdiction were provided for inshore/estuarine habitat impact minimization, mitigation of impacts on scientific surveys, artificial reef avoidance and *in situ* impact monitoring, and provision of locations of relocated boulders, created berms, scour protection, and cables requiring wet storage. | surveying and monitoring would minimize known or reasonably foreseeable adverse impacts on benthic habitats and features, sensitive habitats, sand bedforms, NOAA Complex Category habitats, the western portion of Lobster Hole (AOC 1), the stable, spatially complex, high-relief sand ridge/trough habitats in the southern tip of the Lease Area, and artificial reefs, including the Atlantic City Reef, Manasquan Inlet Reef, and Axel Carson Reef, minimizing the potential for elimination/conversion of existing benthic habitats.<br>Conservation Recommendations for inshore/estuarine and nearshore areas, including the use of HDD, micrositing, and re-rerouting during cable installation, the avoidance of sidecasting and open-water disposal during trenching activities, the use of a closed clamshell/environmental bucket dredge and upland disposal during dredging activities in areas with elevated levels of contaminants, and the restoration of disturbed areas to pre-construction conditions would minimize impacts on inshore/estuarine and nearshore benthic habitats and species.<br>Conservation Recommendations for noise during construction, such as the use of additional noise dampening/mitigation measures during all impact pile driving within 5.9 nautical miles (11 kilometers) of any artificial reef sites/shipwrecks/fish havens (such as the Atlantic City Reef, the Great Egg Reef, and the Little Egg Reef), mandatory quiet periods during pile driving of at least 4 hours per 24 hours, and noise mitigation protocols in consultation with resource agencies prior to construction activities, would avoid and minimize potential noise impacts on benthic species and habitat.<br>Conservation Recommendations for spill preventative measures, anti-corrosion measures, and marine debris removal would minimize potential impacts from any marine debris collected during pre-lay grapnel runs and chemicals, contaminant emissions, anti-corrosive coatings and |

| Measure | Description | Effect |
| --- | --- | --- |
| | | sacrificial anodes to benthic habitats and species. Conservation Recommendations to revise the Benthic Habitat Monitoring Plan would benefit benthic habitat and species by ensuring robust experimental design, methods, and data collection/analysis to assess changes in benthic communities in the Project area.<br>The Conservation Recommendation to mitigate impacts on NMFS scientific surveys would ensure that NMFS can continue to monitor the status and health of trust resources.<br>The Conservation Recommendations to develop a Project-specific *in situ* Monitoring Program and to perform pre-, during, and post-construction *in situ* monitoring of artificial reefs would benefit benthic habitat and species by assessing the stressors created by Project operation on benthic communities in the Project area, and stressors created by Project construction and operation on artificial reefs, from the presence of turbines, construction and operational noise, heat and EMF exposure, and oceanic-wind wake effects, as well as monitor impacts on fish behavior, species occurrence, community composition, and density and abundance on artificial reefs.<br>Conservation Recommendations to provide the locations of relocated boulders, created berms, scour protection, and cables requiring wet storage to relevant marine users would minimize impacts on benthic habitat by reducing the potential of gear obstructions, which would disturb benthic habitat.<br>Although the Conservation Recommendations would provide incremental reductions in impacts on sensitive and complex habitats and artificial reefs, reductions in the overall impact rating are not anticipated for any of the Proposed Action's IPFs. |

### *Measures Incorporated in the Preferred Alternative*

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.5.2-4 and Tables G-2 through G-4 in Appendix G are incorporated into the Preferred Alternative. These measures, if adopted, would have the effect of reducing the potential for interactions with sensitive and complex benthic habitats, inshore/estuarine and nearshore habitats, and artificial reef habitat, as well as reducing impacts on benthic resources related to EMF, noise, marine debris, contaminant emissions, anti-corrosive measures, anchoring, scour protection, gear obstructions, and cable emplacement and maintenance. While the impact determination for benthic resources described in Section 3.5.2.5 would not change, these measures would ensure the effectiveness of, and compliance with, EPMs already analyzed as part of the Proposed Action.

## 3.5.2.10 Comparison of Alternatives

Construction and installation, O&M, and decommissioning of Alternatives C, D, E, and F1 would have the same moderate adverse impacts and moderate beneficial impacts on benthic resources as described under the Proposed Action. Alternative C would result in slightly less impacts on benthic resources due to the avoidance and minimization of impacts on sensitive habitats and the potential removal, relocation, or micrositing of up to 29 WTGs, 1 OSS, and associated interarray cables (Table 3.5.2-5). Alternatives D and E would result in slightly less effects on benthic resources due to the potential removal or relocation of up to 31 WTGs and associated interarray cables or up to 5 WTGs and associated interarray cables, respectively.

Construction and installation, O&M, and decommissioning of Alternatives F2 and F3 would have minor adverse impacts and minor beneficial impacts on benthic resources. This reduction in impacts would be due to avoidance of impact pile-driving noise effects on benthic resources.

**Table 3.5.2-5 Comparison of alternatives**

| Alternative | Number of WTGs[1] | Foundation + Scour Protection Footprint (acres)[2] | Interarray Cable Length (miles)[3] |
|---|---|---|---|
| B | 200 | 261 | 547 |
| C1 | 184 | 240 | 504.1 |
| C2 | 187 | 244 | 512.4 |
| C3 | 194 | 255.8 | 531.6 |
| C4 | 200 | 261 | 547 |
| D1 | 179 | 233.6 | 490.5 |
| D2 | 169 | 220.5 | 463.1 |
| D3 | 194 | 255.8 | 531.6 |
| E | 195 | 254.5 | 534.3 |
| F1 (piled foundation) | 200 | 261 (monopile); 139.7 (jacket piled) | 547 |
| F2 (suction bucket foundation) | 200 | 514.2 (mono-bucket); 514.2 (suction bucket jacket); 426.4 (suction bucket tetrahedron) | 547 |

| Alternative | Number of WTGs[1] | Foundation + Scour Protection Footprint (acres)[2] | Interarray Cable Length (miles)[3] |
|---|---|---|---|
| F3 (gravity-based foundation) | 200 | 133.4 (gravity pad tetrahedron); 267.4 (GBS) | 547 |

[1] Assumes the maximum number of WTGs are removed.
[2] Assumes monopile foundations are used (1.31-acre footprint per foundation).
[3] Assumes an average of 2.74 miles of interarray cable per turbine.

#### 3.5.2.11 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs on the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical mile (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative would include up to 195 WTGs,[2] representing a decrease of 5 WTGs as compared to the Proposed Action. Benthic impacts would be reduced by approximately 3 percent as compared to the Proposed Action due to the removal of at least 5 WTGs and associated interarray cables. The maximum footprint of WTGs and associated scour protection would be approximately 250.6 acres (101.4 hectares), which is a 10.4-acre (4.2-hectare) reduction compared to the Proposed Action. Impacts associated with WTG installation, including pile driving and vessel noise, temporary habitat disturbance, turbidity, and sediment deposition, would also be reduced by approximately 3 percent, decreasing the overall impacts on benthic resources in the Lease Area.

The Preferred Alternative would reduce impacts to the valuable habitats present in AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex). The micrositing of 29 WTGs, 1 OSS, and their associated interarray cables outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 and AOC 2 would minimize impacts to these habitats. Additionally, the uniform grid siting of all structures would remove one potential off-grid OSS position (small/medium/large OSS) and one potential off-grid met tower position from the western portion of AOC 1, four potential off-grid OSS positions (two small, one small/medium, and one small/medium/large) in the eastern portion of AOC 1, and three potential off-grid met tower positions near the boundary of the Atlantic City Artificial Reef. Under the Preferred Alternative, OSSs and the met tower would be installed in positions previously allotted to a WTG. The Preferred Alternative assumes the construction of 4 large OSSs (2 OSSs per

[2] 195 WTGs assumes that 197 total positions are available, and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

Project), and the on-grid siting of large OSSs would remove up to 6.5 acres (2.6 hectares) of additional permanent disturbance from the western portion of AOC 1 and up to 6.5 acres of additional permanent disturbance from the eastern portion of AOC 1. The on-grid siting of the met tower would remove up to 6.5 acres (2.6 hectares) of additional permanent disturbance from near the boundary of the Atlantic City Reef or from the western portion of AOC 1.

Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on benthic resources and would result in **moderate adverse** impacts, with some **moderate beneficial** impacts on benthic resources in the geographic analysis area. Although impacts to the valuable habitat present in AOC 1 and AOC 2 would be reduced, overall impacts due to construction and installation, O&M, and decommissioning of the Preferred Alternative would be highly similar to those of the Proposed Action; however, O&M may result in less routine vessel use and preventive maintenance during the life of the Project due to the reduction in number of turbines.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and connected action would be the same as for the Proposed Action: **moderate**, primarily due to habitat disturbance and conversion, as adverse impacts would be unavoidable but would not result in population-level effects. Beneficial impacts could result from emplacement of structures (habitat conversion to hard substrate), but these impacts would be **moderate beneficial** because they would not result in population-level effects.

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## 3.5.3 Birds

This section discusses potential impacts on bird resources from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for birds. The geographic analysis area, as shown on Figure 3.5.3-1, includes a corridor extending from 0.5 mile (0.8 kilometer) inland to 100 miles (161 kilometers) off the U.S. Atlantic coastline, from Maine to Florida. When possible, more site-specific information about birds in the Mid-Atlantic Bight portion of this area and the proposed location of the Project is provided. The geographic analysis area for birds was established to capture resident species and migratory species that winter as far south as South America and the Caribbean, and those that breed in the Arctic or along the Atlantic Coast that travel through the area. The offshore limit was established to cover the migratory movement of most species in this group. The onshore limit was established to cover onshore habitats used by the species that may be affected by onshore and offshore components of the proposed Project.

### 3.5.3.1 Description of the Affected Environment and Future Baseline Conditions

This section discusses bird species that use onshore and offshore habitats, including both resident bird species that use the Project area during all (or portions of) the year and migrating bird species with the potential to pass through during fall or spring migration. Detailed information regarding habitats and bird species potentially present can be found in the COP (Volume II, Section 4.3.1; Atlantic Shores 2024). Given the differences in life history characteristics and habitat use between marine and terrestrial bird species, the following sections provide separate discussions of each group.

Avian species protected by the Migratory Bird Treaty Act of 1918 (MBTA) are addressed in this section. The Atlantic Flyway, which encompasses all of the areas that could be affected by the proposed Project, is a major route for migratory birds, which are protected under the MBTA. The official list of migratory birds protected under the MBTA, and the international treaties that the MBTA implements, is found at 50 CFR 10.13. The MBTA makes it illegal to “take” migratory birds, their eggs, feathers, or nests. Under Section 3 of EO 13186, BOEM and USFWS established a Memorandum of Understanding (MOU) on June 4, 2009, which identifies specific areas in which cooperation between the agencies would substantially contribute to the conservation and management of migratory birds and their habitats (MMS and USFWS 2009). The purpose of the MOU is to strengthen migratory bird conservation through enhanced collaboration between the agencies (MMS and USFWS 2009, Section A). One of the underlying tenets identified in the MOU is to evaluate potential impacts on migratory birds and design or implement measures to avoid, minimize, and mitigate such impacts as appropriate (MMS and USFWS 2009; Sections C, D, E(1), F(1-3, 5), G(6)).

Bald and golden eagles are also addressed in this section. The Bald and Golden Eagle Protection Act of 1940 (BGEPA), as amended (16 USC 668 et seq.) prohibits the take and trade of bald and golden eagles Lastly, this section addresses federally threatened and endangered bird species, protected under Section 7 of the ESA. The BA for Atlantic Shores South provides a detailed discussion of ESA-listed species and potential Project impacts on the species under the jurisdiction of USFWS. Consultation with

USFWS pursuant to Section 7 of the ESA concluded with the issuance of a Biological Opinion from USFWS in December 2023 (USFWS 2023a), and results of the consultation are presented in this Final EIS.

The Project is located in the Mid-Atlantic Bight, which describes the area between Cape Hatteras, North Carolina, and Martha's Vineyard, Massachusetts, extending westward into the Atlantic to the approximate 325-foot (100-meter) isobath (NOAA 2022). The mainland to the west of the Project location is overlapped by the Atlantic Flyway, a major migration route for many species of land birds and waterbirds. Chapter 4.2.4 of the Atlantic OCS Proposed Geological and Geophysical Activities Programmatic EIS (BOEM 2014a) discusses the use of Atlantic Coast habitats by migratory birds. Many species and higher taxonomic groups of birds may occur within the Project area because of its position along the Atlantic Flyway and the region in which the geographic ranges of many northern and southern species overlap. The mid-Atlantic supports populations of coastal and marine birds in summer, some of which breed in the area (e.g., gulls and terns) while others (e.g., shearwaters and storm-petrels) come from breeding grounds in the southern hemisphere. During autumn, there is turnover in the bird community as many breeding species migrate south for winter while birds that breed farther north migrate to the mid-Atlantic to overwinter. Several important spring and/or fall migration stopover sites or winter foraging and roosting habitat for migratory birds, including the ESA-listed rufa red knot (*Calidris canutus rufa*), 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 2021a). The most prominent of these stopover sites is a large complex extending from the Holgate unit of Edwin B. Forsythe National Wildlife Refuge through the North Brigantine Natural Area (Walsh pers. comm.). Additionally, the Edwin B. Forsythe National Wildlife Refuge supports a large breeding population of the ESA-listed piping plover (*Charadrius melodus*) (USFWS n.d.).

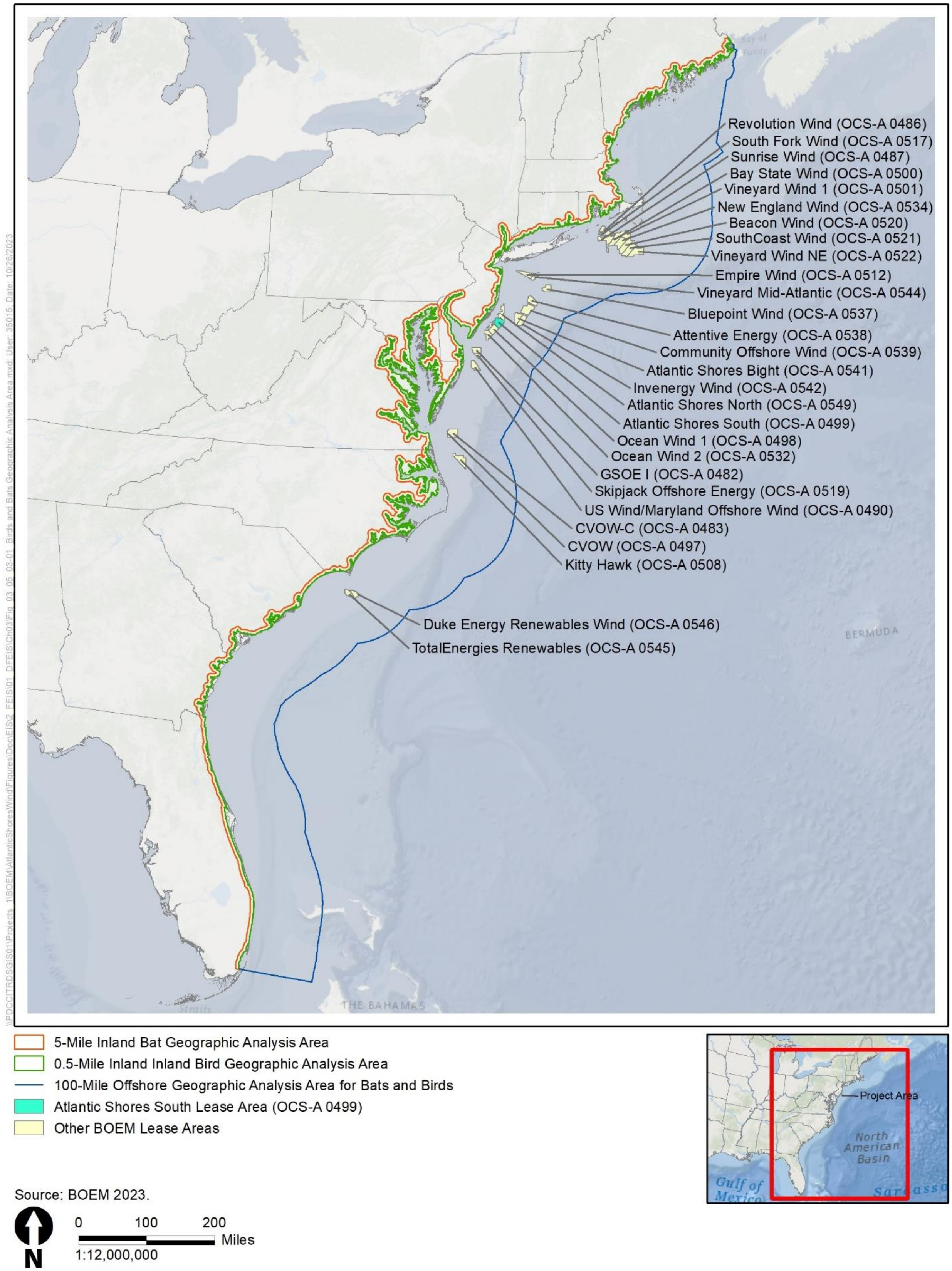



**Figure 3.5.3-1. Bird geographic analysis area**

The affected environment and baseline conditions for birds are described in detail on the basis of several sources of information, including but not limited to:

- NJDEP Ocean/Wind Power Ecological Baseline Studies (Geo-Marine, Inc. 2010)
- Atlantic Shores digital aerial surveys (COP Volume II, Appendix II-F2; Atlantic Shores 2024)
- Marine-life Data and Analysis Team (MDAT) models (Curtice et al. 2018)
- NOAA Northwest Atlantic Seabird Catalog
- Tracking studies of ESA-listed species by Loring et al. (2018, 2019, 2021)
- Atlantic Shores red knot satellite telemetry study (COP Volume II, Appendix II-F3; Atlantic Shores 2024)
- USFWS IPaC query for onshore and offshore facilities (USFWS 2023b).

Birds that may pass through the Offshore Project area include land birds (e.g., songbirds and raptors), coastal waterbirds (e.g., shorebirds, long-legged waders), and marine birds (e.g., loons and sea ducks) (Table 3.5.3-1). The vast majority of birds that occur in the offshore environment are marine birds, such as sea ducks, loons, gulls, scoters, terns, auks, gannets, shearwaters, and petrels. Digital aerial surveys in the WTA found the distribution of marine birds to vary among species and seasons (COP Volume II, Appendix II-F2; Atlantic Shores 2024). These and other birds with potential to occur in the Project area, on the basis of the information sources above, are listed in Table 3.5.3-2.

**Table 3.5.3-1. Taxonomic groups of birds with potential presence in the Offshore Project area**

| Taxonomic Group | Potential Presence in the Offshore Project Area |
|---|---|
| **Non-Marine Migratory Birds** | |
| Shorebirds | Shorebirds are coastal breeders and foragers, and generally avoid flights far offshore over deep waters during the breeding season. Among shorebirds, only red phalarope (*Phalaropus fulicarius*) and red-necked phalarope (*P. lobatus*) are generally considered marine species. Overall, exposure of shorebirds to the offshore infrastructure would be limited to migration and, with the exception of phalaropes, the offshore marine environment does not provide habitat for shorebirds. |
| Wading birds | Most wading birds, such as egrets and herons, breed and migrate in coastal and inland areas. Like shorebirds, wading birds are coastal breeders and foragers, and generally avoid straying out over deep waters, but may traverse the WTA during spring and fall migration periods. Site-specific NJDEP surveys found few wading birds within the WTA (see COP Volume II, Appendix II-F2; Atlantic Shores 2024). Satellite tracking of great blue herons (*Ardea herodias*) suggests some individuals may pass through the WTA and have the potential to fly within the RSZ (COP Volume II, Appendix II-F2; Atlantic Shores 2024). |
| Raptors | The degree to which raptors might occur offshore is dictated primarily by their morphology and flight strategy (i.e., flapping versus soaring), which influences a species' ability or willingness to cross large expanses of open water where thermal formation is poor. Among raptors, falcons are the most likely to be encountered in offshore settings. Merlins (*Falco columbarius*) are the most abundant raptor observed at offshore islands during migration. Migrating merlins have been observed offshore on vessels and offshore |

| Taxonomic Group | Potential Presence in the Offshore Project Area |
|---|---|
| | oil platforms considerable distances from shore. Bald eagles *(Haliaeetus leucocephalus)* and ospreys *(Pandion haliaetus),* two piscivorous raptors commonly found over open water, typically remain close to shore. Similarly, golden eagles (*Aquila chryseatos*), if present, would only be found during migratory periods along the coastal areas. The merlin is therefore the raptor species that is the most likely to pass through the WTA, and only during migration. |
| Songbirds | Songbirds almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine environment except when aloft, during migration. Songbirds regularly cross large bodies of water and there is some evidence that some species migrate over the northern Atlantic. Some songbirds may briefly fly over the water while others, like the blackpoll warbler *(Setophaga striata*), can migrate over vast expanses of ocean. Evidence for a variety of songbird species suggests that overwater migration in the Atlantic is much more common in fall than in spring, possibly because of the assistance and energy savings provided by tailwinds that consistently come from the northwest during fall. Cruising altitudes of migrating songbirds are typically well above the RSZ of offshore WTGs. Overall, exposure of songbirds to the WTA would be limited to migration and would be minimal. |
| Coastal Waterbirds | Coastal waterbirds (including waterfowl) use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. The species in this group are generally restricted to freshwater, and saltmarshes, beaches, and other strictly coastal habitats. They are therefore unlikely to pass through the WTA. |
| **Marine Birds** | |
| Loons | Common loons (*Gavia immer*) and red-throated loons *(G. stellata)* are known to use the Atlantic OCS in winter. Analysis of satellite-tracked red-throated loons, captured and tagged in the mid-Atlantic area, found their winter distributions to be largely inshore of the mid-Atlantic WEAs, although they did overlap with the WTA during spring migration. Loons were also observed within the Project area during site-specific surveys (COP Volume II, Appendix II-F2; Atlantic Shores 2024). |
| Sea ducks | Sea ducks use the Atlantic OCS heavily in winter. Most sea ducks forage on mussels and other benthic invertebrates, and generally winter in shallower inshore waters or out over large offshore shoals, where they can access benthic prey. During tracking studies along the Mid-Atlantic Bight, sea ducks have been found to remain largely in inshore areas, with the exception of surf scoter (*Melanitta perspicillata*) and black scoter (*M. americana*) during spring migration. Site-specific surveys found sea ducks in the Offshore Project area, although modeled exposure level was determined to be minimal to low (COP Volume II, Appendix II-F2; Atlantic Shores 2024). |
| Petrel group | This group consists mostly of shearwaters and storm-petrels that breed in the southern hemisphere and visit the northern hemisphere during the austral winter (boreal summer) and may pass through the WTA. These species use the Atlantic OCS region heavily, but mostly concentrate offshore and in the Gulf of Maine. |
| Gannets, cormorants, and pelicans | Northern gannets (*M. bassanus*) use the Atlantic OCS during winter and migration. They are opportunistic foragers, capable of long-distance oceanic movements, and may pass through the WTA regularly during the non-breeding period. The double-crested cormorant (*Phalacrocorax auritus*) is the most likely species of cormorant exposed to the WTA, but regional MDAT abundance models show that cormorants are concentrated closer to shore and not commonly encountered well offshore. Brown pelicans (*Pelecanus occidentalis*) are rare in the area, and unlikely to pass through the WTA in any numbers. |
| Gulls, skuas, and jaegers | Regional MDAT abundance models show these birds have wide distributions, ranging from near shore (gulls) to offshore (jaegers). Herring gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*) are resident in the region year-round and are found farther |

| Taxonomic Group | Potential Presence in the Offshore Project Area |
|---|---|
| | offshore outside of the breeding season. The parasitic jaeger (*Stercorarius parasiticus*) is often observed closer to shore during migration than the other species, and great skuas (*Stercorarius skua*) may pass along the Atlantic OCS outside the breeding season. |
| Terns | Black tern (*Chlidonias niger*), least tern (*Sternula antillarum*), common tern (*Sterna hirundo*), Forster's tern (*S. Forsteri*), roseate tern *(S. dougallii)*, and royal tern (*Thalasseus maximus*) have been observed in the Offshore Project area (COP Volume II, Appendix II-F2; Atlantic Shores 2024). Terns generally restrict themselves to coastal waters during breeding and foraging, although they may pass through the WTA during migration. Roseate terns are federally listed. |
| Auks | Auks present in the Project area are generally northern or Arctic breeders that winter along the Atlantic OCS. The annual abundance and distribution of auks along the eastern seaboard in winter is erratic, and dependent upon broad climatic conditions and the availability of prey. MDAT abundance models show that during winter auks are generally concentrated offshore, along the shelf edge, and southwest of Nova Scotia. |

Sources: Geo-Marine Inc. (2010), Curtice et al. (2018), Loring et al. (2018, 2019, 2021), APEM Atlantic Shores digital surveys, NOAA Northwest Atlantic Seabird Catalog, COP Volume II, Appendix II-F2 (Atlantic Shores 2024).

### Table 3.5.3-2. Bird species that may occur in the Project area

| | | Source | | | | Conservation Status | |
|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | DEP[1] | MDAT[2] | APEM[3] | IPaC[4] | Federal | State[5] |
| **Ducks, geese, and swans** | | | | | | | |
| Snow goose | *Anser caerulescens* | • | | | | | |
| American black duck | *Anas rubripes* | • | | | | | |
| **Sea ducks** | | | | | | | |
| Long-tailed duck | *Clangula hyemalis* | • | • | • | • | | |
| Surf scoter | *Melanitta perspicillata* | • | • | | | | |
| White-winged scoter | *Melanitta fusca* | • | • | • | | | |
| Black scoter | *Melanitta americana* | • | • | | | | |
| Red-breasted merganser | *Mergus serrator* | • | • | | | | |
| Common eider | *Somateria mollissima* | • | • | • | • | | |
| **Loons** | | | | | | | |
| Red-throated loon | *Gavia stellata* | • | • | • | • | | |
| Common loon | *Gavia immer* | • | • | • | • | | |
| **Herons, egrets, and ibis** | | | | | | | |
| Great blue heron | *Ardea herodias* | • | | | | | SC (B) |
| Black-crowned night-heron | *Nycticorax nycticorax* | • | | | | | T (NB) |
| Cattle egret | *Bubulcus ibis* | • | | | | | T |
| Glossy ibis | *Plegadis falcinellus* | • | | | | | SC |
| Little blue heron | *Egretta caerulea* | • | | | | | SC |
| Snowy egret | *Egretta thula* | • | | | | | SC |
| Tricolor heron | *Egretta tricolor* | • | | | | | SC |
| Yellow-crowned night heron | *Nyctanassa violacea* | • | | | | | T |

| Common Name | Scientific Name | Source DEP[1] | MDAT[2] | APEM[3] | IPaC[4] | Conservation Status Federal | State[5] |
|---|---|---|---|---|---|---|---|
| **Petrels and shearwaters** | | | | | | | |
| Black-capped petrel | *Pterodroma hasitata* | | | | | Cand. | |
| Cory's shearwater | *Calonectris diomedea* | • | • | | • | BCC | |
| Sooty shearwater | *Ardenna grisea* | • | • | | | | |
| Great shearwater | *Ardenna gravis* | • | • | | • | | |
| Audubon's shearwater | *Puffinus lherminieri* | • | • | | | BCC | PS (NB) |
| Wilson's storm-petrel | *Oceanites oceanicus* | • | • | | • | | |
| **Gannets** | | | | | | | |
| Northern gannet | *Morus bassanus* | • | • | • | | | |
| **Cormorants and pelicans** | | | | | | | |
| Double-crested cormorant | *Phalacrocorax auritus* | • | • | | • | | |
| Brown pelican | *Pelecanus occidentalis* | • | • | | • | | |
| **Jaegers and gulls** | | | | | | | |
| Parasitic jaeger | *Stercorarius parasiticus* | • | • | | | | |
| Black-legged kittiwake | *Rissa tridactyla* | • | • | • | • | | |
| Bonaparte's gull | *Chroicocephalus philadelphia* | • | • | • | | | |
| Laughing gull | *Leucophaeus atricilla* | • | • | • | | | |
| Ring-billed gull | *Larus delawarensis* | • | • | | • | | |
| Herring gull | *Larus argentatus* | • | • | • | | | |
| Great black-backed gull | *Larus marinus* | • | • | • | | | |
| **Terns** | | | | | | | |
| Black tern | *Chlidonias niger* | • | | | | | PS (NB) |
| Caspian tern | *Hydroprogne caspia* | • | | | | | SC |
| Common tern | *Sterna hirundo* | • | • | | | | SC (B) |
| Gull-billed tern | *Gelochelidon nilotica* | • | | • | • | | SC |
| Forster's tern | *Sterna forsteri* | • | | | | | |
| Least tern | *Sternula antillarum* | • | | | | | E |
| Roseate tern | *Sterna dougallii* | • | | | • | E | E |
| Royal tern | *Thalasseus maximus* | • | • | | • | | PS (B) |
| **Auks** | | | | | | | |
| Dovekie | *Alle alle* | • | • | • | • | | |
| Common murre | *Uria aalge* | • | • | | | | |
| Thick-billed murre | *Uria lomvia* | • | • | • | • | | |
| Razorbill | *Alca torda* | • | • | | • | | |
| Atlantic puffin | *Fratercula arctica* | • | • | | • | | |
| **Shorebirds** | | | | | | | |
| Black-bellied plover | *Pluvialis squatarola* | • | | | | | |
| Piping plover | *Charadrius melodus* | • | | | | T | E |

| Common Name | Scientific Name | Source DEP[1] | MDAT[2] | APEM[3] | IPaC[4] | Conservation Status Federal | State[5] |
|---|---|---|---|---|---|---|---|
| Red knot | *Calidris canutus rufa* | | | | | T | E |
| Sanderling | *Calidris alba* | • | | | | | SC (NB) |
| Purple sandpiper | *Calidris maritima* | | | • | • | | |
| Least sandpiper | *Calidris minutilla* | • | | | | | |
| Red-necked phalarope | *Phalaropus lobatus* | • | • | | | | |
| Red phalarope | *Phalaropus fulicarius* | • | • | | | | |
| American oystercatcher | *Haematopus palliates* | • | | • | • | | SC |
| Hudsonian godwit | *Limosa haemastica* | | | • | • | | |
| Black skimmer | *Rynchops niger* | • | | • | • | | E |
| Eastern black rail | *Laterallus jamaicensis* | | | • | • | T | E (B); T, PE (NB) |
| King rail | *Rallus elegans* | | | • | • | | PE (B); PU (NB) |
| Lesser yellowlegs | *Tringa flavipes* | • | | • | • | | |
| Ruddy turnstone | *Arenaria interpres morinella* | | | | • | | PSC (NB) |
| Short-billed dowitcher | *Limnodromus griseus* | | | | • | | |
| Willet | *Tringa semipalmata* | | | • | • | | |
| **Passerines** | | | | | | | |
| Purple martin | *Progne subis* | • | | | | | PSC (B) |
| Tree swallow | *Tachycineta bicolor* | • | | | | | |
| Barn swallow | *Hirundo rustica* | • | | | | | |
| House finch | *Haemorhous mexicanus* | • | | | | | |
| Horned lark | *Eremophila alpestris* | • | | | | | T |
| Pine siskin | *Spinus pinus* | • | | | | | |
| American goldfinch | *Spinus tristis* | • | | | | | |
| Brown thrasher | *Toxostoma rufum* | • | | | | | SC |
| Song sparrow | *Melospiza melodia* | • | | | | | |
| Red-winged blackbird | *Agelaius phoeniceus* | • | | | | | |
| Brown-headed cowbird | *Molothrus ater* | • | | | | | |
| Northern waterthrush | *Parkesia noveboracensis* | • | | | | | |
| Canada warbler | *Cardellina canadensis* | | | • | • | | SC (B); PSC (NB) |
| Kentucky warbler | *Geothlypis formosus* | | | • | • | | SC, PT (B) |
| Prothonotary warbler | *Protonotaria citrea* | | | • | • | | |
| Northern parula | *Setophaga americana* | • | | | | | SC, PS (B) |
| Cerulean warbler | *Setophaga cerulea* | | | • | • | | SC |

| Common Name | Scientific Name | Source DEP[1] | MDAT[2] | APEM[3] | IPaC[4] | Conservation Status Federal | State[5] |
|---|---|---|---|---|---|---|---|
| Yellow-rumped warbler | *Setophaga coronate* | • | | | | | PU (B) |
| Prairie warbler | *Setophaga discolor* | | | • | • | | PSC (B) |
| Black-throated green warbler | *Setophaga virens* | • | | | | | |
| Blue-winged warbler | *Vermivora pinus* | | | • | • | | PSC (B) |
| Black-billed cuckoo | *Coccyzus erythropthalmus* | | | • | • | | SC (B); PSC (NB) |
| Bobolink | *Dolichonyx oryzivorus* | | | • | • | | T (B), SC (NB) |
| Chimney swift | *Chaetura pelagica* | • | | • | • | | PSC (B) |
| Eastern whip-poor-will | *Antrostomus vociferus* | | | • | • | | SC (B); PSC (NB) |
| Red-headed woodpecker | *Melanerpes erythrocephalus* | | | • | • | | T, PSC (NB) |
| Rusty blackbird | *Euphagus carolinus* | | | • | • | | PSC (NB) |
| Veery | *Catharus fuscescens* | • | | | | | SC |
| Wood thrush | *Hylocichla mustelina* | • | | • | • | | SC (B) |
| Worm-eating warbler | *Helmitheros vermivorum* | • | | | | | SC |
| **Raptors** | | | | | | | |
| Bald eagle | *Haliaeetus leucocephalus* | • | | • | • | | E, PSC (B); T, PS (NB) |
| Barred owl | *Strix varia* | • | | | | | T |
| Coopers hawk | *Accipiter cooperii* | • | | | | | SC |
| Golden eagle | *Aquila chrysaetos* | | | • | • | | |
| Long-eared owl | *Asio otus* | | | • | • | | T |
| American kestrel | *Falco sparverius* | • | | | | | T |
| Northern harrier | *Circus cyaneus* | • | | | | | E |
| Osprey | *Pandion haliaetus* | • | | | | | T |
| Peregrine falcon | *Falco peregrinus* | • | | | | | E |

[1] New Jersey Department of Environmental Protection (Geo-Marine, Inc. 2010) or COP Volume II, Appendix II-E1 or Appendix II-E2; Atlantic Shores 2024.
[2] Marine-life Data and Analysis Team (Curtice et al. 2018).
[3] APEM Ltd. Atlantic Shores digital surveys, NOAA Northwest Atlantic Seabird Catalog, COP Volume II, Appendix II-F2 (Atlantic Shores 2024).
[4] U.S. Fish and Wildlife Service, Information for Planning and Consultation system (USFWS 2023b).
[5] Many of the species state conservation statuses may be changing and some species may be added or deleted in 2024 pending a NJDEP rule proposal (NJDEP 2023). Proposed statuses are noted along with current statuses.
BCC = Birds of Conservation Concern (migratory birds that USFWS considers of highest conservation priority and likely to become candidates for listing under the ESA without additional conservation action): Cand. = Candidate; PE = Proposed Endangered; PSC = Proposed Special Concern; PS = Proposed Stable; PT = Proposed Threatened; PU = Proposed Undetermined; SC = Special Concern; T = Threatened; B = Breeding; NB = Non-breeding.

Three ESA-listed birds have potential to pass through the Offshore Project area—the roseate tern (Endangered), piping plover (Threatened), and red knot (Threatened)—during spring and fall migration only. The New Jersey Baseline Studies rarely observed these species near the WTA, as they mainly occur in the coastal portions of New Jersey during spring and summer (Geo-Marine 2010). They were not detected during the Atlantic Shores digital aerial surveys. Automated radiotelemetry tracking studies of these species have also found extremely minimal, infrequent passage through the Lease Area, including the New Jersey WEA (Loring et al. 2018, 2019, 2021; COP Volume II, Appendix II-F2 and F3; Atlantic Shores 2024). Of the 11 tagged red knots that successfully yielded data during a 2020 study (COP Volume II, Appendix II-F3; Atlantic Shores 2024), only one was recorded flying through the WTA at an altitude of 1,886 feet (575 meters). The altitudes of the red knots varied during their offshore flights and ranged from approximately 66 feet (20 meters) to over 9,843 feet (3,000 meters). (COP Volume II; Appendix II-F3; Atlantic Shores 2024). Tagging in 2021 yielded data on 29 additional red knots (Feigin et al. 2022). None of these red knots were recorded within the WTA, but interpolated flight paths and uncertainty estimates suggest that eight red knots may have flown through the WTA (Feigin et al. 2022). Overall, 18 of the 40 total tagged birds that provided data over the two years of the study may have crossed the WTA based on direct detections, straight-line connections of points, and modeling, collectively (Feigin et al. 2022). Loring et al. (2020) found that only 12 percent (2 out of 17) of the radio-tagged piping 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. The eastern black rail (*Laterallus jamaicensis*), along with roseate tern, piping plover and red knot may also occur in the Onshore Project area.

Bald eagles (*Haliaeetus leucocephalus*) generally remain near shore in marine environments. Williams et al. (2015) observed bald eagles only within 3.7 miles (6 kilometers) of shore in digital aerial surveys of the mid-Atlantic offshore region, and no eagles were observed offshore during the NJDEP vessel-based surveys (COP Volume II, Appendix II-F2; Atlantic Shores 2024). Golden eagles (*Aquila chrysaetos*) are also not expected to fly offshore. Both eagle species primarily rely on thermal updrafts for flight, which are largely absent or weak over water, thus discouraging long-distance flights of these and most other raptors over large bodies of water (Kerlinger 1985). Because eagles are not expected in the WTA, they are not further evaluated herein.

The official list of migratory birds protected under the MBTA, and the international treaties that the MBTA implements, is found at 50 CFR 10.13. Despite the level of human development and activity present, the Mid-Atlantic coast plays an important role in the ecology of many migratory bird species.

The Atlantic Flyway, which encompasses areas that could be affected by the proposed Project, is a major route for migratory birds, which are protected under the MBTA. In the Atlantic Flyway along the North American Atlantic coast, much of the bird activity is concentrated along the coastline (Watts 2010). However, some of these species can be exposed to offshore wind developments during departure and arrival to their shoreline staging areas (Watts et al. 2022). Thirty-seven species of birds protected under the MBTA may occur within the Offshore and/or Onshore Project areas (USFWS 2023b).

The Atlantic Shores South Project would have one onshore substation and associated interconnection cables routed through the onshore environment. The interconnection cables would be installed underground, mostly along existing roads, paths, and utility ROWs. This would greatly reduce the amount of bird habitat that would be altered or lost, and limit land disturbance mostly to areas that are already disturbed or developed. The substation and/or converter station sites would be adjacent to fragmented habitat that is of relatively low value to native birds, such that minor vegetation removal for their construction would not impact high-quality or large areas of habitat.

Under future baseline conditions, birds in the geographic analysis area will continue to face population pressures from ongoing anthropogenic activities, such as onshore construction, marine minerals extraction, port expansions, installation of new structures in the OCS, and interactions with fisheries and fishing gear. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction and will remain so under future baseline conditions unless significant conservation actions are taken (NABCI 2016). This is likely representative of the conditions for birds within the geographic analysis area. The northeastern United States is also home to more than one-third of the human population of the nation. As a result, species that live or migrate along the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including habitat loss and degradation, hunting (approximately 86,000 sea ducks harvested annually [Roberts 2019]), commercial fisheries by-catch (approximately 2,600 seabirds are killed annually on the Atlantic [Hatch 2017; Sigourney et al. 2019]), and climate change. Increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, and increased erosion and sediment deposition as a result of climate change have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing.

More than half of offshore North American bird species (57 percent, 31 species) have been placed on the North American Bird Conservation Initiative watch-list as a result of small ranges, small and declining populations, and threats to required habitats. This watch-list identified species of high conservation concern based upon high vulnerability to a variety of factors, including population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, and population trend (NABCI 2016). Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015), including those that forage, breed, and migrate over the Atlantic OCS. These conditions and trends for offshore bird species are expected to continue under future baseline conditions.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch-list. Many of these coastal species have small population size or restricted distributions, making them especially vulnerable to habitat loss or degradation and other stressors (NABCI 2016). Models of vulnerability to climate change estimate that, throughout New Jersey, 29 percent of New Jersey's 248 bird species are vulnerable to climate change across all seasons (Audubon 2019), some of which occur in the geographic analysis area. A rapidly changing climate could lead to population declines if species are not able to adapt. In addition, the reshuffling of bird communities at a continental scale will bring together species that previously lived in isolation, leading to unpredictable interactions. Disruptions in food and nesting resources would further compound vulnerabilities to climate change. These ongoing impacts on coastal birds would continue under future baseline conditions regardless of the offshore wind industry.

### 3.5.3.2 Impact Level Definitions for Birds

As described in Section 3.3, *Definitions of Impact Levels,* this Final EIS uses a four-level classification scheme to characterize potential impacts of alternatives, including the Proposed Action. The definitions of potential impact levels for birds are provided in Table 3.5.3-3.

**Table 3.5.3-3. Impact level definitions for birds**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | Impacts would be so small as to be unmeasurable. |
| | Beneficial | Impacts would be so small as to be unmeasurable. |
| Minor | Adverse | Most impacts would be avoided; if impacts occur, the loss of one or a few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved. |
| | Beneficial | Impacts would be localized to a small area but with some measurable effect on one or a few individuals or habitat. |
| Moderate | Adverse | Impacts would be unavoidable but would not result in population-level effects or threaten overall habitat function. |
| | Beneficial | Impacts would affect more than a few individuals in a broad area but not regionally, and would not result in population-level effects. |
| Major | Adverse | Impacts would result in severe, long-term habitat or population-level effects on species. |
| | Beneficial | Long-term beneficial population-level effects would occur. |

### 3.5.3.3 Impacts of Alternative A – No Action on Birds

When analyzing the impacts of the No Action Alternative on birds, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for birds. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Ongoing and Planned Activities Scenario*. This analysis is limited to impacts within the geographic analysis area for birds, as shown on Figure 3.5.3-1, which includes a corridor extending from 0.5 mile (0.8 kilometer) inland to 100 miles (161 kilometers) off the U.S. Atlantic coastline, from Maine to Florida.

### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for birds as described in Section 3.5.3.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on birds are generally associated with onshore impacts (including onshore construction and coastal lighting), activities in the offshore environment (e.g., vessel traffic, commercial fisheries), and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bird species through temporary and permanent habitat removal or conversion, temporary noise impacts related to construction, collisions (e.g., presence of structures), and lighting effects, which could cause avoidance behavior and displacement as well as injury to or mortality of individual birds. However, population-level effects would not be anticipated. Activities in the offshore environment could result in bird avoidance behavior and displacement, but population-level effects would not be anticipated. Impacts of climate change, such as increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, and increased erosion and sediment deposition, have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing. See Appendix D, Table D.A1-4 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for birds.

Ongoing offshore wind activities in the geographic analysis area that contribute to impacts on birds (based on the scenario shown in Appendix D) include:

- Continued O&M of the BIWF (5 WTGs) installed in Massachusetts state waters;
- Continued O&M of the CVOW pilot Project (2 WTGs) installed in OCS-A 0497 approximately 27 miles (44 kilometers) off the coast of Virginia Beach, Virginia;
- Ongoing construction of six offshore wind projects: the Vineyard Wind 1 Project (62 WTGs and 1 OSS) in OCS-A 0501 approximately 14 miles (23 kilometers) offshore of Nantucket, Massachusetts, and approximately 14 miles (23 kilometers) offshore Martha's Vineyard, Massachusetts, and the SFWF Project (12 WTGs and 1 OSS) in OCS-A 0517 approximately 19 miles (31 kilometers) southeast of Block Island, Rhode Island, and 35 miles (56 kilometers) east of Montauk Point, New York; the Ocean Wind 1 Project (98 WTGs and 3 OSSs) in OCS-A 0498 approximately 15 miles (24 kilometers) southeast of Atlantic City, New Jersey; the Revolution Wind Project (65 WTGs and 2 OSSs) in OCS-A 0486 approximately 18 miles (29 kilometers) southeast of Point Judith, Rhode Island and approximately 15 miles (24 kilometers) east of Block Island, Rhode Island; the Empire Wind Project (147 WTGs and 2 OSSs) in OCS-A 512 approximately 14 miles (23 kilometers) south of Long Island,

New York and 19.5 miles (31 kilometers) east of Long Branch, New Jersey; and the CVOW-C Project (202 WTGs and 3 OSSs) in OCS-A 0483 approximately 27 miles (44 kilometers) east of Virginia Beach, Virginia.

Ongoing O&M of the BIWF and CVOW Pilot projects and ongoing construction of the Vineyard Wind 1, South Fork, Ocean Wind 1, Revolution Wind, Empire Wind, and CVOW-C projects would affect birds through the primary IPFs of accidental releases, cable emplacement and maintenance, land disturbance, lighting, noise, presence of structures, and traffic (aircraft). Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and land disturbance described in detail in the *Cumulative Impacts of Alternative A – No Action* section for planned offshore wind activities, but the impacts would be of lower intensity.

### *Cumulative Impacts of Alternative A – No Action*

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

Planned non-offshore wind activities that may affect birds include installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Section D.2 in Appendix D for a description of planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in temporary and permanent impacts on birds including disturbance, displacement, injury, mortality, habitat degradation, and habitat conversion.

The sections below summarize the potential impacts of planned offshore wind activities on birds during construction, O&M, and decommissioning of the projects. In addition to the eight ongoing offshore wind projects, 27 additional offshore wind projects are planned to be constructed in the geographic analysis area for birds. These 27 planned projects, along with the eight ongoing projects, would result in an additional 3,140 WTGs and 41 OSSs/ESPs in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). The impacts of ongoing and planned offshore wind projects are discussed in this section. BOEM expects planned offshore wind development activities to affect birds through the following primary IPFs.

**Accidental releases:** Accidental releases of fuel/fluids, other contaminants, and trash and debris could occur as a result of planned offshore wind activities. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Ingestion of fuel and other hazardous contaminants has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in oiling of feathers can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities, including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). However, based on the volumes potentially involved (refer to Table D.A2-3 in Appendix D), the likely amount of releases associated with planned offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities and would represent a negligible impact on birds.

Vessel compliance with USCG regulations would minimize discharge of trash or other debris; therefore, BOEM expects accidental trash releases from offshore wind vessels to be rare and localized in nature. In the unlikely event of a release, lethal and sublethal impacts on individuals could occur as a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019). Given that accidental releases are anticipated to be rare and localized, BOEM expects that accidental releases of trash and debris would not appreciably contribute to overall impacts on birds.

**Cable emplacement and maintenance:** Generally, emplacement of submarine cables would result in increased suspended sediments that may affect diving birds, result in displacement of foraging individuals, or decreased foraging success, and have impacts on some prey species (e.g., benthic assemblages) (Cook and Burton 2010). The total area of seafloor disturbed by offshore export and interarray cables for ongoing and planned offshore wind facilities is estimated to be 69,613 acres (28,171 hectares) (Appendix D, Table D.A2-2). Impacts associated with cable emplacement would be short term and localized, and birds would be able to successfully forage in adjacent areas not affected by increased suspended sediments. Any dredging necessary prior to cable installation could contribute to additional impacts. Disturbed seafloor from construction of planned offshore wind projects may affect some bird prey species; however, assuming planned projects use installation procedures similar to those proposed in the Atlantic Shores South COP, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance. Section 3.5.2, *Benthic Resources*, and Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, provide more information. Impacts would be negligible because increased suspended sediments would be temporary and generally localized to the emplacement corridor, and no individual fitness or population-level effects on birds would be expected.

**Land disturbance:** The construction of onshore components of offshore wind farms has the potential to result in impacts on birds due to habitat loss or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing onshore development activities. In general, onshore construction would be expected to occur in previously disturbed habitats, and no individual fitness or population-level impacts on birds would be expected to occur; therefore, onshore construction impacts associated with planned offshore wind development would be negligible and would not be expected to appreciably contribute to overall impacts on birds.

**Lighting:** Ongoing and planned offshore wind development would result in additional nighttime light from vessels and offshore wind structures, which could attract birds to the area. Under the No Action Alternative, up to 2,940WTGs and 41 OSSs with hazard and aviation lighting would be added beginning in 2023 and continuing through 2030 (Appendix D, Tables D.A2-1 and D.A2-2). Vessel lighting would result in short-term and localized, impacts on birds; structure lighting may pose an increased collision or predation risk (Hüppop et al. 2006), although this risk would be localized in extent and minimized through the use of red flashing FAA lighting and other BOEM lighting guidelines (BOEM 2021; Kerlinger et al. 2010). BOEM anticipates lighting impacts related to offshore wind structures and vessels would be negligible.

**Noise:** Anthropogenic noise on the OCS associated with planned offshore wind development, including noise from aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic, has the potential to result in impacts on birds on the OCS. Additionally, onshore construction noise has the potential to result in impacts on birds. BOEM anticipates that noise impacts would be negligible because noise would be localized and short term. Potential impacts could be greater if avoidance and displacement of birds occurs during seasonal migration periods.

Noise from low-flying aircraft may cause birds to flush, resulting in increased energy expenditure. Disturbance to birds, if any, would be short term and localized, with impacts dissipating once the aircraft has left the area. No individual- or population-level effects would be expected.

The 2,940 WTGs and up to 41 OSSs from ongoing and planned offshore wind projects (Appendix D, Tables D.A2-1 and D.A2-2) would create noise and may temporarily affect diving birds. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise transmitted through water has the potential to result in temporary displacement of diving birds in a limited space around each pile and can cause temporary stress and behavioral changes ranging from mild annoyance to escape behavior (BOEM 2014b, 2016). Additionally, noise impacts on prey species may affect bird foraging success. Similar to pile driving, geological and geophysical site characterization surveys for offshore wind facilities would create high-intensity impulsive noise around sites of investigation, leading to similar impacts on birds.

Onshore noise associated with intermittent construction of required offshore wind development infrastructure may also result in localized and short-term impacts, including avoidance and displacement, although no individual fitness or population-level effects would be expected to occur.

Noise associated with project vessels could disturb some individual diving birds, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). However, brief responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level effects would be expected.

**Presence of structures:** The presence of structures can lead to long-term effects on birds, both beneficial and adverse, through fish aggregation and associated increase in foraging opportunities, as well as entanglement with lost fishing gear, migration disturbances, and WTG strikes and displacement. These impacts may arise from buoys, meteorological towers, foundations, scour and cable protections, and transmission cable infrastructure.

The primary threat to birds from the presence of structures would be from collision with WTGs. The Atlantic Flyway is an important migratory corridor for as many as 164 species of waterbirds, and a similar number of land birds, with the greatest volume of birds using the Atlantic Flyway during spring and fall migration (Watts 2010). Along the Atlantic Flyway, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). While both groups may occur over land or water within the flyway and may extend considerable distances from shore, the highest diversity and density are centered on the shoreline. Building on this information, Robinson Willmott et al. (2013) evaluated the sensitivity of bird resources to collision and displacement due to offshore wind development on the Atlantic OCS and included the 164 species selected by Watts (2010) plus an additional 13 species, for a total of 177 species that may occur on the Atlantic OCS from Maine to Florida during all or some portion of the year. As discussed in Robinson Willmott et al. (2013) and consistent with Garthe and Hüppop (2004), Furness and Wade (2012), and Furness et al. (2013), species with high scores for sensitivity for collision include gulls, jaegers, and the northern gannet (*Morus bassanus*). A collision sensitivity ranking of migratory birds near the Nysted wind farm in Denmark by Desholm (2009) also found that waterbirds and birds of prey had higher collision sensitivity scores and passerines had lower collision sensitivity scores. In many cases, high collision sensitivity is driven by high occurrence on the OCS, low avoidance rates with high uncertainty, and time spent in the RSZ. Many of the species addressed in Robinson Willmott et al. (2013) have low collision sensitivity, including passerines that spend very little time on the Atlantic OCS during migration and typically fly above the RSZ. Robinson Willmott et al. (2013) stated that because of identified data gaps and related uncertainty, particularly concerning species-specific flight altitude and avoidance behavior, their results should be interpreted with caution. As discussed by Watts (2010), 55 seabird species could encounter operating WTGs on the Atlantic OCS. However, generally the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (Figure 3.5.3-2). Of the 55 bird species, 47 have sufficient survey data to calculate the modeled percentage of a species population that would overlap with the anticipated offshore wind development on the Atlantic OCS (Winship et al. 2018); the relative seasonal exposure of these species is generally very low, ranging from 0.0 to 5.2 percent (Table 3.5.3-4). The estimated percentage of federally listed species and Birds of Conservation Concern populations that overlap offshore wind development areas ranges only 0.0 to 0.9 percent (Table 3.5.3-4). BOEM assumes that the 47 species (85 percent) with sufficient data to model the relative distribution and abundance on the Atlantic OCS are representative of the 55 species that may overlap with offshore wind development on the Atlantic OCS.

Ongoing and planned offshore wind development would result in up to 2,940 WTGs in the bird geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). In the contiguous United States, bird collisions with operating onshore WTGs are relatively rare events. Loss and others (2013) estimated 140,000 to 328,000 (mean = 234,000) birds killed annually from 44,577 onshore monopile wind turbines across the contiguous United States. Bird collisions with onshore monopile turbines in the eastern United States is estimated at 6.86 birds per turbine per year (Loss et al. 2013). Based on this mortality rate, an estimated 20,519 birds could be killed annually from the 2,991 WTGs that would be added for offshore wind development. This represents a maximum-case scenario and does not consider mitigating factors, such as landscape and weather patterns, or bird species that are expected to occur. Given that the relative density of birds in the OCS is low, relatively few birds are likely to encounter offshore WTGs (see Figure 3.5.3-2). Potential annual bird kills from offshore WTGs would be relatively low compared to other causes of migratory bird deaths in the United States; feral cats are the primary cause of migratory bird deaths in the United States (2.4 billion per year), followed by collisions with building glass (599 million per year), collisions with vehicles (214.5 million per year), poison (72 million per year), collisions with electrical lines (25.5 million per year), collisions with communication towers (6.6 million per year), and electrocutions (5.6 million per year) (USFWS 2021b).

Not all individuals that occur or migrate along the Atlantic Coast are expected to encounter the RSZ of one or more operating WTGs associated with planned offshore wind development. Generally, only a small percentage of a species' seasonal population would potentially encounter operating WTGs (Table 3.5.3-4). The addition of WTGs to the offshore environment may result in increased functional loss of habitat for those species with higher displacement sensitivity. However, a recent study of long-term data collected in the North Sea found that despite the extensive observed displacement of loons in response to the development of 20 wind farms, there was no decline in the region's loon population (Vilela et al. 2021). Furthermore, substantial foraging habitat for resident birds would remain available outside of the proposed offshore lease areas, and no individual fitness or population-level impacts would be expected to occur.

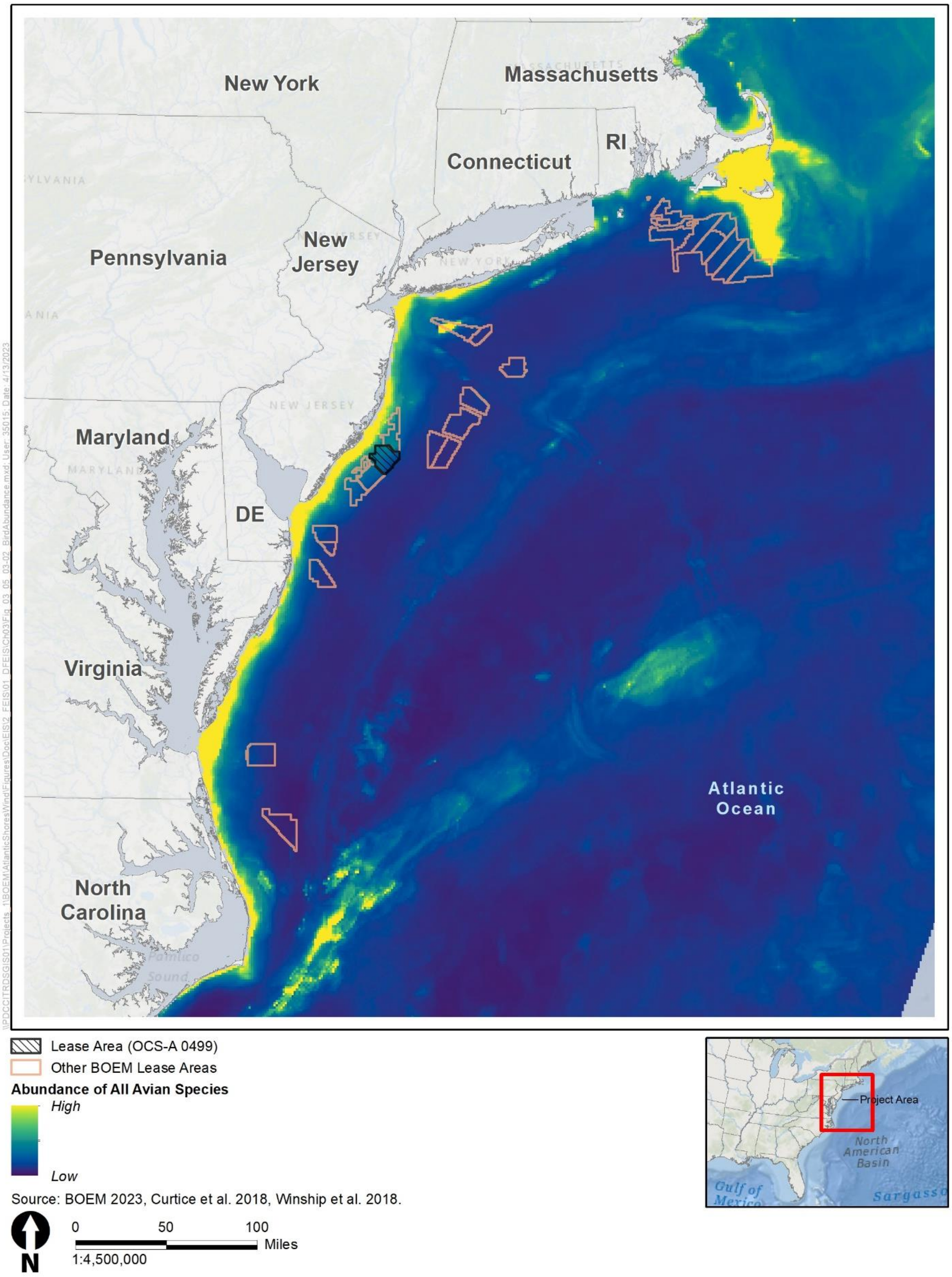



**Figure 3.5.3-2. Total bird relative abundance distribution map**

**Table 3.5.3-4. Percentage of Atlantic seabird population overlap with anticipated offshore wind energy development on the Outer Continental Shelf**

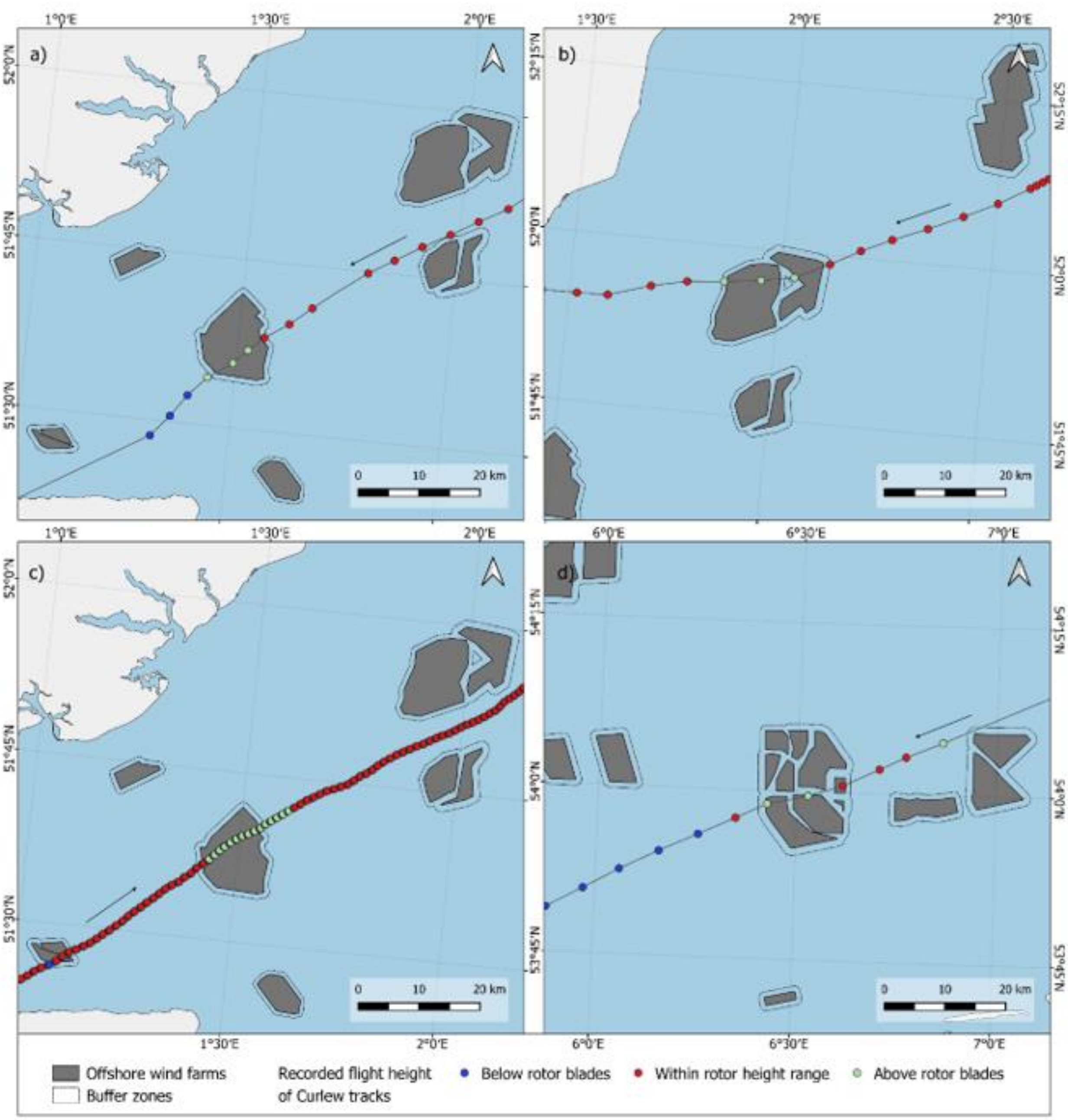
| Species | Spring | Summer | Fall | Winter |
|---|---|---|---|---|
| Artic tern (*Sterna paradisaea*) | NA | 0.2 | NA | NA |
| Atlantic puffin (*Fratercula arctica*)[1] | 0.2 | 0.1 | 0.1 | 0.2 |
| Audubon shearwater (*Puffinus lherminieri*) [4] | 0.0 | 0.0 | 0.0 | 0.0 |
| Black-capped petrel (*Pterodroma hasitata*) [3] | 0.0 | 0.0 | 0.0 | 0.0 |
| Black guillemot (*Cepphus grille*) | NA | 0.3 | NA | NA |
| Black-legged kittiwake (*Rissa tridactyla*)[1] | 0.7 | NA | 0.7 | 0.5 |
| Black scoter (*Melanitta americana*) | 0.2 | NA | 0.4 | 0.5 |
| Bonaparte's gull (*Chroicocephalus philadelphia*) | 0.5 | NA | 0.4 | 0.3 |
| Brown pelican (*Pelecanus occidentalis*) | 0.1 | 0.0 | 0.0 | 0.0 |
| Band-rumped storm-petrel (*Oceanodroma castro*) | NA | 0.0 | NA | NA |
| Bridled tern (*Onychoprion anaethetus*) | NA | 0.1 | 0.1 | NA |
| Common eider (*Somateria mollissima*)[1] | 0.3 | 0.1 | 0.5 | 0.6 |
| Common loon (*Gavia immer*) | 3.9 | 1.0 | 1.3 | 2.1 |
| Common murre (*Uria aalge*) | 0.4 | NA | NA | 1.9 |
| Common tern (*Sterna hirundo*)[1] | 2.1 | 3.0 | 0.5 | NA |
| Cory's shearwater (*Calonectris borealis*) [4] | 0.1 | 0.9 | 0.3 | NA |
| Double-crested cormorant (*Phalacrocorax auritus*) | 0.7 | 0.6 | 0.5 | 0.4 |
| Dovekie (*Alle alle*) | 0.1 | 0.1 | 0.3 | 0.2 |
| Great black-backed gull (*Larus marinus*)[1] | 1.3 | 0.5 | 0.7 | 0.6 |
| Great shearwater (*Puffinus gravis*) | 0.1 | 0.3 | 0.3 | 0.1 |
| Great skua (*Stercorarius skua*) | NA | NA | 0.1 | NA |
| Herring gull (*Larus argentatus*)[1] | 1.0 | 1.3 | 0.9 | 0.5 |
| Horned grebe (*Podiceps auritus*) | NA | NA | NA | 0.3 |
| Laughing gull (*Leucophaeus atricilla*) | 1.0 | 3.6 | 0.9 | 0.1 |
| Leach's storm-petrel (*Oceanodroma leucorhoa*) | 0.1 | 0.0 | 0.0 | NA |
| Least tern (*Sternula antillarum*) | NA | 0.3 | 0.0 | NA |
| Long-tailed ducks (*Clangula hyemalis*) | 0.6 | 0.0 | 0.4 | 0.5 |
| Manx shearwater (*Puffinus puffinus*)[1] | 0.0 | 0.5 | 0.1 | NA |
| Northern fulmar (*Fulmarus glacialis*)[1] | 0.1 | 0.2 | 0.1 | 0.2 |
| Northern gannet (*Morus bassanus*)[1] | 1.5 | 0.4 | 1.4 | 1.4 |
| Parasitic jaeger (*Stercorarius parasiticus*) | 0.4 | 0.5 | 0.4 | NA |
| Pomarine jaeger (*Stercorarius pomarinus*) | 0.1 | 0.3 | 0.2 | NA |
| Razorbill (*Alca torda*)[1] | 5.2 | 0.2 | 0.4 | 2.1 |
| Ring-billed gull (*Larus delawarensis*) | 0.5 | 0.5 | 0.9 | 0.5 |
| Red-breasted merganser (*Mergus serrator*) | 0.5 | NA | NA | 0.7 |
| Red phalarope (*Phalaropus fulicarius*) | 0.4 | 0.4 | 0.2 | NA |
| Red-necked phalarope (*Phalaropus lobatus*) | 0.3 | 0.3 | 0.2 | NA |
| Roseate tern (*Sterna dougallii*) [2] | 0.6 | 0.0 | 0.5 | NA |
| Royal tern (*Thalasseus maximus*) | 0.0 | 0.2 | 0.1 | NA |
| Red-throated loon (*Gavia stellate*)[1] | 1.6 | NA | 0.5 | 1.0 |
| Sooty shearwater (*Ardenna grisea*) | 0.3 | 0.4 | 0.2 | NA |
| Sooty tern (*Onychoprion fuscatus*) | 0.0 | 0.0 | NA | NA |
| South polar skua (*Stercorarius maccormicki*) | NA | 0.2 | 0.1 | NA |
| Surf scoter (*Melanitta perspicillata*) | 1.2 | NA | 0.4 | 0.5 |

| Species | Spring | Summer | Fall | Winter |
|---|---|---|---|---|
| Thick-billed murre (*Uria lomvia*) | 0.1 | NA | NA | 0.1 |
| Wilson's storm-petrel (*Oceanites oceanicus*) | 0.2 | 0.9 | 0.2 | NA |
| White-winged scoter (*Melanitta deglandi*) | 0.7 | NA | 0.2 | 1.3 |

Source: Winship et al. (2018).
[1] Species also included in collision risk modeling by Winship et al. (2018).
[2] U.S. Endangered
[3] U.S. Candidate
[4] Bird of Conservation Concern

Vattenfall (a European energy company) recently studied bird movements within an offshore wind farm situated 1.9–3 miles (3–4.9 kilometers) off the coast of Aberdeen, Scotland (Vattenfall 2023). The purpose of the study was to improve the understanding of seabird flight behavior inside an offshore wind farm with a focus on the bird breeding period and post-breeding period when densities are highest. The study was robust in that seabirds were tracked inside the array with video cameras and radar tracks, which allowed for measuring avoidance movements (meso- and micro-avoidance)[1] with high confidence and at the species level. Detailed statistical analyses of the seabird flight data were enabled both by the large sample sizes and by the high temporal resolution in the combined radar track and video camera data. Meso-avoidance behavior showed that species avoided the RSZ by flying in between the turbines with very few avoiding by changing their flight altitude in order to fly either below or above the rotors. The most frequently recorded adjustment under micro-avoidance behavior was birds flying along the plane of the rotor; other adjustments included crossing the rotor either obliquely or perpendicularly, and some birds cross the rotor-swept area without making any adjustments to the spinning rotors. The study concluded that, together with the recorded high levels of micro-avoidance in all species (>0.96), it is now evident that seabirds will be exposed to very low risks of collision in offshore wind farms during daylight hours. This was substantiated by the fact that no collisions or even narrow escapes were recorded in over 10,000 bird videos during the 2 years of monitoring covering the April–October period. The study's calculated micro-avoidance rate (above 0.96) is similar to Skov et al. (2018). Further evidence supporting turbine avoidance can be found in Schwemmer and others (2023), in which 70 percent of approaching 143 GPS tracked Eurasian curlews (*Numenius arquata arquata*) demonstrated horizontal avoidance responses when approaching offshore wind farms in the Baltic and North Seas. While most curlews avoided entire wind farms, others changed their flight altitude to fly below or above the rotor swept zone as they pass through the wind farm (Figures 3.5.3-3, 3.5.3-4, and 3.5.3-5). Given that curlews and red knots are in the same family (Scolopacidae) and are ecologically similar, it is reasonable to expect that red knots would behave similarly to curlews when encountering wind farms and turbines.

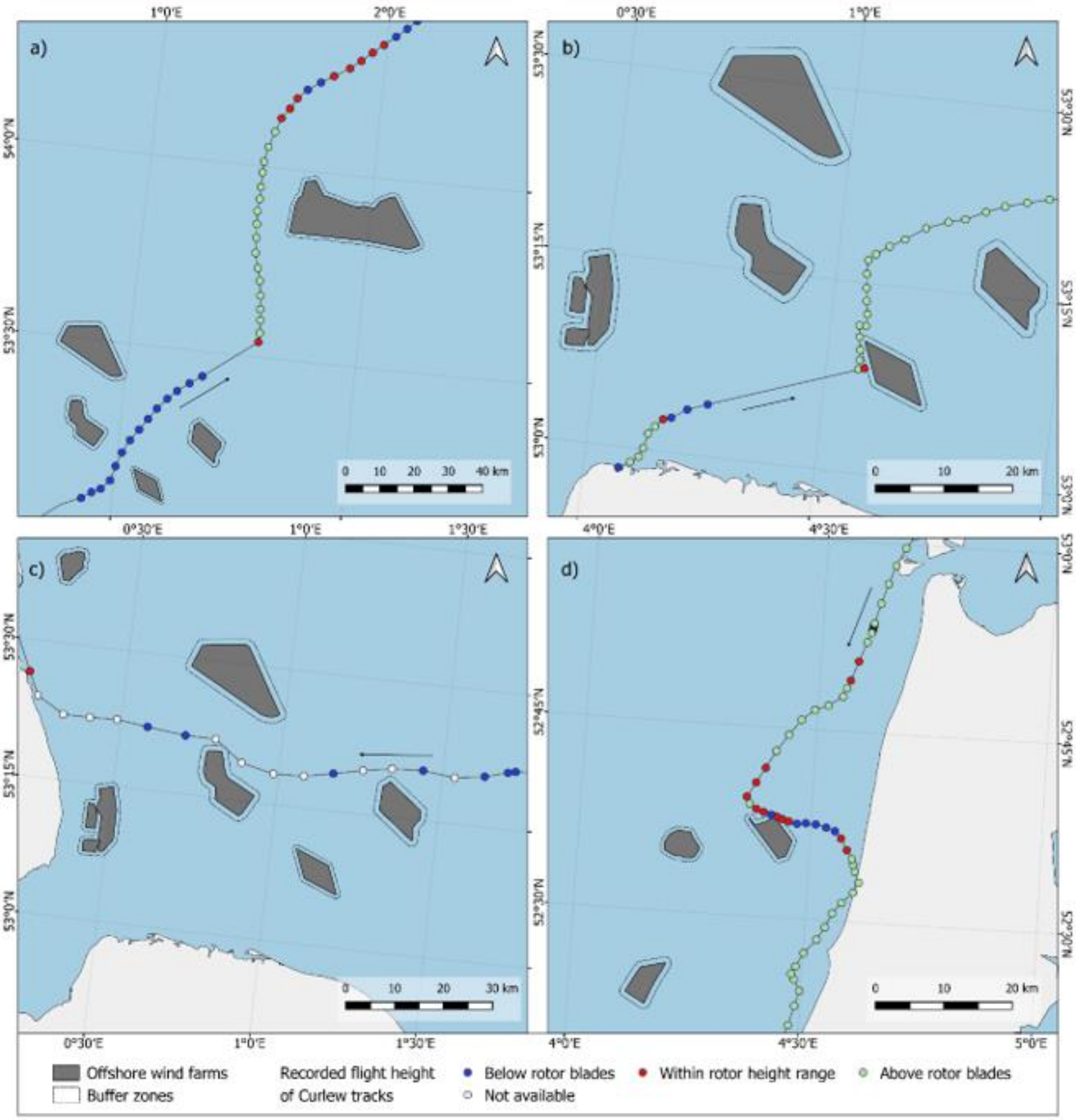
[1] Micro-avoidance is flight behavior within and in the immediate vicinity of individual wind turbine rotor-swept areas (i.e., last second action to avoid collision); meso-avoidance is flight behavior within and in the immediate vicinity of the wind farm (i.e., anticipatory/impulsive evasion of rows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




Source: Figure S2 in Schwemmer et al. (2023).

Note: Four examples of curlews approaching WTAs that show avoidance in the vertical plane by increasing flight altitudes: a) WTA “London Array” (UK; rotor level: 27–147 meters); b) WTA “Galloper” and “Greater Gabbard” (UK; mean rotor level: 26.1–145.9 meters); c) WTA “London Array” (UK; rotor level 27–147 meters); d) WTA “Alpha Ventus”, “Borkum Riffgrund 1”, “Borkum Riffgrund 2” “Merkur”, “Triane Windpark”, “Borkum I” and “Trianel Windpark Borkum II (Germany; mean rotor level: 27.3–166.2 meters). Different colors of GPS fixes represent different flight altitudes.

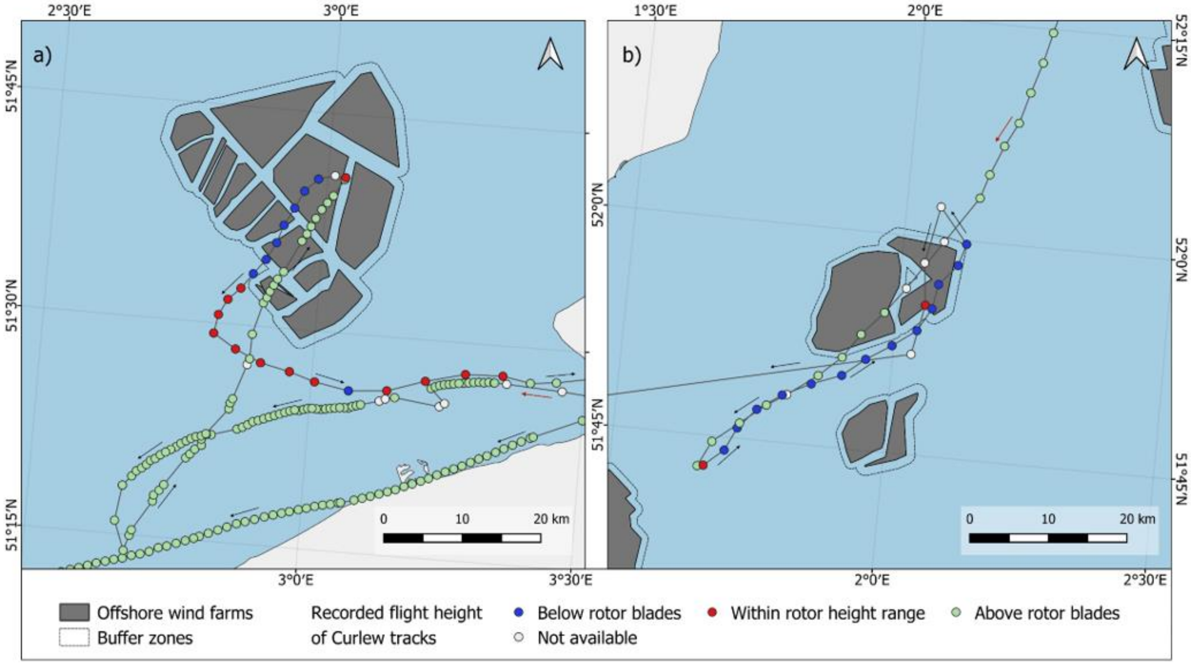
**Figure 3.5.3-3. Four examples of curlews approach WTAs that show avoidance in the vertical plane by increasing flight altitudes**




Source: Figure S3 in Schwemmer et al. (2023).

Note: Four examples of curlews approaching WTAs that show avoidance in the horizontal plane by changing flight directions: a) WTA “Hornsea Project One” (United Kingdom; rotor level: 36–190 meters); b) WTA “Sheringham Shoal” (United Kingdom; rotor level: 26.5–133.5 meters); c) WTA “Race Bank” (United Kingdom; rotor level 23–177 meters); d) WTA “Egmond aan Zee” (The Netherlands; rotor level: 25–115 meters). Different colors of GPS fixes represent different flight altitudes.

**Figure 3.5.3-4. Four examples of curlews approaching WTAs that show avoidance in the horizontal plane by changing flight directions**




Source: Figure S4 in Schwemmer et al. (2023).

Note: Left panel: WTA cluster belonging to Belgium and The Netherlands. The bird entered the North Sea approaching from The Netherlands, performed a loop in the south, entered the WTA cluster and returned to a roost in The Netherlands where it stayed for 9 days before continuing its journey in a straight track. Right panel: WTA "Galloper" and "Greater Gabbard" belonging to the United Kingdom. The bird entered from the north, crossed the WTA cluster performed a circle in the south, entered the WTA cluster again, performed another circle in the north, entered the WTA cluster for a third time and left the area towards the southwest. Arrows depict flight directions.

**Figure 3.5.3-5. Non-directional flights within or in the vicinity of two WTAs made by two curlews tagged as breeding in north Germany.**

Because most structures would be spaced 0.6 to 1 nautical mile (1.1 to 1.9 kilometers) apart, ample space between WTGs should allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. The effects of offshore wind farms on bird movement ultimately depends on the bird species, the size of the offshore wind farm, the spacing of the turbines, and the extent of extra energy cost incurred by the displacement of flying birds (relative to normal flight costs pre-construction) and their ability to compensate for this degree of added energy expenditure. Little quantitative information is available on how offshore wind farms may act as a barrier to movement, but Madsen et al. (2012) modeled bird movement through offshore wind farms using bird (common eider) movement data collected at the Nysted offshore wind farm in the western Baltic Sea just south of Denmark. After running several hundred thousand simulations for different layouts/configurations for a 100 WTG offshore wind farm, the proportion of birds traveling between turbines increased as distance between turbines increased. With eight WTG columns at 0.1 nautical mile (200-meter spacing, no birds passed between the turbines. However, increasing inter-turbine distance to 0.27 nautical mile (500 meters) increased the percentage of birds to more than 20 percent, while a spacing of 0.54 nautical mile (1,000 meters) increased this further to 99 percent. The 0.6- to 1-nautical mile (1.1- to 1.9-kilometer) spacing estimated for most structures that will be proposed on the Atlantic OCS is greater than the distance at which 99 percent of the birds passed through in the model. As such, adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of offshore wind lease areas would not be expected to be biologically significant. Any additional flight distances would likely be small for most migrating birds when compared with the overall migratory distances traveled, and no individual fitness or population-level effects would be expected to occur. Similar results were also reported for foraging birds. A recent study based on GPS tracking of sandwich terns (*Thalasseus sandvicensis*) near several European wind farms found that avoidance rates of offshore wind turbines increased with turbine density (van Bemmelen et al. 2023); interestingly, the turbines in those wind farms were much closer to each other than in the proposed Project, suggesting the proposed turbine spacing may not create a barrier that would displace foraging sandwich terns or other tern species.

In the Northeast and mid-Atlantic waters, there is an average of 2,570 seabird fatalities through interaction with commercial fishing gear each year; of those, 84 percent are interactions with gillnets involving shearwaters/fulmars and loons (Hatch 2017). Abandoned or lost fishing nets from commercial fishing may get tangled with WTG, OSS, or met tower foundations, reducing the chance that abandoned gear would cause additional harm to birds and other wildlife if left to drift until sinking or washing ashore. A reduction in derelict fishing gear (in this case by entanglement with foundations) has a beneficial impact on bird populations (Regular et al. 2013). In contrast, the presence of structures may also increase recreational fishing and thus expose individual birds to harm from fishing lines and hooks.

An indirect effect of the presence of new structures is the possibility of increased prey items for some marine bird species. Offshore wind foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017). Additionally, the new structures may create habitat for structure-oriented and hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), indicating that offshore wind energy facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for individuals of some marine bird species. BOEM anticipates that the presence of structures may result in permanent minor beneficial impacts. Conversely, increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs.

**Traffic:** General aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2021). Because aircraft flights associated with offshore wind development are expected to be minimal in comparison to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic impacts would be negligible and would not be expected to appreciably contribute to cumulative impacts on birds.

### *Impacts of Alternative A – No Action on ESA-Listed Birds*

ESA-listed birds, including the roseate tern, piping plover, red knot, eastern black rail, and saltmarsh sparrow, may occur in onshore and/or offshore wind project areas. Impacts from reasonably foreseeable offshore wind activities on ESA-listed species will be discussed in detail in subsequent project-specific analysis documents. As is the case with the proposed Atlantic Shores South Project, each proposed project will be required to address ESA-listed species at both the individual project scale and cumulatively. Additionally, BOEM is currently working on a programmatic framework for ESA consultation with USFWS to address the potential impacts of the anticipated development of Atlantic offshore wind energy facilities on ESA-listed species.

### *Conclusions*

**Impacts of Alternative A – No Action.** Under the No Action Alternative, birds would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on birds primarily through construction and climate change. Given that the abundance of bird species that overlap with ongoing wind energy facilities on the Atlantic OCS is relatively small, ongoing wind activities would not appreciably contribute to impacts on birds. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. The No Action Alternative would result in **minor** impacts on birds.

**Cumulative Impacts of Alternative A – No Action.** Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and birds would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on birds due to habitat loss from increased onshore construction and interactions with offshore developments.

BOEM anticipates that the overall impacts associated with offshore wind activities in the geographic analysis area would result in adverse impacts but could potentially include beneficial impacts because of the presence of structures. The majority of offshore structures in the geographic analysis area would be attributable to offshore wind development. Migratory birds that use the offshore wind lease areas during all or parts of the year would either be exposed to new collision risk or experience long-term functional habitat loss due to behavioral avoidance and displacement from wind lease areas on the OCS. The offshore wind development would also be responsible for the majority of impacts related to new cable emplacement and pile-driving noise, but effects on birds, including ESA-listed species, resulting from these IPFs would be localized and short term and would not be expected to be biologically significant.

BOEM anticipates that the cumulative impacts of the No Action Alternative, which would result primarily from collision risk and functional habitat loss, would have **moderate adverse** impacts on birds because impacts, though unavoidable, would not result in population-level effects. The No Action Alternative could also include beneficial impacts on marine birds due to the presence of offshore structures; however, these impacts would be **minor beneficial** because although they would have some measurable effects on one or a few individuals or habitat, they would be localized to a small area.

#### 3.5.3.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The proposed new onshore substations and/or converter stations, which could require the removal of trees and shrubs in or on the edge of the construction footprint;
- The routing variants within the selected onshore export cable system, which could require removal of trees and shrubs along the construction corridor;
- The number, size, and location of the WTGs;
- The size and location of the met tower;
- The number, size, and location of metocean buoys; and
- The time of year during which construction occurs.

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

- Onshore export cable routes and substation footprints: the route chosen (including variants within the general route) and substation footprints would determine the amount of habitat affected.
- WTG number, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to birds.
- Met tower size and location: The level of hazard related to the met tower may be affected by the size and location of the met tower; a larger met tower may present more of a hazard to birds.
- Metocean buoy numbers, sizes, and locations: The level of hazard related to met towers and metocean buoys is proportional to the number of met towers and metocean buoys installed; fewer met towers and metocean buoys would present less hazard to birds.
- Season of construction: The activity and distribution of birds exhibit distinct seasonal changes. For instance, summer and fall months (generally May through October) constitute the most active season for birds in the Project area, and the months on either side coincide with major migration events. Therefore, construction during months in which birds are not present, not breeding, or less active would have a lesser impact on birds than construction during more active times.

### 3.5.3.5 Impacts of Alternative B – Proposed Action on Birds

The following sections summarize the potential impacts of the Proposed Action on birds during the various phases of the proposed Project. This includes construction and installation, O&M, and decommissioning both onshore and offshore, as described in Chapter 2, *Alternatives.*

#### *Onshore Activities and Facilities*

Construction and installation of onshore facilities has the potential to affect birds through habitat loss, noise disturbance, and artificial lighting at night.

**Land disturbance:** Generally, onshore activities are not expected to pose any significant impacts (i.e., hazards) on birds because activities would disturb little if any habitat that is not already disturbed or developed, and the transmission lines would be below ground. Bird communities in these areas are composed of mostly disturbance-tolerant generalists that would not be expected to be affected at the population level by the construction, O&M, and decommissioning of the onshore facilities. The proposed onshore interconnection cables would travel underground from landfall sites to onshore substations and/or converter stations, and open trenching and direct impacts would be almost entirely limited to existing roads and other ROWs where existing levels of human disturbance are already high (GEO-12; Appendix G, Table G-1). Tree clearing and other land disturbance for two of the proposed substations and/or converter stations would occur in an urbanized, fragmented landscape, have a small footprint, and would not eliminate high-quality habitat for birds. This long-term but negligible effect on bird habitat would occur for the duration of the Project's operational lifetime. Approximately 18 acres (7.3 hectares) of permanent tree clearing could occur at the Fire Road Onshore Substation/Converter Station site. No more than 14 acres (5.7 hectares) of permanent tree clearing could occur at either the Lanes Pond Road Substation/Converter Station site or the Randolph Road Substation/Converter Station site. Tree clearing at the potential Brook Road parcel would be performed by the SAA-awardee (or the designated lead state or federal agency, as appropriate) as part of the development under the SAA and is thereby not included as part of the Proposed Action. Atlantic Shores would minimize required tree clearing to the maximum extent practicable and conduct tree clearing during the winter months (BIR-12; Appendix G, Table G-1). Additionally, overhead transmission is not being proposed for this Project. Birds in habitats adjacent to these areas are inherently tolerant of human disturbances such that construction, O&M, and decommissioning activities for the onshore facilities would not be expected to have additional impacts.

Elsewhere, HDD would be used to avoid any surface disturbance to wetlands and beaches and other sensitive habitats, thereby avoiding impacts on marsh birds and plovers and other beach-nesting colonial waterbirds such as piping plovers and red knots. The use of HDD would not require construction vehicles in beach and wetland areas, thereby avoiding any impacts on sensitive habitats and sensitive species nesting in those areas. Disturbance to bird habitat is expected to be minimal overall, mainly limited to minor tree-clearing near the existing Cardiff and Larrabee substations and proposed new substation and/or converter station sites, where adjacent forest is already fragmented and otherwise degraded. This could reduce foraging and nesting habitat for some common bird species associated with degraded habitat fragments, but any such effects would not have measurable impacts on their local populations. Land disturbance that would occur during decommissioning would also be short term and limited to the footprint of the onshore facilities and their immediately adjacent, disturbed areas.

**Lighting:** Because the Onshore Project components are in developed areas, lighting would represent a negligible increase in existing levels of artificial lighting at night in the overall area during construction, O&M, and decommissioning. To the extent practicable, a communications antenna that would potentially be constructed on the O&M facility in Atlantic City would have obstruction lighting and other features designed in accordance with USFWS guidelines to minimize potential for lighting and collision impacts on birds (BIR-15; Appendix G, Table G-1). Construction and decommissioning lighting would be short term, localized to the work area, and down-lighted/shielded to the maximum extent practicable (BIR-06 and BIR-13; Appendix G, Table G-1). Lighting during onshore O&M operations would be limited to the minimum required by regulation and for safety (BIR-14; Appendix G, Table G-1). Bird communities in the area would be composed of disturbance-tolerant generalists that would not experience significant impacts on their local populations as a result of lighting related to the construction, O&M, and decommissioning of the onshore facilities.

**Noise:** Construction and installation, O&M, and decommissioning noise from the operation of vehicles and equipment could displace birds from nearby habitats, although these effects would be short term and highly localized. Further, the bird community in the surrounding area is expected to be composed of disturbance-tolerant generalists given the fragmented and degraded habitat conditions, and high existing levels of human disturbance in the landscape. Birds in the area are therefore expected to be habituated to ambient noises typical of urban areas. Overall, noise from the construction, O&M, and decommissioning of onshore facilities would not have measurable population-level impacts on local birds.

### *Offshore Activities and Facilities*

Construction and installation, O&M, and decommissioning of offshore facilities has the potential to affect birds through accidental release of waste and contaminants; disturbance to the seafloor and benthic prey communities due to WTG, OSS, and met tower foundations and cable installation and maintenance; vessel, WTG, OSS, and construction lighting; noise disturbance; aircraft traffic; and the presence of structures.

**Accidental releases:** Some potential exists for mortality, decreased fitness, and health effects on birds due to accidental release of fuel, hazardous materials, and trash and debris from vessels associated with the construction and installation, O&M, and decommissioning of the Proposed Action. Vessels associated with the Proposed Action may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with the Proposed Action would comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Atlantic Shores would remove any marine debris caught on offshore Project structures, when safe and practicable, to reduce the risk of bird entanglement (BIR-7; Appendix G, Table G-1). In addition, Atlantic Shores has prepared and would implement an OSRP (COP Volume I, Appendix I-D; Atlantic Shores 2024), which would minimize the potential for spills and identify procedures in the event of a spill. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on birds. Planned offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazardous materials exposure but, compared to the overall spill risk from ongoing activities, the contribution from the Proposed Action would be low.

**Cable emplacement and maintenance:** Construction and installation of offshore export cables associated with the Proposed Action would disturb up to 1,606 acres (650 hectares) of seafloor (Appendix D, Table D.A2-2), which would result in turbidity effects that have the potential to reduce marine bird foraging success or have short-term and localized impacts on the prey of marine birds. To evaluate the impacts of submarine export and interarray cable installation, a conservative analytical sediment transport model was developed using publicly available data and data provided by Atlantic Shores to quantify potential maximum plume dispersion and sediment concentrations and potential maximum sediment deposition thicknesses (see COP Volume II, Appendix II-J3 for details; Atlantic Shores 2024) Suspended sediments at above-ambient concentrations (TSS ≥ 10 mg/L) could be transported 1.6 and 1.8 miles (2.6 and 2.9 kilometers) at the Atlantic and Monmouth ECCs, respectively, and 1.1 miles (1.7 kilometers) at the interarray area. The sediment transport modeling indicated that the above-ambient TSS concentrations would be short-lived (fully dissipated in 6–24 hours), remain relatively close to the centerline of the export cable corridor routes, and would be generally constrained to the bottom of the water column. Sediment deposition of ≥ 0.04 inch (1 millimeters) in thickness would occur within 656 feet (200 meters) from the Monmouth ECC centerline, within 164 feet (50 meters) of the Atlantic ECC centerline, and within 361 feet (110 meters) of the centerline for jet trenching installation of the interarray cables. The maximum sediment deposition modeled was less than 0.2 inch (5 millimeters) for interarray cables, between 0.2 and 0.4 inch (5 and 10 millimeters) for the Atlantic ECC route, and between 0.4 and 0.8 inch (10 and 20 millimeters) for the Monmouth ECC route; however, in all scenarios maximum deposition was predicted to occur within 49 feet (15 meters) from each route's centerline.

Results from the analysis were also consistent with other sediment transport models completed for wind farm installation projects in the mid-Atlantic region. Data collections and modeling studies of plowing, trenching, and dredging projects showed that displacement of sediments is low, and they typically dissipated to background levels very close to the site (e.g., BERR 2008; Tetra Tech 2021). Individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement, and only non-measurable impacts, if any, on individuals or populations would be expected given the localized and short-term nature of the potential impacts. Given the localized nature of these impacts, impacts associated with the emplacement of cables for other offshore wind projects in the geographic analysis area are not anticipated to overlap spatially with the Proposed Action, and impacts would be unlikely.

**Lighting:** Under the Proposed Action, up to 200 WTGs, 1 met tower, 4 metocean buoys, and 10 OSSs would be lit with USCG navigational and FAA hazard lighting; these lights have some potential to attract birds and result in increased collision risk (Hüppop et al. 2006). In accordance with BOEM lighting guidelines (BOEM 2021), all WTGs in excess of 699 feet (213 meters) above ground level would be lit with two synchronized red flashing obstruction lights (with medium-intensity FAA model L-864 and light-emitting diode color between 800 and 900 nanometers) placed on the back of the nacelle on opposite sides, and up to three FAA model L-810 red flashing lights at mid-mast level, adding up to 1,000 new red flashing lights to the offshore environment where none currently exist. However, red flashing aviation obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010; Orr et al. 2013). Additionally, marine navigation lighting would consist of multiple types of flashing yellow lights on the corners of each OSS, corner-located WTGs, and significant peripheral structures such as a met tower, outer boundary WTGs, and interior WTGs. Atlantic Shores is considering the use of an FAA-approved ADLS (BIR-05; Appendix G, Table G-1), subject to FAA and BOEM approval, which is a lighting system that would only activate WTG and met tower lighting when aircraft enter a predefined airspace. For the Proposed Action, based on historical air traffic data, obstruction light activation under ADLS was estimated to occur approximately 9 hours over the course of 1 year for flights passing through the Project light activation volume, which equals less than 1 percent of the time that full-time obstruction lights would be active (COP Volume II, Appendix II-M4; Atlantic Shores 2024).

Lighting not required by FAA and USCG during offshore construction and installation, O&M, and decommissioning would be limited to reduce attraction of birds (BIR-03; Appendix G, Table G-1). Vessel lights during construction and installation would have short-term but minimal effects and would be limited to vessels transiting to and from construction areas.

The impact of the Proposed Action alone would not noticeably increase the impacts of light beyond those described under the No Action Alternative. BOEM expects impacts on birds, if any, to be long term but negligible from vessel, WTG, and OSS lighting.

**Noise:** The expected impacts of construction vessel, aircraft, G&G survey, pile driving, and other noises associated with the construction and installation of the Proposed Action alone would not increase the impacts of noise on birds beyond those described under the No Action Alternative. The pile-driving noise impacts would be short term and would cease after piles are installed. Vessel and construction noise could temporarily disturb offshore bird species, but they would likely acclimate to the noise or move away and be able to return post-disturbance (BOEM 2012). BOEM anticipates the short-term impacts, if any, related to construction and installation of the offshore components would be negligible.

**Presence of structures:** The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, entanglement and fishing gear loss or damage, migration disturbances, and WTG strikes and displacement, are described in Section 3.5.3.3, *Cumulative Impacts of Alternative A – No Action*. The up to 200 WTG structures, along with one permanent met tower and up to 10 OSSs, associated with the Proposed Action would remain at least until decommissioning of the Project is complete. While the up to 200 WTGs would be aligned in a uniform grid with rows in an east-northeast to west-southwest direction spaced 1.0 nautical mile (1.9 kilometers) apart and rows in an approximately north to south direction spaced 0.6 nautical mile (1.1 kilometers) apart, the OSSs and met tower would be sited in off-grid positions within the Lease Area. The impacts of the Proposed Action alone as a result of presence of structures would be long term but minor and may include some beneficial impacts. Due to the anticipated use of flashing red tower lights (BIR-05; Appendix G, Table G-1), restricted time period of exposure during migration, and small number of migrants that could cross the Project area, the presence of structures from the Proposed Action would not be expected to adversely impact populations of migrating birds.

As previously described and shown in Figure 3.5.3-2, the locations of the OCS offshore wind lease areas were selected to minimize impacts on all resources, including birds. Most of the bird migration along the Atlantic Flyway is concentrated along the coastline, while relatively little bird migration occurs offshore (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). Nevertheless, operation of the Proposed Action would result in individual-level impacts on some offshore bird species and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs or other associated structures within the WTA, or through behavioral avoidance and habitat loss (Drewitt and Langston 2006; Fox et al. 2006; Goodale and Milman 2016). The predicted activity of bird populations that have a higher sensitivity to collision (as defined by Robinson Willmott et al. 2013) is relatively low in the OCS during all seasons of the year (Figure 3.5.3-2), suggesting that bird fatalities due to collision are likely to be low. When WTGs are present, many birds would avoid the WTG site altogether, especially the species that ranked "high" in vulnerability to displacement by offshore wind energy development (Robinson Willmott et al. 2013). In addition, many birds would likely adjust their flight paths to avoid WTGs and other structures by flying above, below, or between them (e.g., Desholm and Kahlert 2005; Plonczkier and Simms 2012; Skov et al. 2018) and others may take extra precautions to avoid WTGs when the WTGs are moving (Johnston et al. 2014). Several species have very high avoidance rates; for example, the northern gannet, black-legged kittiwake, herring gull, and great black-backed gull have measured avoidance rates of at least 99.6 percent (Skov et al. 2018).

Atlantic Shores performed an exposure and relative vulnerability assessment to estimate the collision and displacement risk of various offshore bird species encountering the Project area (COP Volume II, Appendix II-F2; Atlantic Shores 2024). As discussed below, most species were identified as having "minimal" to "low" overall exposure risk.

Land birds are generally considered to have minimal exposure to the Offshore Project elements because the Offshore Project elements are far enough offshore as to be beyond their range. Peregrine falcons (*Falco peregrinus*) can fly offshore during migration (DeSorbo 2014), and have been tracked adjacent to the WTA (COP Volume II, Appendix II-F2; Atlantic Shores 2024), but while falcons can be attracted to WTGs (Hill et al. 2014; Skov et al. 2016), falcon mortalities have not been documented at offshore wind projects in Europe. Uncertainty exists about what proportion of migrating peregrine falcons might be attracted to offshore wind energy projects for perching, roosting, and foraging, and the extent to which individuals might avoid WTGs and associated structures or collide with them. To minimize the introduction of perching structures to the offshore environment, Atlantic Shores has committed to installing bird deterrent devices, where appropriate, on offshore, above-water structures (BIR-04; Appendix G, Table G-1). Among other raptors, ospreys can make water crossings (Kerlinger 1985) and fly offshore, but satellite telemetry data indicate they generally remain close to the mid-Atlantic coast during fall migration (Bierregaard et al. 2020; COP Volume II, Appendix II-F2; Atlantic Shores 2024). Eagles and hawks are rarely observed offshore (DeSorbo 2014).

Migrating songbirds typically fly at heights well above or below the RSZ (72 feet to 1,043 feet [22 to 318 meters] above highest astronomical tide (HAT) (COP Volume II, Appendix II-F2; Atlantic Shores 2024). As shown in Robinson Willmott et al. (2013), species with low sensitivity scores include many songbirds that only cross the Atlantic OCS briefly during migration and typically fly well above the RSZ. It is generally assumed that inclement weather and reduced visibility cause birds to decrease their flight altitudes (Ainley et al. 2015), increasing potential for large-scale mortality events at structures. However, this has not been shown to be the case in studies of offshore wind facilities in Europe, with oversea migration completely, or nearly so, ceasing during inclement weather (Fox et al. 2006; Pettersson 2005; Hüppop et al. 2006), and with migrating birds avoiding flying through fog and low clouds (Panuccio et al. 2019). Furthermore, many songbird species have been documented in only relatively low numbers on the OCS during migration (Robinson Willmott and Forcey 2014). In addition, most of the activity (including blackpoll warblers) was during windspeeds less than 8.8 feet (2.68 meters) per second—below the turbine cut in speed (see Figure 109 in Robinson Willmott and Forcey 2014)—and thus of little risk to migrating songbirds, although songbirds elsewhere have been found to sometimes migrate during higher windspeeds (e.g., Abdulle and Fraser 2018; Chapman et al. 2016) and more remains to be learned about the associations of offshore songbird migration with weather conditions. Overall, population-level impacts are unlikely because exposure to the WTA is expected to be minimal to low and limited in duration.

All marine birds were identified as having minimal to low exposure except loons, which received a medium exposure assessment. Gulls were identified as having the highest vulnerability to collisions, but were still low to medium (see Table 3.5.3-5); (COP Volume II, Appendix II-F2; Atlantic Shores 2024; Wade et al. 2016). Sea ducks, auks, loons, petrels (including black-capped petrels), shearwaters, and storm-petrels are generally not considered vulnerable to collision because they avoid WTGs (Furness et al. 2013). Terns are thought to typically fly below the RSZ, although some studies indicate that terns as well as northern gannets may have some limited vulnerability to collision. COP Volume II, Appendix II-F2 (Atlantic Shores 2024) includes more detailed discussion, as well as supporting tables and maps for each species group's exposure and vulnerability assessment. In brief, while collisions with WTGs and associated structures may impact individual non-listed marine birds (i.e., gulls and cormorants), population-level impacts are not expected because the species vulnerable to collision have minimal to low exposure to the WTA. Furthermore, gulls and cormorants have minimal to medium overall population vulnerability.

Some marine bird species might avoid the WTA during its operation, leading to an effective loss of habitat. For example, loons (Dierschke et al. 2016; Drewitt and Langston 2006; Lindeboom et al. 2011; Percival 2010; Petersen et al. 2006), grebes (Dierschke et al. 2016; Leopold et al. 2011; Leopold et al.

2013), sea ducks (Drewitt and Langston 2006; Petersen et al. 2006), and northern gannets (Drewitt and Langston 2006; Lindeboom et al. 2011; Petersen et al. 2006) typically avoid offshore wind developments (i.e., have high displacement sensitivity; Table 3.5.3-5). In such cases, the proposed Project would potentially no longer provide foraging opportunities to those species with high displacement sensitivity, but suitable foraging habitat would remain abundantly available in the surrounding region. A complete list of species included in the higher displacement sensitivity group can be found in Robinson Willmott et al. (2013). Because the WTA is not likely to contain important foraging habitat for the species susceptible to displacement, BOEM expects this loss of habitat to be insignificant. Population-level, long-term impacts resulting from habitat loss would likely be negligible.

Atlantic Shores has committed to developing and implementing an avian post-construction monitoring plan to assess any Project impacts on avian species (BIR-1, BIR-08, and BIR-16; Appendix G, Table G-1). Any dead or injured birds would be reported to BOEM on an annual basis, and those with USFWS bands would be reported to the USGS Bird Banding Lab (BIR-09; Appendix G, Table G-1). Additionally, Atlantic Shores has installed two Motus receiving antennae on separate metocean buoys to track the offshore movements of tagged bird species within the WTA (BIR-02; Appendix G, Table G-1).

**Table 3.5.3-5. Summary of the assessment of potential exposure and vulnerability of marine birds**

| Group | Exposure | Relative Vulnerability to | | |
|---|---|---|---|---|
| | | Collision | Displacement | Population |
| Sea ducks | min–low | low | med–high | low–med |
| Auks | min–low | min–low | med–high | low–med |
| Jaegers and gulls | min–low | low–med | low–med | min–med |
| Terns | min–low | low | med–high | low–high |
| Loons | min–med | low | high | low–med |
| Shearwaters, petrels, and storm-petrels | min–low | low | med | low–med |
| Gannets, cormorants, and pelicans | min–low | low–med | low–med | min–low |

Source: COP Volume II, Table 4.3-4 (Atlantic Shores 2024). Methods of population vulnerability calculation detailed in COP Volume II, Appendix II-F2, Section 4.1.2.1 (Atlantic Shores 2024).

The expected impacts of the Proposed Action alone would increase only slightly over those described under the No Action Alternative. The structures associated with the Proposed Action and the consequential impacts would be long term and would remain at least until decommissioning of the proposed Project is complete.

**Traffic:** The expected impacts of aircraft traffic associated with construction and installation, O&M, and decommissioning of the Proposed Action alone would not increase the impacts of this IPF beyond those described under the No Action Alternative. Impacts due to Project-related aircraft traffic are expected to be negligible.

### *Impacts of Alternative B – Proposed Action on ESA-Listed Birds*

The Proposed Action is not expected to have the potential to significantly impact populations of ESA-listed species, including the roseate tern, piping plover, red knot, eastern black rail, and saltmarsh sparrow due to low degrees of exposure. No modeled roseate tern flight paths were estimated in the

WTA by Loring et al. (2019) or in the NJDEP Baseline Studies data (Geo-Marine, Inc. 2010), indicating minimal exposure (COP Volume II, Appendix II-F2; Atlantic Shores 2024). Further, flight height estimates and records suggest roseate terns have a low probability of flying within the RSZ (COP Volume II, Appendix II-F2; Atlantic Shores 2024). Occurrence of piping plovers within the WTA has been found to be minimal (Loring et al. 2019). Piping plovers have also been found to fly relatively high and during clear weather conditions that reduce chances of collisions with structures (Loring et al. 2019). Tracking data from red knots suggest that some long-distance, southbound migrants may pass through the WTA. Loring et al. (2018) found red knots to fly at heights ranging from 72 feet (22 meters) to 2,893 feet (882 meters), indicating some potential exposure to the RSZ. Flights across WEAs occurred under clear conditions, however, reducing the likelihood of collisions (Loring et al. 2018). During red knot tracking studies performed for Atlantic Shores in 2020–2021, all but 1 of the 15 birds suspected to cross the Lease Area during their migration flew below the RSZ (altitudes of 3.3 to 72 feet [1 to 22 meters]), with the remaining red knot flying well above the RSZ at an altitude of 1,887 feet (575 meters) (Feigin et al. 2022). Taken together, low abundance and flight heights either below or above the RSZ during clear conditions make the exposure level for red knots low and unlikely to significantly affect their populations.

Due to the anticipated use of flashing red tower lights, restricted seasons of exposure, and small number of individuals that could cross the Project area, BOEM concluded that the Proposed Action would not likely adversely affect ESA-listed roseate terns, piping plovers, eastern black rails, or saltmarsh sparrows. Additionally, the use of HDD onshore would avoid impacts to coastal beach and wetland habitats of these ESA-listed birds (BIR-11; Appendix G, Table G-1). BOEM has prepared a BA for the potential effects on federally listed species, which concluded that the Proposed Action *may affect, but is not likely to adversely affect* the roseate tern, eastern black rail, or saltmarsh sparrow, or their critical habitat. However, because collision modeling predicted the chances of annual and 35-year collision mortality of piping plover and *rufa* red knots to be above zero, the BA found that the Proposed Action may adversely affect the *rufa* red knot (BOEM 2023). BOEM requested concurrence from USFWS on its conclusion that the impacts of the proposed activities are expected to be discountable and insignificant, and thus *may affect but are not likely to adversely affect* the piping plover, roseate tern, eastern black rail, or saltmarsh sparrow. The BA also found that the proposed activities would have *no effect* for the black-capped petrel and that there would be *no effect* on designated critical habitat by the Proposed Action (BOEM 2023, 2024). Consultation with USFWS pursuant to Section 7 of the ESA concluded with the issuance of a Biological Opinion from USFWS in December 2023 (USFWS 2023a). In the Biological Opinion, USFWS concluded that the Proposed Action is not likely to adversely affect the eastern black rail and saltmarsh sparrow. USFWS also concluded that effects of the Proposed Action on the piping plover, roseate tern, and *rufa* red knot are expected to insignificant or discountable, except for collision risk; however, USFWS does not anticipate any reductions in the overall distribution, abundances, or reproduction of these species and stated that the Proposed Action is not likely to jeopardize their continued existence.

### *Impacts of the Connected Action*

As described in Chapter 2, bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). The bulkhead site and dredging activities are in-water activities that would be conducted within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area. Due to the mobility of birds, a variety of species have the potential to pass through the Inlet Marina area. However, due to its highly developed nature, the Marina Inlet area does not provide quality, undisturbed bird habitat. BOEM expects the activities associated with the connected action to affect birds primarily through the accidental releases and noise IPFs. Other IPFs considered under the Proposed Action do not apply (e.g., cable emplacement and maintenance, traffic [aircraft]), and because the surrounding area consists of existing structures and other infrastructure, the presence of structures IPF would not pose a substantial risk to birds. Additionally, because all activities associated with the connected action are in-water activities, the land disturbance IPF does not apply.

**Accidental releases:** In-water construction activities would require heavy equipment use, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Some potential exists for bird impacts (e.g., injury from exposure) due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with dredging and construction equipment in the aquatic and terrestrial environment around Inlet Marina. An SPCC plan would be developed and implemented to avoid, minimize, and contain spills (GEO-16; Appendix G, Table G-1). Accidental releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on birds. In addition, all dredging equipment/use of watercraft and in-water work would comply with federal, state, and local permitting (e.g., CWA Sections 404 and 401) requirements for prevention and control of petrochemical spills, including oil and fuel. Therefore, BOEM anticipates accidental releases associated with the connected action to be negligible.

**Noise:** The expected impacts of noise associated with the connected action activities could affect any birds that may be in the vicinity of the Inlet Marina area. However, similar to the Proposed Action, construction noise would be temporary and localized and would not be anticipated to be significantly different than the noise levels in the surrounding urban environment. If pile driving is necessary during construction, the noise would be temporary and would cease after piles are installed. Similarly, dredging vessels and other construction noise could temporarily disturb and displace bird species, but they are likely already acclimated to noise in an urban environment and would be able to move away from the noise. Normal operation at the O&M facility in the Inlet Marina area would generate continuous noise, but BOEM expects negligible long-term impacts when considered in the context of the other commercial and industrial noises in the Onshore Project area. Overall, BOEM anticipates noise impacts associated with the connected action to be negligible.

### *Cumulative Impacts of Alternative B – Proposed Action*

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities related to installation of new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS would contribute to impacts on birds through the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance. Construction related to the connected action could affect birds by generating temporary and localized noise, and with potential accidental releases of fuels and hazardous materials. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of accidental releases, lighting, cable emplacement and maintenance, presence of structures, traffic (aircraft), and land disturbance. Given that the abundance of bird species that overlap with wind energy facilities on the Atlantic OCS is relatively small, offshore wind activities would not appreciably contribute to impacts on bird populations. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area. Ongoing and planned offshore wind activities in combination with the Proposed Action would result in an estimated 3,191 WTGs, of which the Proposed Action would contribute 200 (or about 6.3 percent) and would include up 36,207 acres (14,652 hectares) of seafloor disturbed from the offshore export cable and interarray cables (Appendix D, Tables D.A2-1 and D.A2-2).

The cumulative impacts on birds would likely be moderate because, although bird abundance on the OCS is low, there could be unavoidable impacts offshore and onshore; however, BOEM does not anticipate the impacts to result in population-level effects or threaten overall habitat function. The Proposed Action would contribute a negligible impact to the cumulative accidental releases, lighting, cable emplacement and maintenance, noise, traffic (aircraft), presence of structures, and land disturbance impacts on birds.

### *Conclusions*

**Impacts of Alternative B – Proposed Action.** Construction and installation, O&M, and eventual decommissioning of the Proposed Action alone would have **moderate adverse** impacts on birds, depending on the location, timing, and species affected by an activity. The primary impacts of the Proposed Action affecting birds are habitat loss and potential collision-induced mortality from rotating WTGs, and long-term but minimal habitat loss and conversion from onshore construction. The Proposed Action would also result in potential **minor beneficial** impacts associated with foraging opportunities for marine birds. The primary impacts of the connected action are related to noise and accidental releases, which could affect birds in the area of Inlet Marina. Given the developed nature of the Inlet Marina area, birds are likely acclimated to activities similar to those related to the connected action; therefore, BOEM anticipates that impacts of the connected action would be negligible.

**Cumulative Impacts of Alternative B – Proposed Action.** The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action at the Inlet Marina in Atlantic City, New Jersey. BOEM anticipates that the cumulative adverse impacts on birds in the geographic analysis area, primarily due to collision risk and functional habitat loss, would be **moderate** because impacts would be unavoidable, but not result in population-level effects. The Proposed Action could also include cumulative beneficial impacts on marine birds due to the presence of offshore structures; however, these impacts would be **minor beneficial** because although they would have some measurable effects on one or a few individuals or habitat, they would be localized to a small area. The contribution of the Proposed Action to the cumulative impacts of individual IPFs resulting from ongoing and planned activities would range from negligible to moderate, as well as moderate beneficial impacts. The Proposed Action would contribute to the cumulative impact rating primarily through the permanent impacts from the presence of structures.

#### 3.5.3.6 Impacts of Alternatives C, D, E, and F on Birds

**Impacts of Alternatives C, D, E, and F.** Construction and installation, O&M, and decommissioning of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization, D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would only differ from the Proposed Action for offshore activities and facilities. Onshore activities and facilities would be the same as those described under the Proposed Action (Section 3.5.3.5). Impacts on birds resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the offshore portion of the Project under Alternatives C, D, E, and F would be the same or substantially similar to those described under the Proposed Action. Alternative C would include removing up to 29 WTGs, 1 OSS and associated interarray cables with the goal of minimizing impacts on sensitive habitats including submerged vegetation. Alternative D would include removing up to 31 WTGs, with the height of the remaining WTGs restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters) AMSL to reduce visual impacts. Under Alternative E, modifications would be made to the wind turbine array layout to create a 0.81-nautical-mile (1,500--meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Lease Areas of Atlantic Shores South (OCS-A 0499) and Ocean Wind 1 (OCS-A 0498) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation. Alternative F would analyze the extent of potential impacts from alternative foundation types (piled, suction bucket, and gravity-based foundations). None of the differences between these alternatives and the Proposed Action would have the potential to significantly reduce or increase impacts on birds from the analyzed IPFs. All conclusions reached for the Proposed Action, with regard to adverse impacts on birds, would also apply to Alternatives C through F. Alternatives C, D, and E would potentially benefit birds through reduced effects on habitats that support prey for some waterbird species, but any such benefits would be negligible. Under Alternatives C, D, and E, there could be reduced potential for collisions with structures due to a lower number of WTGs operating, but the difference would have negligible population-level benefits to birds.

**Cumulative Impacts of Alternatives C, D, E, and F.** The cumulative impacts on birds would be moderate and moderate beneficial for the same reasons described for the Proposed Action. The negligible impacts contributed by Alternatives C, D, E, and F to the cumulative impacts of birds would be the same or similar to those described under the Proposed Action.

### *Impacts of Alternative C, D, E, and F on ESA-Listed Birds*

Construction and installation, O&M, and decommissioning of Alternatives C, D, E, and F would only differ from the Proposed Action for offshore activities and facilities. Onshore activities and facilities would be the same as those described under the Proposed Action (Section 3.5.3.5). Under Alternatives C through F, impacts on ESA-listed bird species from construction and installation, O&M, and decommissioning of offshore facilities would be the same as described for the Proposed Action. Alternatives C, D, and E would potentially benefit birds through reduced construction and installation effects on habitats that support prey for roseate terns, but any such benefits would be negligible. Under Alternatives C, D, and E, there could be reduced potential for collisions of piping plovers, red knots, and roseate terns with structures due to a lower number of WTGs operating, but the difference would have negligible population-level benefits.

### *Conclusions*

**Impacts of Alternatives C, D, E, and F.** The impacts on birds resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives C, D, E, and F would be the same or substantially similar to those described under the Proposed Action. None of the differences between these alternatives and the Proposed Action would have the potential to significantly reduce or increase impacts on birds from the analyzed IPFs. All conclusions reached for the Proposed Action also apply to Alternatives C through F, with **moderate adverse** impacts on birds, primarily due to habitat loss and potential collision-induced mortality from rotating WTGs, and potential **minor beneficial** impacts associated with foraging opportunities for marine birds.

**Cumulative Impacts of Alternatives C, D, E, and F.** The impacts contributed by Alternatives C, D, E, and F to the cumulative impacts of birds would be negligible. Because the impacts of the Proposed Action would not change under Alternatives C, D, E, or F, BOEM anticipates that the cumulative impacts of Alternatives C, D, E, and F would be the same or similar to those described under the Proposed Action. Therefore, cumulative impacts of Alternatives C, D, E, and F on birds, primarily due to habitat loss and collision risk, would be **moderate** because impacts would be unavoidable, but not result in population-level effects, and **minor beneficial** because although increased foraging habitat due to the presence of structures would have some measurable effects on one or a few individuals or habitat, they would be localized to a small area.

## 3.5.3.7 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Tables G-2 and G-3 and summarized and assessed in Table 3.5.3-6. If one or more of the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts on birds could be further reduced.

**Table 3.5.3-6. Proposed mitigation measures – birds**

| Mitigation Measure | Description | Effect |
| --- | --- | --- |
| Tree clearing restrictions | Because many wildlife species overwinter in cavities and nests, any mature trees slated for removal should be checked (including for vacant raptor nests) and avoided if possible. If the tree must be taken down, the Lessee will coordinate with USFWS and clearing would occur between October 1 and March 31. Mature trees are defined as live trees and/or snags ≥3 inches dbh. | While this mitigation measure would reduce impacts on birds present in the onshore Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Bird and Bat Monitoring Plan (BBMP) | A BBMP will be implemented that includes monitoring, annual monitoring reports, post-construction quarterly progress reports, monitoring plan revisions, operational reporting, and raw data sharing. | The monitoring plan will determine if revisions are needed, including technical refinements and/or additional monitoring in order to reduce impacts incurred on bird and bat resources. |
| Monitoring and conservation | The Lessee will implement monitoring and other conservation measures to minimize disturbance of *rufa* red knots and other ESA-listed birds, in coordination with USFWS and NJDEP. | While this mitigation measure would reduce impacts on birds present in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Bird deterrent | To minimize attracting birds to operating WTGs, the Lessee must, where safety permits, install bird perching-deterrent device(s) on each WTG and OSS. The Lessee must submit a plan to deter perching on offshore infrastructure by roseate terns and other marine birds for BOEM and BSEE approval. | While this mitigation measure would reduce impacts on birds present in the offshore Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Light impact reduction | The Lessee must use lighting technology that minimizes impacts on avian species to the extent practicable, including lighting designed to minimize upward illumination and will 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. The Lessee must provide USFWS with a courtesy copy of the final Lighting, Marking, and Signaling Plan, and the Lessee's approved application to USCG to establish Private Aids to Navigation and will confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the FDR. | While this mitigation measure would reduce Project-related illumination in the offshore Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs due to the already low presence of birds in the offshore Project area. |

| Mitigation Measure | Description | Effect |
|---|---|---|
| Minimization of beach impacts | The Lessee will avoid the use of HDD at the Monmouth Landfall location during the piping plover nesting season (March 15 to the fledging of the last chick), unless coordination with USFWS deems not necessary. Both during and after construction, the Lessee must avoid Project-related intrusion (i.e., access through or disturbance from personnel or equipment) into any beach, dune, or tidal marsh area from March 1 to August 31. Both during and after construction, the Lessee must avoid Project activities within 500 feet of any beach or dune from March 15 to August 31. | While this mitigation measure would reduce impacts on birds present at the Monmouth landfall, and beach, tidal, and dunes within the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Minimization of impacts on ESA-listed species | The Lessee will minimize or avoid impacts on ESA-listed species by 1) avoiding permanent modification of suitable *rufa* red knot habitats and developing a restoration plan in areas where temporary habitat disturbance is unavoidable; 2) avoiding disturbing roosting roseate terns to the extent practicable during construction and operations and maintenance, affording at least a 300-foot buffer for people on foot and for vehicles to avoid flushing the birds; and 3) avoiding entry or intrusion into wetlands during and after construction to avoid impacts on eastern black rail and saltmarsh sparrow. Additionally, if areas of suitable eastern black rail and/or saltmarsh sparrow habitat will be affected by Project activities, the Lessee must coordinate with USFWS to develop appropriate conservation measures that the Lessee is required to implement to avoid adverse effects on these species, including the seasonal restriction of construction-related activities and other Project-related intrusions into areas of suitable habitat from April 1 through September 30 (April 1 through September 30 for eastern black rail and May 1 to September 30 for saltmarsh sparrow). | While this mitigation measure would reduce impacts on ESA-listed species present within the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |

| Mitigation Measure | Description | Effect |
|---|---|---|
| Bird mortality reporting | Any occurrence of a dead or injured 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 72 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state. The Lessee must provide an annual report to BOEM, BSEE, and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. Carcasses with federal or research bands must be reported to the USGS Bird Band Laboratory. | This mitigation would help inform future collision and impact estimates for birds; however, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Compensatory mitigation for ESA-listed species | At least 180 days prior to the commissioning of the first WTG, the Lessee must distribute a Compensatory Mitigation Plan to BOEM, BSEE, and USFWS for review and comment. The Compensatory Mitigation Plan must provide compensatory mitigation actions to offset take of piping plover, red knot, and roseate tern by the fifth year of WTG operation. | While this mitigation would offset any take of ESA-listed species in the Project Area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Turbine configuration and maintenance | The Lessee will design WTGs to have a wind turbine air gap that minimizes collision risk to marine birds and remove debris caught on offshore Project structures, when safe and practicable. | While this mitigation measure would reduce impacts on birds present in the offshore Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Collision risk model support and utilization | BOEM commits to continue funding the refinement and advancement of SCRAM, or its successor, with the goal of continually improving the accuracy and robustness of collision mortality estimates. Additionally, BOEM will work cooperatively with USFWS to re-run the SCRAM model (or its successor) for the ASOWS projects on a schedule determined by USFWS. | This mitigation would help fund and inform future collision and impact estimates for birds; however, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Collision minimization and detection reports | Periodically review current technologies and methods for detecting collisions of listed birds, as well as for minimizing the collision risk of listed birds. | The reports will help determine if revisions to the monitoring plan and future mitigation measures are needed, including technical refinements and/or additional monitoring in order to reduce impacts incurred on bird and bat resources. |

### *Measures Incorporated in the Preferred Alternative*

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.5.3-6 and Tables G-2 and G-3 in Appendix G are incorporated in the Preferred Alternative. These measures would further define how the effectiveness and enforcement of EPMs would be ensured and improve accountability for compliance with EPMs by requiring monitoring, reporting, and adaptive management of potential bird impacts on the OCS. However, given bird use of the OCS is anticipated to be low, offshore wind activities are unlikely to appreciably contribute to impacts on birds regardless of measures intended to address potential offshore bird impacts. In the onshore environment, tree clearing restrictions and conducting post-construction monitoring and reporting would ensure impacts on birds and their habitats would be avoided and minimized to the extent practicable. Because these measures ensure the effectiveness of and compliance with EPMs that are already analyzed as part of the Proposed Action, these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.3.5.

## 3.5.3.8 Comparison of Alternatives

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

## 3.5.3.9 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical miles (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative would include up to 195 WTGs,[2] representing a decrease of 5 WTGs as compared to the Proposed Action. Impacts associated with WTG installation, O&M, and decommissioning, including pile driving and vessel noise and the presence of offshore structures, would

[2] 195 WTGs assumes that 197 total positions are available and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

be reduced by approximately 3 percent, decreasing the overall impacts on bats in the Lease Area. In addition to fewer WTGs, the Preferred Alternative would result in uniform grid spacing of offshore structures, and this potential for wider and uniform space between offshore structures may allow greater opportunity for birds to avoid WTGs, OSSs, and the met tower. Changes to WTG hub height and the micrositing of WTGs and interarray cables within AOC 1 and AOC 2 under the Preferred Alternative would not materially change the analyses of any IPF as compared to the Proposed Action.

As with the Proposed Action, activities associated with the construction and installation, O&M, and eventual decommissioning of the Preferred Alternative would have **moderate adverse** impacts on birds, depending on the location, timing, and species affected by an activity. The primary impacts of the Preferred Alternative affecting birds are habitat loss and collision-induced mortality from rotating WTGs and long-term habitat loss and conversion from onshore construction. The Preferred Alternative would also potentially result in **minor beneficial** impacts associated with foraging opportunities for some marine birds.

The contribution of the Preferred Alternative to the cumulative impacts of individual IPFs resulting from ongoing and planned activities would range from negligible to moderate, as well as moderate beneficial impacts. The Proposed Alternative would contribute to the cumulative impact rating primarily through the permanent impacts from the presence of structures. BOEM anticipates that the cumulative impacts on birds in the geographic analysis area, primarily due to habitat loss and collision-induced mortality from rotating WTGs, would be **moderate** because impacts would be unavoidable, but not result in population-level effects, as well as **minor beneficial** because although increased foraging habitat due to the presence of structures would have some measurable effects on one or a few individuals or habitat, they would be localized to a small area.

### 3.5.4 Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitat and fauna resources from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for these resources. The coastal habitat and fauna geographic analysis area, as shown on Figures 3.5.4-1 and 3.5.4-2, includes flora and fauna located within state waters (which extend 3 nautical miles [5.6 kilometers] from the shoreline) inland to the mainland, including the foreshore, backshore, dunes, and interdunal areas. The geographic analysis area also includes the area within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area that includes the export cable landfalls, onshore export cable routes, the onshore substations and/or converter stations, the connection from the onshore substations and/or converter stations to the POI, and the O&M facility and potentially an associated parking structure. BOEM expects the resources in this area to have small home ranges. These resources are unlikely to be affected by impacts outside their home ranges.

This section analyzes the affected environment and environmental consequences of the Proposed Action and alternatives on coastal flora and fauna, including special-status species that are not otherwise included in Sections 3.4.1, *Air Quality*; 3.4.2, *Water Quality*; 3.5.1, *Bats*; 3.5.2, *Benthic Resources*; 3.5.3, *Birds*; 3.5.5, *Finfish*, *Invertebrates, and Essential Fish Habitat*; 3.5.6, *Marine Mammals*; 3.5.7, *Sea Turtles*; or 3.5.8, *Wetlands*.

#### 3.5.4.1 Description of the Affected Environment and Future Baseline Conditions

The New Jersey Coastal Management Zone (coastal zone) is managed by NJDEP in accordance with New Jersey Administrative Code 7:7. The coastal zone includes approximately 1,800 miles (2,897 kilometers) of tidal shoreline, including 126 miles (203 kilometers) of oceanfront from Sandy Hook to Cape May. The boundaries of the coastal zone include inland, seaward, and interstate areas (NJDEP 2020). The coastal portion of the geographic analysis area for coastal habitat and fauna is a small subset of this much larger coastal zone area. The geographic analysis area encompasses portions of coastal New Jersey within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area and includes tidal and non-tidal waters (including wetlands), maritime dune and beach areas, forested areas, and developed areas (e.g., residential, commercial, industrial, and linear development). The onshore export and interconnection cables, onshore substations and/or converter stations, and O&M facility are located primarily along or within existing roadway corridors and railroad ROWs.

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

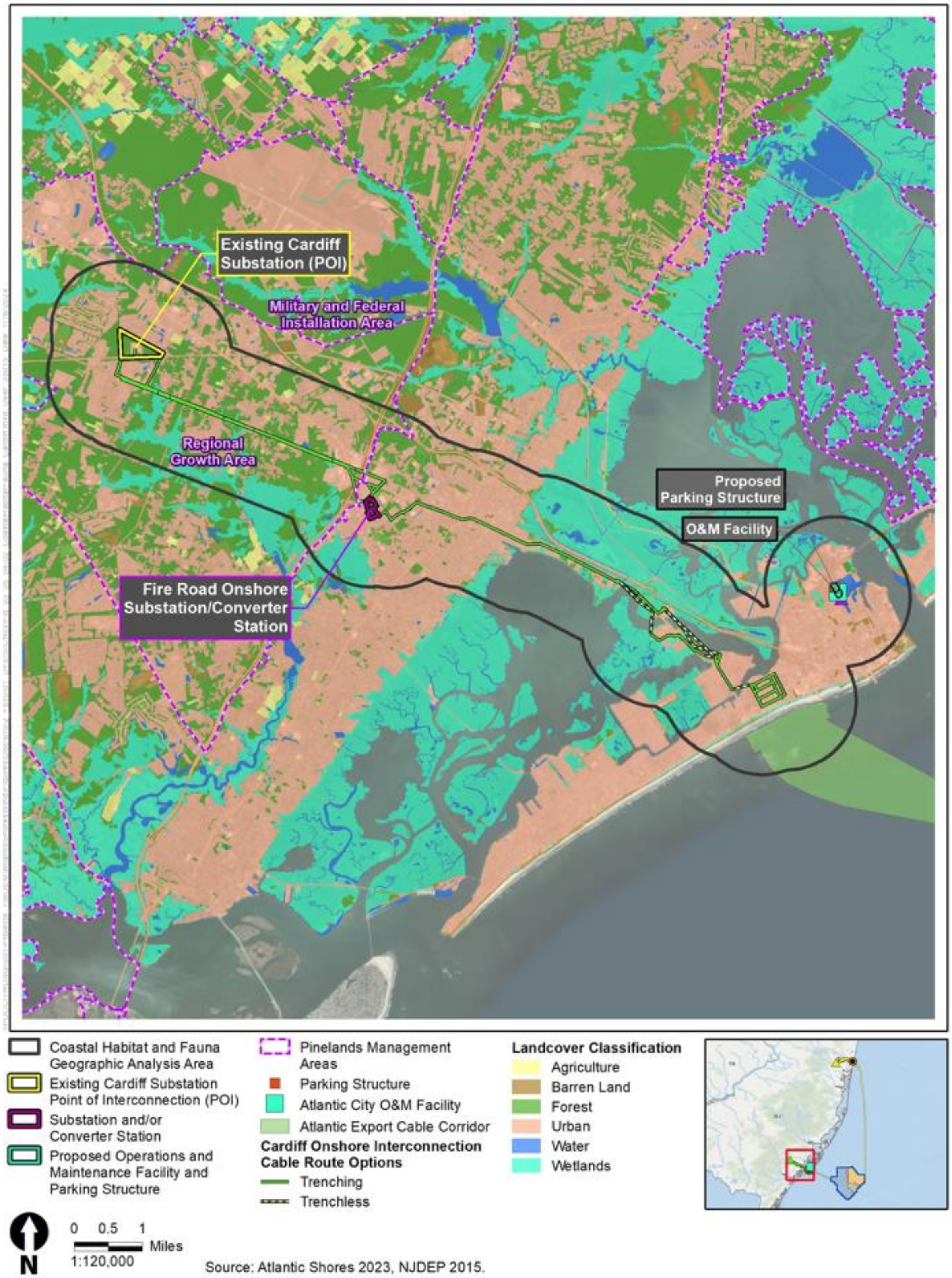



**Figure 3.5.4-1. Coastal habitat and fauna geographic analysis area for Cardiff Onshore Project area.**

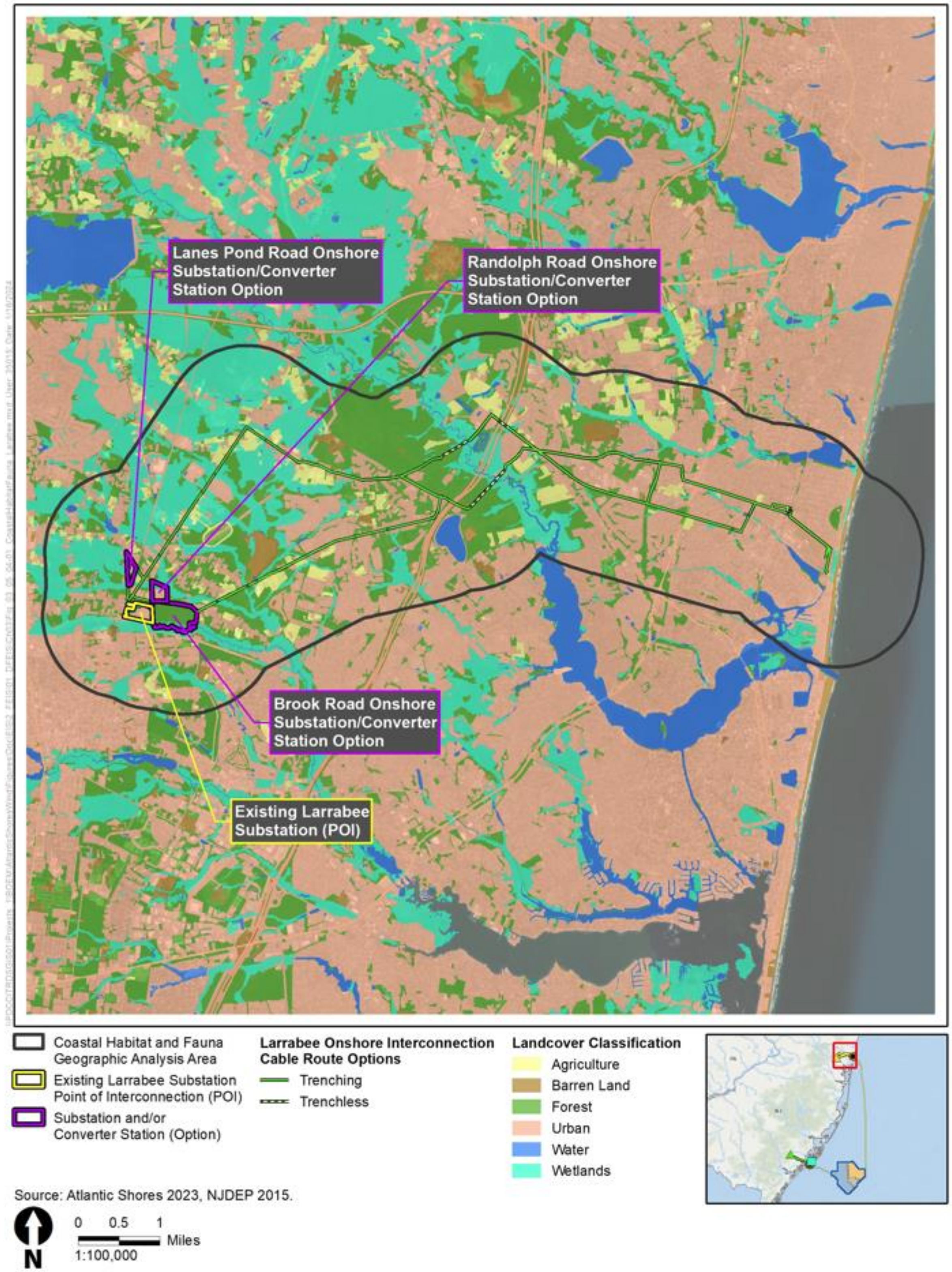



**Figure 3.5.4-2. Coastal habitat and fauna geographic analysis area for Larrabee Onshore Project area**

### *Cardiff Onshore Project Area*

Portions of the geographic analysis area associated with the Cardiff Onshore Project area within the Atlantic Shores South Project overlap with mapped New Jersey Pinelands shown on Figure 3.5.4-2. The Pinelands ecosystem covers a large area of southern New Jersey characterized by unconsolidated sand and gravel with a shallow aquifer that is characteristically acidic and nutrient poor, and specialized plant and animal species adapted to these conditions and to wildfires. The Pinelands area is protected under the Pinelands Protection Act (New Jersey Statutes Annotated 13:18-1 et seq.), managed by the Pinelands Commission and is defined by three separate zones: protected areas, managed use areas, and zones of cooperation. Part of the Cardiff Onshore Project area overlaps with the Pinelands Area of Egg Harbor Township that is designated as a "Regional Growth Area" (i.e., a managed use area). The Cardiff Onshore Project area does not intersect with any Pinelands designated protected area (State of New Jersey 2021a, 2021b; Pinelands Preservation Alliance 2021).

The Cardiff Onshore Project area consists of approximately 71.5 percent developed or disturbed area. The remainder of the Cardiff Onshore Project area consists of mixed forest, scrub-shrub wetlands, shrublands (i.e., evergreen, deciduous, and mixed shrublands), herbaceous fields, herbaceous tidal and non-tidal wetlands, and forested wetlands. Apart from tidal herbaceous wetlands associated with the tidal waterways of the Great Thorofare and Beach Thorofare and the mixed upland forest at the Cardiff POI and substation/interconnection substation site, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat. Table 3.5.4-1 summarizes the acreage of each habitat type observed within the Cardiff Onshore Project area according to the Atlantic Shores Habitat Assessment Survey. These habitat types and locations are shown on the Habitat Assessment Mapping in COP Volume II, Appendix II-E1 (Atlantic Shores 2024).

**Table 3.5.4-1. Estimated area and percent cover of habitat types within the Cardiff Onshore Project area and temporary disturbance and permanent impacts of the Proposed Action**

| Habitat Type | Onshore Project Area (acres) | Percentage of Onshore Project Area | Temporary Disturbance (acres) | Permanent Impacts (acres)[1] |
|---|---|---|---|---|
| Developed / Disturbed | 103.5 | 71.5 | 57.1 | 41.7 |
| Forest – Mixed | 22.1 | 15.2 | 3.6 | 18.5 |
| Water | 11.0 | 7.6 | 0.0002 | 0 |
| Herbaceous Field | 3.9 | 2.7 | 2.8 | 1.1 |
| Herbaceous Wetland | 3.0 | 2.1 | 0.05 | 0.01 |
| Shrub – Deciduous | 0.8 | 0.6 | 0.5 | 0.3 |
| Shrub – Evergreen | 0.06 | 0.04 | 0.03 | 0.02 |
| Forested Wetlands | 0.04 | 0.02 | 0.04 | 0 |
| Scrub-Shrub | 0.4 | 0.3 | 0.06 | 0.02 |
| **Total** | **144.8** | **100** | **64.8** | **60.1** |

Source: COP Volume II, Section 4.2.1.1, Table 4.2-1; Section 4.2.2.1, Table 4.2-4; Atlantic Shores 2024.
1- Permanent impact calculations assume the entirety of the onshore substation and/or converter station parcel would require permanent impacts.

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 Cardiff Onshore Project area found only urban-adapted birds, such as house sparrow (*Passer domesticus*), mourning dove (*Zenaida macroura*), herring gull (*Larus argentatus*), and laughing gull (*Leucophaeus atricilla*) and no reptiles, amphibians, or mammals (COP Volume II, Section 4.2.1.1; Atlantic Shores 2024). Coastal birds may forage or nest on beaches and in tidal wetlands adjacent to cable landfall locations, although cabling would be installed using HDD rather than open trenches to minimize disturbance to these habitats and their wildlife.

ESA-listed wildlife species included in the USFWS IPaC system (USFWS 2023a) as potentially occurring in the vicinity of the Cardiff Onshore Project area include: northern long-eared bat (*Myotis septentrionalis*; endangered), tricolored bat (*Perimytis subflavus;* proposed endangered), piping plover (*Charadrius melodus;* threatened), red knot (*Calidris canutus;* threatened), eastern black rail (*Laterallus jamaicensis;* threatened), saltmarsh sparrow (*Ammospiza caudacuta*),[1] and monarch butterfly (*Danaus plexippus;* candidate). State-listed species recorded by NJDEP in the area include several birds, northern long-eared bat, spotted turtle (*Clemmys guttata*), and Pine Barrens treefrog (*Dryophytes andersonii*), as shown in Table 3.5.4-2 (COP Volume II, Appendix II-E1; Atlantic Shores 2024). However, none of the habitat in the Cardiff Onshore Project area is suitable or federally or state-designated as “critical” for any of these species, because of existing levels of development and human disturbance. Beaches that have the potential to support ESA-listed piping plovers and red knots would not be affected by landfall or cabling routes associated for the Cardiff Onshore Project area, because of below-ground cable installation using HDD rather than open trenches.

Four federally listed plant species (American chaffseed [*Schwalbea americana;* endangered], Knieskern’s beaked-rush [*Rhynchospora knieskernii*; threatened], seabeach amaranth [*Amaranthus pumilus*; threatened], and swamp pink [*Helonias bullata*; threatened]) were identified as having the potential to be present within the Cardiff Onshore Project area (USFWS 2023a). Suitable habitat for American chaffseed is not believed to occur within the Larrabee Onshore Project Area. The Natural Heritage Grid Map indicates that there are no known American chaffseed occurrences within the Project area (NJDEP 2021). 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 Cardiff Onshore Project Area (USFWS 2022). Atlantic Shores conducted species surveys for American chaffseed and swamp pink within the Cardiff Onshore Project area and determined that conditions were not favorable for this species (COP Volume II, Appendix II-E1; Atlantic Shores 2024). Suitable habitat for seabeach amaranth (i.e., beaches) would be entirely avoided, because the export cable makes landfall via HDD from an offshore location.

[1] Included although not identified in IPaC. Currently under consideration by USFWS for ESA listing, but not a Candidate or Proposed species.

**Table 3.5.4-2. State-listed wildlife species recorded by NJDEP associated with the Cardiff Onshore Project area**

| Scientific Name | Common Name | New Jersey State Conservation Status [a] |
|---|---|---|
| *Circus cyaneus* | Northern harrier | Endangered |
| *Falco peregrinus* | Peregrine falcon | Endangered |
| *Haliaeetus leucocephalus* | Bald eagle | Endangered |
| *Rynchops niger* | Black skimmer | Endangered |
| *Sternula antillarum* | Least tern | Endangered |
| *Nyctanassa violacea* | Yellow-crowned night-heron | Threatened |
| *Nycticorax nycticorax* | Black-crowned night-heron | Threatened |
| *Bubulcus ibis* | Cattle egret | Threatened |
| *Pandion haliaetus* | Osprey | Threatened |
| *Strix varia* | Barred owl | Threatened |
| *Ardea herodias* | Great blue heron | Special concern |
| *Egretta caerulea* | Little blue heron | Special concern |
| *Egretta thula* | Snowy egret | Special concern |
| *Egretta tricolor* | Tricolored heron | Special concern |
| *Gelocehelidon nilotica* | Gull-billed tern | Special concern |
| *Hylocichla mustelina* | Wood thrush | Special concern |
| *Helmitheros vermivorum* | Worm-eating warbler | Special concern |
| *Hydroprogne caspia* | Caspian tern | Special concern |
| *Plegadis falcinellus* | Glossy ibis | Special concern |
| *Sterna hirundo* | Common tern | Special concern |
| *Myotis septentrionalis* | Northern myotis | Endangered |
| *Clemmys guttata* | Spotted turtle | Special concern |
| *Dryophytes andersonii* | Pine barrens treefrog | Endangered |

Source: COP Volume II, Appendix II-E1; Atlantic Shores 2024.
[a] Many of the species conservation statuses may be changing and some species may be added or deleted in 2024 pending a NJDEP rule proposal (NJDEP 2023).

### *Larrabee Onshore Project Area*

The Larrabee Onshore Project area consists of approximately 81.3 percent developed or disturbed areas. The remainder of the Larrabee Onshore Project area consists of edges of mixed forest; deciduous forest, evergreen forest, water, herbaceous fields; agricultural pastures; forested wetlands, evergreen scrub-shrub, scrub-shrub wetlands, and herbaceous non-tidal wetlands. Apart from wetlands and stream crossings, these habitats occur along the edge of developed and disturbed areas and are marginal, edge habitat.

Table 3.5.4-3 and Figure 3.5.4-2 summarize the acreage of each habitat type observed within the Larrabee Onshore Project area according to the Atlantic Shores Habitat Assessment Survey. These habitat types and locations are shown on the Habitat Assessment Mapping in COP Volume II, Appendix II-E2 (Atlantic Shores 2024).

**Table 3.5.4-3. Estimated area and percent cover of habitat within the Larrabee Onshore Project area and temporary disturbance and permanent impacts of the Proposed Action**

| Habitat Type | Onshore Project Area (acres) | Percentage of the Onshore Project Area | Temporary Disturbance[1] (acres) | Permanent Impacts[1] (acres) |
|---|---|---|---|---|
| Developed / Disturbed | 124.5 | 81.3 | 59.0 | 63.4 |
| Forest – Deciduous | 3.12 | 2.1 | 0.4 | 2.3 |
| Forest – Mixed | 11.2 | 7.3 | 1.9 | 6.3 |
| Shrub – Evergreen | 0.003 | 0.002 | 0.003 | 0 |
| Forested Wetland | 1.1 | 0.7 | 0.5 | 0.09 |
| Agricultural | 9.5 | 6.2 | 0.01 | 9.5 |
| Herbaceous Field | 3.1 | 2.0 | 0.4 | 2.7 |
| Water | 0.2 | 0.1 | 0.02 | 0.00005 |
| Forest Evergreen | 0.2 | 0.1 | 0.1 | 0.08 |
| Herbaceous Wetland | 0.2 | 0.1 | 0.0008 | 0.2 |
| Scrub-Shrub Wetland | 0.001 | 0.0007 | 0 | 0 |
| **Total** | **153.12** | **100** | **62.33** | **84.57** |

Source: COP Volume II, Section 4.2.1.2, Table 4.2-2 and Section 4.2.2.1, Table 4.2-5; Atlantic Shores 2024.
[1] Permanent impacts assume both Lanes Pond and Randolph Road Sites would be impacted for the Proposed Action; however, only one location would be utilized if the Brook Road Site is not available as part of the New Jersey SAA. The Brook Road Site would be prepared and developed as part of New Jersey's SAA. All siting, environmental review, permitting, and other preparation activities for the Brook Road Site would be completed by the SAA-awardee (or the designated lead state or federal agency, as appropriate. Thus, no tree clearing at the Brook Road Site is included as part of the Proposed Action.

Due to existing levels of development and habitat degradation in the area, the wildlife community is expected to be dominated by urban-adapted, disturbance-tolerant generalist species. Wildlife surveys conducted in the Larrabee Onshore Project area found only common, urban-adapted birds, such as herring gull, laughing gull, house sparrow, northern cardinal (*Cardinalis cardinalis*), eastern bluebird (*Sialia sialis*), and mourning dove; and no reptiles, amphibians, or mammals (COP Volume II, Section 4.2.1.2; Atlantic Shores 2024). ESA-listed wildlife species included in the USFWS IPaC system (USFWS 2023a) as potentially occurring in the vicinity of the Larrabee Onshore Project area, include northern long-eared bat (endangered), tricolored bat (proposed endangered), piping plover (threatened), red knot (threatened), piping plover (threatened) bog turtle (*Glyptemys muhlenbergii;* threatened) and monarch butterfly (candidate). State-listed species recorded by NJDEP in the area include several birds, reptiles, amphibians, and insects, as shown in Table 3.5.4-4. No suitable or critical habitat to support these species occurs in the Larrabee Onshore Project area, although some species may occur in adjacent areas where more suitable habitat is present (COP Volume II, Appendix II-E2; Atlantic Shores 2024).

**Table 3.5.4-4. State-listed wildlife species recorded by NJDEP associated with the Larrabee Onshore Project area**

| Scientific Name | Common Name | New Jersey State Conservation Status[a] |
|---|---|---|
| *Circus cyaneaus* | Northern harrier | Endangered |
| *Charadrius melodus* | Piping plover | Endangered |
| *Haliaeetus leucocephalus* | Bald eagle | Endangered |
| *Sternula antillarum* | Least tern | Endangered |

| Scientific Name | Common Name | New Jersey State Conservation Status[a] |
|---|---|---|
| *Eremophila alpestris* | Horned lark | Threatened |
| *Falco sparverius* | American kestrel | Threatened |
| *Nyctanassa violacea* | Yellow-crowned night-heron | Threatened |
| *Nycticorax* | Black-crowned night-heron | Threatened |
| *Pandion haliaetus* | Osprey | Threatened |
| *Strix varia* | Barred owl | Threatened |
| *Accipiter cooperii* | Coopers hawk | Special concern |
| *Ardea herodias* | Great blue heron | Special concern |
| *Catharus fuscescens* | Veery | Special concern |
| *Egretta thula* | Snowy egret | Special concern |
| *Egretta tricolor* | Tricolored heron | Special concern |
| *Haematopus palliatus* | American oystercatcher | Special concern |
| *Hydroprogne caspia* | Caspian tern | Special concern |
| *Hylocichla mustelina* | Wood thrush | Special concern |
| *Plegadis falcinellus* | Glossy ibis | Special concern |
| *Sterna hirundo* | Common tern | Special concern |
| *Toxostoma rufum* | Brown thrasher | Special concern |
| *Glyptemys muhlenbergii* | Bog turtle | Endangered |
| *Glyptemys insculpta* | Wood turtle | Threatened |
| *Terrapene carolina* | Eastern box turtle | Special concern |
| *Hyla andersonii* | Pine barrens treefrog | Threatened |
| *Anaxyrus fowleri* | Fowler’s toad | Special concern |

Source*:* COP Volume II, Appendix II-E2; Atlantic Shores 2024.
[a] Many of the species conservation statuses may be changing and some species may be added or deleted in 2024 pending a NJDEP rule proposal (NJDEP 2023).

Three federally listed plant species (American chaffseed [*Schwalbea americana*; endangered], seabeach amaranth [*Amaranthus pumilus*; threatened], and swamp pink [*Helonias bullata*; threatened]) were identified as having the potential to be present within the Larrabee Onshore Project area. In addition, two state-listed plant species (seabeach knotweed [*Polygonum glaucum*]; state endangered and Pine Barren’s bellwort [*Uvularia puberula var. nitida*]; state endangered) were identified as having the potential to be present within the Larrabee Onshore Project area (COP Volume II, Appendix II-E2; Atlantic Shores 2024). Suitable habitat for American chaffseed is not believed to occur within the Larrabee Onshore Project area. The Natural Heritage Grid Map indicates that there are no known American chaffseed occurrences within the Project area (NJDEP 2021). 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 Larrabee Onshore Project area (USFWS 2022). Atlantic Shores conducted species surveys for swamp pink within the Larrabee Onshore Project area and determined that conditions were not favorable for this species (COP Volume II, Appendix II-E2; Atlantic Shores 2024). Suitable habitat for seabeach amaranth and seabeach knotweed would be entirely avoided because the export cable makes landfall via HDD from an offshore location.

### *O&M Facility Project Area*

The Onshore Project area for the O&M facility, shown on Figure 3.5.4-1, is located in an urbanized area and consists of approximately 80 percent developed or disturbed land uses, with the remaining 20 percent consisting of the surface waters and herbaceous wetlands of Clam Creek (COP Volume II, Appendix II-E1; Atlantic Shores 2024). Table 3.5.4-5 summarizes the acreage of each habitat type observed within the Onshore Project area for the O&M facility according to the Atlantic Shores Habitat Assessment Survey. These habitat types and locations are shown on the Habitat Assessment Mapping in COP Volume II, Appendix II-E2 (Atlantic Shores 2024).

**Table 3.5.4-5. Estimated area and percent cover of habitat within the Onshore Project area for the O&M facility and temporary disturbance and permanent impacts of the Proposed Action**

| Habitat Type | Onshore Project Area (acres) | Percentage of the Onshore Project Area | Temporary Disturbance (acres) | Permanent Impacts (acres) |
|---|---|---|---|---|
| Developed/Disturbed | 2.1 | 80 | 0 | 2.1 |
| Herbaceous Wetlands | 0.002 | 0.08 | 0 | 0.002 |
| Water | 0.5 | 20 | 0 | 0.5 |
| **Total** | **2.602** | **100** | **0** | **2.602** |

Source: COP Volume II, Section 4.2.1.3 and Section 4.2.2.1, Table 4.2-6; Atlantic Shores 2024.

Due to heavy levels of urban development in the Onshore Project area, the wildlife community is dominated by urban-adapted, disturbance-tolerant generalist species, such as gulls, pigeons, house sparrows, squirrels, striped skunk (*Mephitis mephitis*), and raccoons (COP Volume II, Appendix II-E1; Atlantic Shores 2024).

ESA-listed wildlife species included in the USFWS IPaC system (USFWS 2023a) as potentially occurring in the vicinity of the Onshore Project for the O&M include: tricolored bat (proposed endangered) piping plover (threatened), red knot (threatened), and eastern black rail (threatened). ESA-listed plants include seabeach amaranth (threatened). State-listed species recorded by NJDEP in the vicinity of the O&M facility were reported in conjunction with those in the Cardiff Onshore Project area (see Table 3.5.4.4; COP Volume II, Appendix II-E-2; Atlantic Shores 2024). However, given the highly developed nature of the O&M facility site, no occurrence of protected species is anticipated within the Onshore Project area for the O&M facility.

## 3.5.4.2 Impact Level Definitions for Coastal Habitat and Fauna

This Final EIS uses a four-level classification scheme to characterize potential impacts of the alternatives, including the Proposed Action, as shown in Table 3.5.4-6. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions. There are no beneficial impacts on coastal habitat and fauna.

**Table 3.5.4-6. Impact level definitions for coastal habitat and fauna**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | Impacts on species or habitat would be so small as to be unmeasurable. |
| Minor | Adverse | Most impacts on species would be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts that do occur are temporary or short term in nature. |
| Moderate | Adverse | Impacts on species would be unavoidable but would not result in population-level effects. Impacts on habitat may be short term, long term, or permanent and may include impacts on sensitive habitats but would not result in population-level effects on species that rely on them. |
| Major | Adverse | Impacts would affect the viability of the population and would not be fully recoverable. Impacts on habitats would result in population-level impacts on species that rely on them. |

### 3.5.4.3 Impacts of Alternative A – No Action on Coastal Habitat and Fauna

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

#### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for coastal habitats and fauna described in Section 3.5.4.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities (see Section D.2 in Appendix D for a description of ongoing activities). Ongoing activities within the geographic analysis area that contribute to impacts on coastal habitats and fauna include onshore residential, commercial, and industrial development and climate change. Ongoing onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect coastal habitats and fauna. Onshore construction activities and associated impacts are expected to continue and have the potential to affect coastal habitat and fauna through temporary and permanent loss of coastal habitat and temporary noise impacts, which can cause avoidance behavior and displacement. Injury or mortality of individual animals could occur, but population-level effects would not be expected. There are no ongoing offshore wind activities within the geographic analysis area for coastal habitat and fauna.

Climate change would contribute to impacts on coastal habitats and fauna through global warming, sea level rise, and resulting modifications to species’ habitat and ecology. Climate change and associated intense storms and sea level rise will result in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides in the mid-Atlantic and southern New England regions (USDA n.d.). Climate change may also affect coastal habitats through increases in instances and severity of droughts and range expansion of invasive species. Warmer temperatures will cause plants to flower earlier, will not provide needed periods of cold weather, and will likely result in declines in reproductive success of plant and pollinator species. Increased temperatures could lead to changes in mating, nesting, reproductive, and foraging behaviors of species. The effects of climate change on animals will likely include loss of habitat, population declines, increased risk of extinction, decreased reproductive productivity, and changes in species distribution; New Jersey is warming faster than other areas of the region (NJDEP 2020).

See Appendix D, Section D.2.11 for a discussion of ongoing and planned activities relevant to climate change. See Appendix D, Table D.A1-5 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for coastal habitat and fauna.

### *Cumulative Impacts of Alternative A – No Action*

The cumulative impact analysis for the No Action Alternative considered impacts of the No Action Alternative, inclusive of ongoing activities, in combination with the other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned activities within the geographic analysis area that would contribute to impacts on coastal habitats and fauna would be similar to ongoing activities in terms of their nature and impacts (see Section D.2 in Appendix D for a description of planned activities). Planned activities may result in loss of coastal habitat and short-term or permanent displacement and injury or mortality of individual animals, but population-level effects would not be expected.

One offshore wind project (Atlantic Shores North in Lease Area OCS-A 0549) is planned to be constructed in the geographic analysis area for coastal habitats (Appendix D, Tables D.A2-1 and D.A2-2). BOEM expects planned offshore wind development activities to affect coastal habitat and fauna within the geographic analysis area through the following primary IPFs.

**Land disturbance**: BOEM anticipates that any planned offshore wind activities would require minimal disturbance of undisturbed lands and habitats given the extent of the highly developed areas and urbanized landscapes of the geographic analysis area. Some clearing of vegetation may be required for constructing the landfall, widening a transmission right-of-way, or clearing the substation footprint, but construction would be expected to generally occur in previously disturbed areas and areas generally fragmented or disconnected from other natural habitats. Traffic during the use of construction and maintenance equipment could result in collisions with wildlife. However, it is anticipated that these collisions would be rare because wildlife presence is expected to be limited due to the urban environment and because most individuals are expected to avoid construction areas or have the mobility to avoid construction equipment. Therefore, no individual fitness or population-level impacts on wildlife would be expected to occur during land disturbance activities. Furthermore, onshore construction associated with planned offshore wind development would not be expected to appreciably contribute to cumulative impacts on wildlife.

**Lighting**: Nighttime lighting associated with planned offshore wind activities would not be expected to affect coastal fauna at the individual or population level because of the high existing levels of development and associated light pollution in the geographic analysis area, and the anticipated placement of most onshore wind components within developed areas. Additional lighting associated with planned offshore wind development would not be expected to increase existing levels to an extent that would be capable of impacting coastal fauna.

**Noise**: Onshore construction noise associated with any planned offshore wind activities could result in temporary and highly localized impacts at the landing site, along the onshore export cable route, and at the onshore substation and/or converter station location. Impacts, if any, would be limited to behavioral avoidance of construction activity and noise. Displaced wildlife could use adjacent habitat and would likely return to these areas once construction ceases. Construction would likely occur in the highly developed and urbanized landscape areas where wildlife is already habituated to human activity and noise. Therefore, no individual fitness or population-level effects on wildlife would be expected.

**Presence of structures**: Additional structures and cables that are anticipated to be constructed in association with planned offshore wind activities would not be expected to affect coastal fauna at the individual or population level considering the high existing levels of development in the geographic analysis area and the anticipated placement of most onshore wind components within developed areas.

**Traffic**: Additional traffic that would occur in association with planned offshore wind activities would not be expected to affect coastal fauna at the individual or population level considering the high existing levels of development and human activity in the geographic analysis area and the anticipated placement of most onshore wind components within developed areas. Additional vehicle and equipment activity associated with future offshore wind would not be expected to increase existing levels to an extent that would impact coastal fauna.

### *Impacts of Alternative A – No Action on ESA-Listed Species*

ESA-listed fauna and flora with the potential to occur in the geographic analysis area include the northern long-eared bat, tricolored bat, eastern black rail, saltmarsh sparrow, piping plover, roseate tern, *Rufa* red knot, bog turtle, monarch butterfly, American chaffseed, Knieskern's beaked-rush, seabeach amaranth, and swamp pink. Planned non-offshore wind activities without the Proposed Action are not expected to significantly impact populations of ESA-listed species.

### *Conclusions*

**Impacts of Alternative A – No Action**. Under the No Action Alternative, baseline conditions for coastal habitats and fauna would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. BOEM expects ongoing activities to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on coastal habitats and fauna, primarily through onshore construction and climate change. BOEM anticipates that the potential adverse impacts on coastal habitats and fauna as a result of ongoing activities associated with the No Action Alternative would range from negligible to moderate as impacts on habitat may be short term, long term, or permanent, with overall **moderate** impacts.

**Cumulative Impacts of Alternative A – No Action**. In addition to ongoing activities, BOEM anticipates that the impacts of planned activities other than offshore wind would be moderate. Currently, there is one other planned offshore wind activity proposed that overlaps with portions of the geographic analysis area of the Proposed Action. If it was to occur, it would have some potential to result in temporary disturbance and some permanent loss of onshore habitat. However, habitat removal is anticipated to be minimal due to the developed and urbanized landscape of the geographic analysis area. Any impacts resulting from habitat loss or disturbance would not be expected to result in population-level effects on species within the geographic analysis area.

BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would range from negligible to moderate impacts, resulting in overall **moderate adverse** impacts on coastal habitats and fauna, primarily driven by unavoidable permanent impacts associated with onshore activities and climate change because impacts would be unavoidable but would not result in population-level effects.

### 3.5.4.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The onshore export cable routes, including routing variants, and extent of ground disturbance, which could require the removal of vegetation; and
- The onshore substations and/or converter stations, which could require the removal of trees and shrubs in or on the edge of the construction footprint for the substations.

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

- Onshore export cable routes and substation/converter station footprints: The route chosen (including variations of the general route) and substation footprints would determine the amount of habitat affected.

### 3.5.4.5 Impacts of Alternative B – Proposed Action on Coastal Habitat and Fauna

This section summarizes the potential impacts of the Proposed Action on coastal habitat and fauna, including special-status species, during the various phases of the Project. Phases would include construction and installation, O&M, and conceptual decommissioning of the Project, as described in Chapter 2, *Alternatives*. Potential impacts of these phases are assessed for onshore and offshore activities and facilities.

Construction and installation, O&M, and decommissioning of the Proposed Action would include both onshore and offshore activities. Anticipated onshore activities would include installation of the interconnection cable and construction of the onshore substation and/or converter station; remote monitoring of offshore structures, maintenance of onshore substations and/or converter stations, and maintenance of interconnection cables; and removal of onshore cables. Time of year restrictions for construction would be followed, as required, through permitting and resource agency consultation with NJDEP and USFWS (COA-06; Appendix G, Table G-1). Environmental/Construction Monitors would be assigned to ensure compliance with applicable permit conditions and BMPs during construction (COA-10; Appendix G, Table G-1). Anticipated offshore activities include installation of the submarine export cable, WTG foundations, interarray and interlink cables, and construction and commissioning of the WTGs and OSSs or OCS; inspection and maintenance of WTGs, structural inspection, and maintenance of OSSs; inspection and maintenance of scour protection at WTG foundations and along the interarray and export cables, and submarine cable surveys and maintenance; removal, disassembly, and shipment of WTGs and OSS structures to shore; potential removal of foundations from WTGs and OSSs; and potential removal of offshore cables and cable protection. Effects of IPFs associated with these activities on coastal habitat and fauna are discussed below.

**Land disturbance**: The potential impacts of onshore construction associated with the Proposed Action would not increase the impacts of this IPF beyond those described under the No Action Alternative. Onshore land-disturbing activities (e.g., trenching, excavating, and grading) associated with the Proposed Action would be limited to existing roadways, railroads, and other established ROWs, and adjacent disturbed habitat fragments to the maximum extent practicable (COA-01; Appendix G, Table G-1). Impacts on wildlife and their habitat, both temporary and permanent, are expected to be localized.

Installation of the onshore interconnection cables would occur in disturbed upland areas via direct trenching and excavation. Trenchless installation (e.g., jack-and-bore, jack piping, and HDD) would be used to cross surface waters, wetlands, and other sensitive habitats (COA-03, GEO-15; Appendix G, Table G-1). Therefore, construction and installation of the onshore interconnection cables would result in minor impacts on wildlife and their habitat. Similarly, HDD would be used at the Atlantic and Monmouth Landfall sites to avoid sensitive maritime beach and dune habitats, and sensitive coastal wildlife, like beach-nesting birds. All solid and liquid wastes would be managed in accordance with applicable regulations to reduce risks of spill, discharges and accidental releases (PUB-10; Appendix G, Table G-1). In addition, HDD activities would be managed by an HDD Contingency Plan for the Inadvertent Release of Drilling Fluid (WAT-04; Appendix G, Table G-1). Onshore cables would be buried, to avoid collision risk to birds associated with overhead structures and conductors (BIR-10; Appendix G, Table G-1). Land-disturbing activities associated with the Proposed Action at the Monmouth Landfall site would occur in coordination with the U.S. National Guard Training Center's local beach manager to ensure consistency with the Local Beach Management Plan and in consultation with NJDEP. In addition, use of HDD at the landfall sites and installation at depths designed to prevent exposure of the cable due to beach erosion (based on coordination with USACE, local geotechnical information, and hydrofracture analysis) would also prevent the potential of dune collapse at the landfall sites. No portions of the

Onshore Project areas for the Atlantic Shores South Project would overlap with protected areas of the New Jersey Pinelands.

Tree trimming and clearing of immature trees during winter months would occur, and only where necessary during construction and installation of the Project, thereby minimizing impacts on wildlife and their habitat (COA-02; Appendix G, Table G-1). Tree clearing would be minimized to the maximum extent practicable and would not include mature trees (BAT-07, BIR-12; Appendix G, Table G-1). While no tree clearing is anticipated to occur during the O&M phase of the Project, Atlantic Shores would coordinate with USFWS in the event that significant tree clearing should be required (BAT-07; Appendix G, Table G-1). Siting of onshore facilities would avoid bat habitat to the maximum extent practicable (BAT-06; Appendix G, Table G-1). While these impacts could be minimized, some impacts would be permanent in nature due to localized vegetation clearing.

Construction and installation of the Project would comply with a New Jersey Division of Land Resource Protection approved NJPDES permit and a SWPPP, and would utilize BMPs, including implementation of a certified Soil Erosion and Sediment Control Plan from the appropriate County Conservation District, to avoid indirect impacts on sensitive habitats (COA-07; Appendix G, Table G-1). Temporarily disturbed areas would be restored to pre-construction conditions as required and where necessary through seeding or repaving in accordance with NJDEP and local permitting requirements (COA-08, COA-09, GEO-20; Appendix G, Table G-1). BMPs would be used to properly contain excavated soils and sediments to avoid erosion and sediment runoff; BMPs would be regularly monitored (GEO-17, GEO-18, GEO-19; Appendix G, Table G-1). Environmental/Construction Monitor(s) would be assigned to ensure compliance with applicable permit conditions and that BMPs are functional (COA-10; Appendix G, Table G-1).

**Lighting**: Most of the area where Onshore Project components would be constructed is highly developed and urbanized; therefore, existing levels of artificial light at night are currently high. Wildlife inhabiting these areas is therefore inherently tolerant of artificial light at night and additional, highly localized nighttime lighting associated with the Onshore Project components would represent a negligible increase in current levels of light pollution that would not alter wildlife community composition, population sizes, or individual fitness. Furthermore, nighttime lighting associated with the Onshore Project components would not be present within sensitive maritime beach or dune habitats. Onshore construction lighting would be temporary and localized to the work area, and light would be limited during onshore operations to the minimum required by regulation and for safety, minimizing the potential for any light-driven attraction of birds and/or bats (BAT-09, BAT-10, BIR-13, and BIR-14; Appendix G, Table G-1).

**Noise**: Construction noise could lead to temporary and highly localized disturbance and displacement of wildlife. Displaced individuals would likely return to the affected areas once the noise has ended. It is possible that individuals could experience repeated stress events if they returned to the site at night, when construction has paused, only for construction to drive them away again in the morning. Lower decibel construction equipment (e.g., smaller backhoes) would be utilized when feasible (COA-04; Appendix G, Table G-1). Construction would also be conducted during permitted hours, to the maximum extent practicable, when ambient noise levels are highest (COA-05; Appendix G, Table G-1). Reasonable efforts would be made to minimize onshore construction noise (BAT-11; Appendix G, Table G-1). BOEM expects these impacts to be limited and short term in nature. Normal operation of the substation/converter stations would generate continuous noise, but BOEM expects minimal associated impacts in the context of existing noises near the proposed substations/converter stations that are generated from the highly developed and urbanized landscape around the substation sites. The impacts on coastal habitats and fauna of noise from the Proposed Action alone would add to the impacts of other anthropogenic noise. Terrestrial fauna may habituate to noise so that it has little to no effect on their behavior or biology (Kight and Swaddle 2011). Considering that most of the onshore area where the Onshore Project components would be constructed is highly developed and urbanized, terrestrial fauna in this area are likely to be already subject to and habituated to anthropogenic noise. Decommissioning noise could lead to temporary and highly localized disturbance and displacement of wildlife comparable to that assessed for construction and installation of the Proposed Action. Overall, the impacts on coastal habitats and fauna from noise associated with ongoing and planned actions, including the Proposed Action, are anticipated to be negligible, and no individual fitness or population-level effects on wildlife would be expected.

**Presence of structures**: Most of the area where Onshore Project components would be operating is highly developed and urbanized; therefore, the wildlife communities there are composed of disturbance-tolerant species inhabiting an area with numerous existing structures, cables, and other infrastructure. Additional structures and cables from the Onshore Project components would not alter the characteristics of the existing environment to an extent that would alter wildlife species composition, population sizes, or individual fitness.

Offshore construction and installation, O&M, and conceptual decommissioning activities for the Proposed Action are outside of the geographic analysis area for coastal habitat and fauna and would therefore not produce any IPFs for these resources.

**Traffic**: Most of the onshore area where the Onshore Project components would be constructed is highly developed and urbanized; therefore, the wildlife communities there are composed of disturbance-tolerant species inhabiting an area with high existing levels of motorized vehicle and equipment activity. HDD would be used at the Atlantic and Monmouth Landfall sites to avoid sensitive maritime beach and dune habitats, and sensitive coastal wildlife, like beach-nesting birds (COA-03; Appendix G, Table G-1). Therefore, no motor vehicle and equipment activity associated with the Onshore Project components would occur within maritime beach and dune habitats. Motor vehicle and equipment activity associated with the Onshore Project components would represent a negligible increase in baseline levels of anthropogenic noise and activity that would not alter the characteristics of the existing environment to an extent that would alter wildlife species composition, population sizes, or individual fitness. Individual fauna mortality due to collisions with vehicles and equipment may occur, particularly for species with limited mobility, but would not likely be a common occurrence.

### *Impacts of the Connected Action*

As described in Chapter 2, bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per (40 CFR 1501.9(e)(1)). The bulkhead site and dredging activities are in-water activities that would be conducted entirely within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area, directly adjacent to the proposed O&M facility, with a majority of that area consisting of maintenance dredging. The surrounding land is characterized as an urbanized area and consists primarily of developed or disturbed land uses and surface waters.

Due to the developed and disturbed nature of the surrounding area, the wildlife community is dominated by urban-adapted, disturbance-tolerant generalist species, such as gulls, pigeons, house sparrows, squirrels, striped skunk, and raccoons. There are no documented occurrences of federally or state-listed threatened and endangered species within the Onshore Project area for the O&M facility, directly adjacent to the area of work for the connected action.

BOEM expects the activities associated with the connected action to affect coastal habitat and fauna primarily through the accidental releases and noise IPFs. Other IPFs considered under the Proposed Action do not apply (e.g., cable emplacement and maintenance, traffic [aircraft]), and because the surrounding area consists of existing structures and other infrastructure, the presence of structures IPF would not pose a substantial risk to birds. Additionally, because all activities associated with the connected action are in-water activities, the land disturbance IPF does not apply.

**Accidental releases:** In-water construction activities would require heavy equipment use, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Some potential exists for impacts on coastal fauna (e.g., injury from exposure) due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with dredging and construction equipment in the aquatic and terrestrial environment around Inlet Marina. An SPCC plan would be developed and implemented to avoid, minimize, and contain spills. Accidental releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and short-term impacts on birds. In addition, all dredging equipment/use of watercraft and in-water work would comply with federal, state, and local permitting (e.g., CWA Sections 404 and 401) requirements for prevention and control of petrochemical spills, including oil and fuel. Normal operation at the O&M facility at Inlet Marina could result in accidental releases, but BOEM expects negligible impacts due to federal, state, and local requirements to contain and clean up releases. Therefore, BOEM anticipates the impacts from accidental releases associated with the connected action to be negligible.

**Noise**: As with the Proposed Action, construction noise could lead to temporary and highly localized disturbance and displacement of wildlife. Displaced individuals would likely return to the affected areas once the noise has ended. It is possible that individuals could experience repeated stress events if they returned to the site at night, when construction has paused, only for construction to drive them away again in the morning. Lower decibel construction equipment would be utilized when feasible. Construction would also be conducted during permitted hours, to the maximum extent practicable, when ambient noise levels are highest. BOEM expects these impacts to be limited and short term in nature. The impacts on coastal habitats and fauna of noise from the connected action alone would add to the impacts of other anthropogenic noise. Terrestrial fauna may habituate to noise so that it has little to no effect on their behavior or biology (Kight and Swaddle 2011). Considering that most of the onshore area adjacent to the connected action would be highly developed and urbanized, terrestrial fauna in this area are likely to be already subject to and habituated to anthropogenic noise, like noise that will occur during the in-water work. The cumulative impacts on coastal habitats and fauna from noise associated with the connected action are anticipated to be negligible, and no individual fitness or population-level effects on wildlife would be expected.

### *Impacts of Alternative B – Proposed Action on ESA-Listed Species*

ESA-listed fauna and flora with the potential to occur in the geographic analysis area include the northern long-eared bat, tricolored bat, eastern black rail, saltmarsh sparrow, piping plover, roseate tern, *Rufa* red knot, bog turtle, monarch butterfly, American chaffseed, Knieskern's beaked-rush, seabeach amaranth, and swamp pink. BOEM has prepared a BA for the potential effects on USFWS federally listed species, which found that the Proposed Action *may affect but is not likely to adversely affect* ESA-listed species in the Onshore Project area (BOEM 2023, 2024). There is no critical habitat designated for this species. Consultation with USFWS pursuant to Section 7 of the ESA concluded in December 2023 (USFWS 2023b). USFWS concluded that the Proposed Action is not likely to affect the bog turtle, eastern black rail, saltmarsh sparrow, northern long-eared bat, tricolored bat, monarch butterfly, swamp pink, Knieskern's beaked-rush, American chaffseed, or seabeach amaranth[2].

### *Cumulative Impacts of Alternative B – Proposed Action*

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities related to onshore development activities would contribute to impacts on coastal habitat and fauna through the primary IPFs of land disturbance and noise. Temporary disturbance and permanent loss of habitat onshore may occur as a result of offshore wind development. BOEM is not aware of any planned offshore wind activities other than the Proposed Action that would overlap the geographic analysis area for coastal habitat and fauna. However, if habitat removal is anticipated, it would be minimal, and any related impacts would not be expected to result in individual fitness or population-level effects in the geographic analysis area. The onshore cable routes and substation/converter station locations are within a previously disturbed and developed landscape. Most disturbance associated with the Proposed Action would be temporary and localized. Impacts of the Proposed Action when combined with impacts from ongoing and planned activities, including the connected action and other offshore wind activities, would be negligible to moderate within the geographic analysis area.

### *Conclusions*

**Impacts of Alternative B – Proposed Action**. In summary, activities associated with the construction and installation, O&M, and conceptual decommissioning of the Proposed Action alone would have negligible to moderate impacts on coastal habitats and fauna due to the developed and urbanized landscape that dominates the geographic analysis area and measures taken to avoid sensitive habitat, but the likelihood of some permanent impacts to be incurred from the presence of onshore substations and/or converter stations. The connected action activities would have negligible impacts on coastal habitats and fauna due to the developed and urbanized landscape that dominates the surrounding area where activities are proposed. Overall adverse impacts of the Proposed Action are expected to be **moderate**.

**Cumulative Impacts of Alternative B – Proposed Action.** BOEM anticipates that the cumulative impacts on coastal habitat and fauna in the geographic analysis area would range from negligible to moderate due to the previously disturbed and developed landscape in which the activities associated with the Proposed Action would occur, though some permanent changes to habitat would be incurred with the Proposed Action. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the impacts from ongoing and planned activities would result in overall **moderate adverse** impacts on wildlife in the geographic analysis area, primarily driven by unavoidable permanent impacts from onshore activities and climate change because impacts would be unavoidable but would not result in population-level effects.

## 3.5.4.6 Impacts of Alternatives C, D, E, and F on Coastal Habitat and Fauna

**Impacts of Alternatives C, D, E, and F**. Impacts on coastal habitat and fauna under Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would be the same as those of the Proposed Action because these alternatives would differ only with respect to the offshore components of the Proposed Action, which would be outside of the geographic analysis area for these resources. Therefore, impacts resulting from individual IPFs associated with onshore construction and installation, O&M, and decommissioning under Alternatives C, D, E, and F on coastal habitat and fauna would be the same as those of the Proposed Action and are expected to be overall moderate, primarily driven by onshore activities and climate change.

Construction and installation, O&M, and decommissioning of Alternatives C, D, E, and F would only differ from the Proposed Action in terms of offshore facilities. Onshore activities and facilities would be the same as those described under the Proposed Action.

Impacts associated with onshore construction and installation, O&M, and decommissioning activities for Alternatives C, D, E, and F would be identical to the impacts of onshore construction and installation, O&M, and decommissioning activities associated with the Proposed Action.

Offshore construction and installation, O&M, and decommissioning activities for Alternatives C, D, E, and F would not cause IPFs for coastal habitat and fauna.

**Cumulative Impacts of Alternatives C, D, E, and F**. The contribution of Alternatives C, D, E, and F to the impacts of ongoing and planned activities would be the same as that of the Proposed Action. Therefore, the cumulative impacts on coastal habitat and fauna from ongoing and planned activities in combination with each of these action alternatives would be the same as that described for the Proposed Action (negligible to moderate, overall moderate, primarily driven by onshore activities and climate change).

#### *Impacts of Alternatives C, D, E, and F on ESA-Listed Species*

Impacts of Alternatives C, D, E, and F on ESA-listed species are identical to the impacts previously described for the Proposed Action.

#### *Conclusions*

**Impacts of Alternatives C, D, E, and F**. The expected impacts associated with the Proposed Action alone would not change under Alternatives C, D, E, and F because each of these alternatives would only differ in terms of the offshore components, which would be outside of the geographic analysis area for these resources; the same onshore construction and installation, O&M, and conceptual decommissioning activities would occur for each of these alternatives.

The contribution of Alternatives C, D, E, and F to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action: negligible to moderate due to the previously disturbed and developed landscape in which the activities associated with Alternatives C, D, E, and F would occur and the temporary and localized nature of many of the disturbances that would occur as a result of the activities associated with Alternatives C, D, E, and F. Overall **moderate adverse** impacts would primarily be driven by onshore activities and climate change.

**Cumulative Impacts of Alternatives C, D, E, and F**. Considering all IPFs together, BOEM anticipates that the contribution of Alternatives C, D, E, and F to the impacts from ongoing and planned activities would result in negligible to moderate impacts on wildlife in the geographic analysis area, overall **moderate adverse,** primarily driven by onshore activities and climate change, because impacts would be unavoidable but would not result in population-level effects.

### 3.5.4.7 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Tables G-2 and G-3, and summarized and assessed in Table 3.5.4-7. If one or more of the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts on coastal habitat and fauna could be further reduced.

**Table 3.5.4-7. Proposed mitigation measures – coastal habitat and fauna**

| Mitigation Measure | Description | Effect |
|---|---|---|
| Pre-construction surveys | Conduct pre-construction habitat surveys for ESA-listed plants, including milkweed (*Asclepias* spp.) and implement avoidance and mitigation measures in coordination with USFWS and NJDEP. | While this mitigation measure would reduce impacts on wildlife species located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Seasonal restriction for milkweed habitat | Avoid clearing milkweed to the extent practicable from May 15 through September 30 when monarch caterpillars may be present. If/when the monarch is proposed for federal listing, the Lessee will coordinate with the USFWS prior to initiating any in-season vegetation disturbance that may involve milkweed. | While this mitigation measure would reduce impacts on wildlife species, such as the monarch butterfly, located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Tree clearing restrictions | Because many wildlife species overwinter in cavities and nests, any mature trees slated for removal should be checked (including for vacant raptor nests) and avoided if possible. If the tree must be taken down, the Lessee will coordinate with USFWS and clearing would occur between October 1 and March 31. Mature trees are defined as live trees and/or snags ≥3 inches dbh. | While this mitigation measure would reduce impacts on wildlife species located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Limited use of herbicides | Eliminate the use of herbicide for ROW maintenance and in other portions of the Project where milkweed is likely to occur. | While this mitigation measure would reduce impacts on wildlife species located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |
| Revegetation Plan | Development of a Revegetation Plan for areas of temporary disturbance that includes replanting with native vegetation and monitoring and corrective action for invasive plant species.<br>The Revegetation Plan will be developed to enhance monarch butterfly habitat for areas of temporary disturbance and incidental to other Project activities. | While this mitigation measure would reduce impacts on wildlife species located in the Project area, it would not reduce the impact rating for any of the Proposed Action's IPFs. |

### *Measures Incorporated in the Preferred Alternative*

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.5.4-7 and Tables G-2 and G-3 in Appendix G are incorporated in the Preferred Alternative. These measures would ensure and improve accountability for compliance with EPMs by requiring surveys, coordination with NJDEP and USFWS, and appropriate restoration of disturbed areas. Most of these measures ensure the effectiveness of and compliance with EPMs that are already analyzed as part of the Proposed Action; therefore, these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.4.5.

### 3.5.4.8 Comparison of Alternatives

None of the other action alternatives would affect the types, placement, or areal extent of the onshore components of the Project or the offshore components of the Project that could affect coastal habitat and fauna. All of the other action alternatives would therefore have the same impacts as the Proposed Action on coastal habitat and fauna.

### 3.5.4.9 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two BOEM-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical miles (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative is expected to have the same impacts as the Proposed Action on coastal habitat and fauna. Activities associated with the Preferred Alternative would have negligible to moderate, overall **moderate adverse** impacts on coastal habitats and fauna due to the developed and urbanized landscape that dominates the geographic analysis area and measures taken to avoid sensitive habitat, but small amounts of permanent impacts to be incurred associated with onshore activities and climate change.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and the connected action, would be similar to those of the Proposed Action: overall **moderate adverse**, primarily driven by onshore activities and climate change, because impacts would be unavoidable but would not result in population-level effects.

### 3.5.5 Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on finfish, invertebrates, and EFH from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.5.5-1, includes the Northeast Continental Shelf LME,[1] which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, encompasses population and movement ranges for most finfish and invertebrate species found in the Project Area. The northern portion of the geographic analysis area extends beyond U.S. waters while the width tapers to within U.S. waters towards the southern boundary. Due to the size of the geographic analysis area, the analysis in this Final EIS focuses on finfish, invertebrates, and EFH that are expected to occur in the Project area and be affected by Project activities. Many species that occur in the LME and Project area have broad ranges that extend beyond the geographic analysis area. Some of these species have distinct populations or stocks within the geographic analysis area that are not connected with populations or stocks of the same species outside of it (e.g., the red drum, *Sciaenops ocellatus*). The individual populations or stocks of these species are typically managed separately due to lack of connectivity and for practical reasons. In most cases individuals of one population rarely occur in the geographic extent of another population and may be genetically distinct, as is the case with red drum (Vaughan and Carmichael 1999). In some cases, however, individuals from one population may occur within the geographic extent of another (e.g., Atlantic sturgeon). Furthermore, some species only occur seasonally (e.g., giant manta ray). For the purposes of this analysis, nuances in species occurrence are stated explicitly while discussions are focused in the geographic analysis area.

Some Project vessels are expected to transit through the Gulf of Mexico to and from the Port of Corpus Christi (see Section 3.6.6, *Navigation and Vessel Traffic*). However, the 20 round trips anticipated to this port is a relatively small amount and would only occur during the construction phase of the Project. Typical vessel routes through the Gulf of Mexico to the Port of Corpus Christi have limited steam time within nearshore waters where two ESA-listed fish species occur, gulf sturgeon and giant manta ray (Farmer et al. 2022; Ross et al. 2009). Other vessel-related impacts that may occur in the Gulf of Mexico are expected to be negligible (e.g., accidental releases) (Section.3.5.5.5, *Impacts of Alternative B – Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat*). For these reasons, impacts in the Gulf of Mexico are not considered further in this section.

[1] LMEs are delineated based on ecological criteria including bathymetry, hydrography, productivity, and trophic relationships among populations of marine species, and NOAA uses them as the basis for ecosystem-based management.

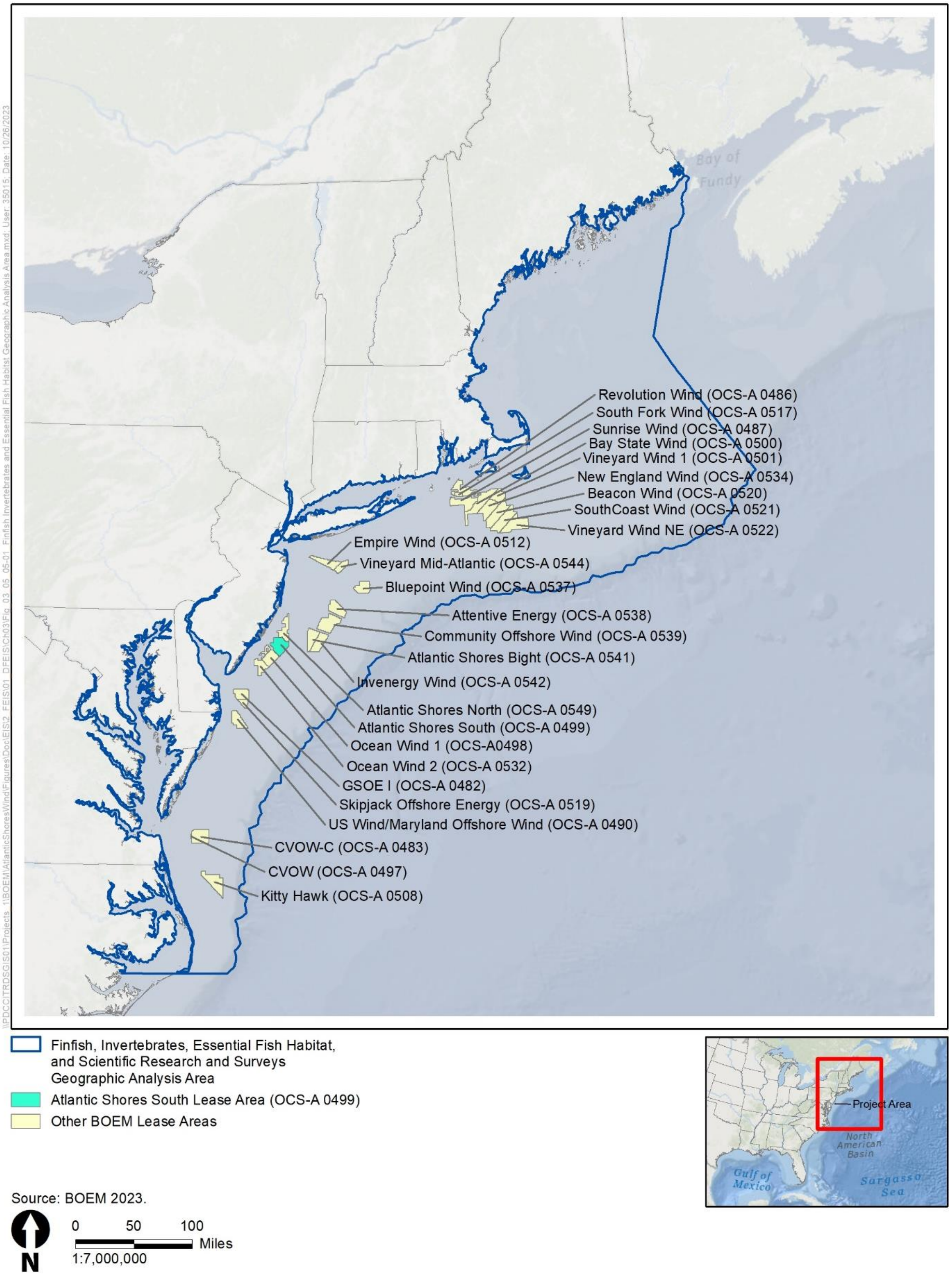



**Figure 3.5.5-1. Finfish, invertebrates, and essential fish habitat geographic analysis area**

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 USC 1802(10)). This section provides a qualitative assessment of the impacts of each alternative on finfish, invertebrates, and EFH, which has been designated under the MSA as “essential” for the conservation and promotion of specific fish and invertebrate species. A discussion of benthic species is provided in Section 3.5.2, *Benthic Resources*, and a discussion of commercial fisheries and for-hire recreational fishing is provided in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*.

#### 3.5.5.1 Description of the Affected Environment and Future Baseline Conditions

##### *Regional Setting*

The geographic analysis area for finfish, invertebrate, and EFH species, as shown on Figure 3.5.5-1, is defined as the Northeast U.S. Shelf LME, which extends well beyond the boundaries of the Proposed Action to include the geographic extent of all life stages of transient/migratory species (Appendix D, *Ongoing and Planned Activities Scenario,* Table D1). Detailed, baseline descriptions of the affected environment are provided in COP Volume II, Section 4.5.1 and Appendices II-G1 through G4 (Atlantic Shores 2024) and summarized in this section.

The Northeast Atlantic OCS gradually slopes from shallow nearshore depths to maximum depths ranging between 262 to 394 feet (80 to 140 meters) along the outer edge (Emery 1966). In the Offshore Project area (Atlantic Shores South WTG and export cable areas), approximate depths range from 62 to 121 feet (19 to 37 meters) in the WTA, 0 to 72 feet (0 to 22 meters) in the Atlantic ECC, and 0 to 98 feet (0 to 30 meters) in the Monmouth ECC. Bathymetry in the OCS is predominately flat with sand wave bedform features (COP Volume II, Appendix II-J3; Atlantic Shores 2024).

The affected environment for finfish, invertebrate, and EFH resources includes the water column and the seafloor within the geographic analysis area. Ocean currents in the Mid-Atlantic Bight, where the Project area is located, are influenced by counter-clockwise shelf circulation from two main systems: a southwest along-shore current and the Gulf Stream (Lentz 2008; Stevenson et al. 2004; Ford et al. 1952). The net direction of currents on the shelf is southwest along the coast (Levin et al. 2018; Townsend et al. 2004). The southwest along-shore current entrains into the Gulf Stream near Cape Hatteras, North Carolina, forming a counter-clockwise circulation (Lentz 2008; Ford et al. 1952). Across the shelf in deeper waters, the current flows in the opposite direction of the shelf current (COP Volume II, Section 2.2.1.1 and Figure 2.2-1; Atlantic Shores 2024; Stevenson et al. 2004). Although ocean currents are largely stable, local-scale (i.e., meters to a few kilometers) variability in currents is observed, in part due to wind and tides and their combined effects. Beardsley and Winant (1979) have demonstrated that winds contribute to the along-shore southward flow of currents close to shore in the Mid-Atlantic Bight. In the Offshore Project area, winds from the southwest predominate but, by comparison, these winds are weaker than those from the north to northwest direction (wind speeds of > 33 feet/second [10 meters/second]) (COP Volume II, Appendix II-B2; Atlantic Shores 2024). Strong winds from the north-northwest occurring during winter Nor’easter storms may force nearshore currents in a shoreward direction (Beardsley and Butman 1974).

From 2003–2016, sea temperatures within the New Jersey WEA, from depth profile CTD casts taken at 3.3-foot (1-meter) intervals, decreased from surface to bottom between April and September (i.e., negative temperature gradient) and increased during the colder months (i.e., positive temperature gradient) (Guida et al. 2017). Average sea temperature ranged seasonally from < 41 to 75°F (< 5 to approximately 24°C) at the surface; < 41 to 66°F (< 5 to approximately 19°C) at the bottom (Guida et al. 2017). Within the geographic analysis area, two types of temperature-influencing water masses (i.e., relatively smaller areas with unique oceanographic properties) are present: (1) the Mid-Atlantic Cold Pool (Chen et al. 2018) and (2) the Maine Bottom Water/Intermediate Water (Townsend et al. 2015). The Mid-Atlantic Cold Pool is a seasonally occurring "cold" (i.e., temperatures below 50°F [10°C]) bottom water mass with salinities less than the average salinity of ocean water (35 practical salinity units). The Cold Pool forms in waters of the New England Shelf in spring and drifts southward along shore to shelf waters between the Hudson Shelf Valley and Cape May, New Jersey, in fall (Chen et al. 2018). Where present, the Mid-Atlantic Cold Pool creates strong vertical stratification in the water column.

Based on a sediment characterization study within the Offshore Project area, surficial sediments are dominated by medium (0.01 to 0.02 inch [0.25 to 0.5 millimeter]) and coarse (0.01 to 0.04 inch [0.5 to 1.0 millimeter]) sands (COP Volume II, Section 4.5.1.1; Atlantic Shores 2024). Smaller areas of fine sands are also present (0.005 to 0.01 inch [0.125 to 0.25 millimeter]) (COP Volume II, Section 4.5.1.1; Atlantic Shores 2024). The WTA is dominated by sands, with fine sands being more prevalent at the south end (COP Volume II, Appendix II-G4; Atlantic Shores 2024). Like the WTA, the Atlantic ECC is dominated by sands, transitioning from medium to fine sand in a shoreward direction along the corridor. The northern one quarter of the Monmouth ECC is also dominated by sands transitioning from medium to fine sands in a landward along this segment. Fine and medium sand is classified as soft-bottom habitat according to the Coastal and Marine Ecological Classification Standard sediment classification system. The southern three quarters of the Monmouth ECC is dominated by gravels, gravel mixes, and sandy gravels which are classified as complex habitat under the Coastal and Marine Ecological Classification Standard.

Bedforms including sandwaves, ripples, mega ripples, depressional areas, and textured seafloor are present in the WTA. The most common bathymetric feature in the WTA is ripples (COP Volume II, Appendix II-G4; Atlantic Shores 2024). Hard, structured, elevated relief (i.e., reef habitat) also occurs in the geographic analysis area, scattered among the relatively flat, sandy, shelf seafloor of the Mid-Atlantic Bight and Southern New England, but is relatively scarce (Steimle and Zetlin 2000). Two artificial reef areas are located along the boundaries of the Monmouth ECC (COP Volume II, Appendix II-J2; Atlantic Shores 2024; Steimle and Figley 1996b). Other hard-bottom complex habitat near the Offshore Project area includes multiple shipwrecks (Steimle and Figley 1996a). Unique fish assemblages are associated with hard-bottom habitats (Ross et al. 2015; Steimle and Figley 1996a).

Zooplankton communities are an important part of the food web base of the marine ecosystem. Zooplankton in the geographic analysis area include pelagic forms of copepods, amphipods, and water fleas (Cladocera) as well as larvae of most invertebrates (e.g., crab and shrimp larval stages). Copepods are the dominant taxa in the Mid-Atlantic Bight (Sherman et al. 1983). The three species *Centropages typicus*, *Pseudocalanus minutus*, and *Calanus finmarchicus* are the most abundant copepod taxas in the Mid-Atlantic Bight. Of these three species, *C. typicus* followed by *P. minutus* are more abundant from spring through winter (Sherman et al. 1983). Peak abundance of *C. finmarchicus* in the Mid-Atlantic Bight occurs from March through May.

### *Finfish*

Many of the finfish species within the Project area are common throughout the geographic analysis area. The fish communities within BOEM-defined Northeast U.S. WEAs were described in a BOEM-funded study by Guida et al. (2017) using 2003–2016 data from the long-term Northeast Fisheries Science Center's (NEFSC) spring and fall bottom trawl surveys. Other offshore monitoring surveys for finfish within the geographic analysis area include the Northeast Area Monitoring and Assessment Program survey, conducted annually since 2007 (Bonzek et al. 2017), and the 5-year (1995–1999) Belmar Borrow Area Finfish Collection survey (Burlas and Clarke 2001). Recent (2009–2019) site-specific NOAA Fisheries and NJDEP trawl survey data were used to characterize the finfish communities in the WTA and ECCs (COP Volume II, Section 4.6.1; Atlantic Shores 2024).

The offshore and estuarine trawl monitoring programs listed here primarily survey late-stage juvenile and adult fishes. Seasonal and long-term patterns of ichthyoplankton communities in the geographic analysis area have also been described from NEFSC's historical (1977–1987) monitoring program known as Marine Resource Monitoring Assessment and Prediction (Berrien and Sibunka 1999). Ichthyoplankton in the geographic analysis area continues to be monitored by the NEFSC's Ecosystem Monitoring Program (1992–present) (NOAA Fisheries 2018).

Species of finfish collected in these surveys can be categorized into two general groups based on the habitat they prefer: near-bottom or "demersal" fishes and those that occupy the water column or "pelagic." Demersal fishes in the geographic analysis area include Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), kingfish (*Menticirrhus* spp.), weakfish (*Cynoscion regalis*), scup (*Stenotomus chrysops*), black sea bass (*Centropristis striata*), northern sea robin (*Prionotus carolinus*), Atlantic butterfish (*Peprilus triacanthus*), cods (Gadiforms) (i.e., haddock [*Melanogrammus aeglefinus*], hakes [Merlucciidae and Phycidae], and Atlantic cod [*Gadus morhua*]), flounders (e.g., summer flounder [*Paralichthys dentatus*], winter flounder *[Pseudopleuronectes americanus*]), sand lances (*Ammodytes* spp.), monkfishes (*Lophius* spp.), spiny dogfish (*Squalus acanthias*), little skate (*Leucoraja erinacea*), clearnose skate (*Raja eglanteria*), and winter skate (*Leucoraja ocellata*) (MAFMC 2017; NOAA Office of National Marine Sanctuaries 2017; Bonzek et al. 2017; Guida et al. 2017; Wilber et al. 2003; Burlas and Clarke 2001). Black sea bass, cunner (*Tautogolabrus adspersus*), tautog (*Tautoga onitis*), and other demersal species are strongly associated with reefs or structured high relief habitat. Atlantic butterfish and sand lances are major forage fish for demersal predators. Of the demersal fish species, haddock, flounders, hakes, scup, black sea bass, spiny dogfish, and skates are commercially valuable (Guida et al. 2017; Petruny-Parker et al. 2015). Within the New Jersey WEA, the demersal finfish community is dominated by Atlantic croaker and scup during the warm season and little skate and spiny dogfish during the cold season (Guida et al. 2017). Common benthic species from recent surveys in the Offshore Project area include Atlantic butterfish, Atlantic croaker, northern sand lance (*Ammodytes dubius*), northern sea robin, scup (*Stenotomus chrysops*), spiny dogfish, spotted hake (*Urophycis regia*), silver hake (*Merluccius bilinearis*), weakfish, and windowpane flounder (*Scophthalmus aquosus*) (COP Volume II, Sections 4.6.1.1 and 4.6.1.2; Atlantic Shores 2024).

Common pelagic fishes within the geographic analysis area include bay anchovy (*Anchoa mitchilli*), striped anchovy (*A. hepsetus*), Atlantic menhaden (*Brevoortia tyrannus*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), Atlantic herring (*Clupea harengus*), bluefish (*Pomatomus saltatrix*), and striped bass (*Morone saxatilis*) (MAFMC 2017; Petruny-Parker et al. 2015; Guida et al. 2017; Bonzek et al. 2017). Pelagic fish also include species that are purely marine (i.e., species not known to enter estuarine habitats) including yellowfin (*Thunnus albacares*) and bluefin tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), blue shark (*Prionace glauca*), common thresher (*Alopias vulpinus*), and shortfin mako (*Isurus oxyrinchus*) (BOEM 2021a). Within the New Jersey WEA, the pelagic finfish community is dominated by Atlantic herring, occurring during the cold season (Guida et al. 2017). From recent surveys in the Offshore Project area, common pelagic species include Atlantic herring, bay anchovy, round herring (*Etrumeus teres*), and Atlantic silverside (*Menidia menidia*) (COP Volume II, Sections 4.6.1.1 and 4.6.1.2; Atlantic Shores 2024).

Many species from both demersal and pelagic groups can be found in both offshore and coastal, estuarine habitats (e.g., Atlantic croaker, weakfish, river herrings, striped bass). While many finfish species migrate into estuaries to spawn, others migrate into estuaries seasonally for other reasons, presumably to take advantage of favorable feeding opportunities (Haven 1959). The young of anadromous species typically remain in estuaries for the first few years of life, utilizing the estuarine habitat as a nursery prior to joining offshore populations of older juveniles and adults (Able and Fahay 1998). The young of some species that spawn offshore (e.g., Atlantic croaker, Atlantic menhaden) also utilize estuarine habitats as nurseries (Able and Fahay 1998). Larvae of these species hatch offshore and are assisted by ocean processes for transport and entry into coastal estuaries (Boehlert and Mundy 1988).

Egg and larval stages of fishes in the geographic analysis area may be benthic/demersal or pelagic, irrespective of their adult category. Examples of pelagic eggs and larvae from demersal adult fishes are Atlantic cod and black sea bass (BOEM 2021a). An example of benthic/demersal eggs from a pelagic adult fish is Atlantic herring (BOEM 2021a). Walsh et al. (2015) evaluated 39 larval Mid-Atlantic Bight OCS finfish species from pelagic trawl records in two periods (1977–1987 and 1999–2014). Their list of species included Atlantic cod, Atlantic croaker, Atlantic herring, weakfish, and sand lance, which are included in the list of common species found in the Offshore Project area. A species reported by Walsh et al. (2015) that is not commonly sampled in bottom trawl gear used to describe the fish community in the Offshore Project area is Atlantic menhaden. Finfish species potentially present in the Offshore Project area as egg and larvae include American eel (*Anguilla rostrata*), Atlantic cod, Atlantic menhaden, black sea bass, bluefish, cunner, monkfish, northern sand lance, and tautog (COP Volume II, Section 4.6.1, Appendix II-J2; Atlantic Shores 2024).

Fishes with pelagic early life stages (i.e., eggs and larvae) rely on ocean processes and conditions (e.g., ocean currents, Mid-Atlantic Cold Pool) for retention or transport/dispersal, and, to some degree, recruitment success (i.e., survival of early life stages into later life stages) (Paris and Cowen 2004;

Boehlert and Mundy 1988). Shifts in dispersal, including from changes in ocean conditions and climate (Walsh et al. 2015), may have consequences to recruitment success (Thaxton et al. 2020). Variability in distribution and abundance of fish eggs and larvae may occur on interannual and annual scales (Berrien and Sibunka 1999).

ESA-listed finfish species that occur in the geographic analysis area include Atlantic salmon (*Salmo salar*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), shortnose sturgeon (*A. brevirostrum*), giant manta ray (*Mobula birostris*), and oceanic whitetip shark (*Carcharhinus longimanus*). Of these species, giant manta ray and Atlantic sturgeon occur in the Offshore Project area. Endangered Atlantic salmon are not expected to occur south of Central New England, and the natural spawning population in North America occurs primarily between West Greenland and the Labrador Sea (Rikardsen 2021; USASAC 2020). Adults of the endangered oceanic whitetip shark primarily occur on the outer edge of the shelf and prefer deep waters (Young and Carlson 2020). It is thought that juvenile oceanic white tip sharks utilize shallow reef habitats that do not occur in the geographic analysis area (Passerotti et al. 2020). The migratory giant manta ray is threatened and occurs in shelf waters of the Mid-Atlantic Bight and Southern New England portion of the geographic analysis area, including in the WTA and ECC corridors, from June to October (Farmer et al. 2022).

The coastwide Atlantic sturgeon stock is separated into five distinct population segments (DPSs): South Atlantic, Carolina, Chesapeake Bay, New York Bight, and Gulf of Maine. The Gulf of Maine DPS is listed as threatened under the ESA, while the other four are endangered (NMFS 2012a, 2012b). All five DPSs occur in nearshore shelf waters and in tributaries of the Mid-Atlantic Bight (Kazyak et al. 2021). Juvenile and adult Atlantic sturgeon occur in the offshore marine environment during fall, winter, and summer (Stein et al. 2004). Atlantic sturgeon have been documented to mostly occur approximately within 62 miles (100 kilometers) of shore in the Mid-Atlantic Bight (see Figure 6 in Kazyak et al. 2021). Atlantic sturgeon have not been documented to spawn in tributaries between the Delaware and Hudson rivers (Hilton et al. 2016).

The shortnose sturgeon is predominately a riverine/estuarine species that is less likely to occur in the Offshore Project area. However, shortnose sturgeon have been documented to occasionally venture outside of estuaries and enter other rivers in the Gulf of Maine, migrating through nearshore marine habitats (Dionne et al. 2013).

Both sturgeon species may occur in the inshore Project area along export cable routes nearest to landfall sites and in the Chesapeake and Delaware estuaries where Project-related vessel trips are planned. Atlantic sturgeon enter the Chesapeake Bay in July and continue migrating into the James, York, and Pamunkey Rivers in Virginia to spawn in September (Hager et al. 2020, 2014; Kahn 2014; Balazik et al. 2012a). Few shortnose sturgeon have been documented in Chesapeake Bay tributaries (Balazik 2017; Kynard et al. 2009; Welsh et al. 2002). More information is needed to evaluate the downstream movements of shortnose sturgeon in the Chesapeake Bay and its tributaries; however, a single observation of a shortnose sturgeon at the mouth of the Rappahannock River, Virginia, indicates the downstream extent in the system (Welsh et al. 2002). In the Delaware Estuary, adult Atlantic sturgeon enter to spawn from April to May as in other mid-Atlantic estuaries (Smith and Clugston 1997).

Spawning habitat in the Delaware River is thought to occur between river kilometers 118 and 141 (Hale et al. 2016), a segment of the estuary that Project vessels would transverse in route to the planned ports of Paulsboro Marine (river kilometer 145) and Repauno Port & Rail (river kilometer 139) terminals. Resident subadult Atlantic sturgeon also exist in the Delaware Estuary year-round (Hale et al. 2016). Shortnose sturgeon in the Delaware River have been rarely documented to occur south of Philadelphia, Pennsylvania (O'Herron et al. 1993; Dadswell et al. 1984; Brundage and Meadows 1982).

Critical habitat for the New York Bight Atlantic sturgeon DPS has been designated in aquatic habitats of rivers in Connecticut, Massachusetts, New York, New Jersey, Pennsylvania, and Delaware, including the lower 85 miles (137 kilometers) of the Delaware River Estuary (NMFS 2017). Specific physical and biological features essential for Atlantic sturgeon include rock, cobble, gravel, limestone, boulder and similar hard substrate habitats in freshwater or low salinity (0.5 ppt), aquatic habitats with gradual downstream salinity gradients of 0.5–30.0 ppt, soft bottom substrate in lower portions of estuaries, unimpeded river-estuarine systems to allow movements of individuals among habitats, salinity, temperature, and dissolved oxygen conditions that support successful spawning.

BOEM has provided a detailed discussion of ESA-listed fish species and potential impacts on these species due to the Project in consultation with NMFS in a BA (BOEM 2023a). The BA submitted to NMFS found that the Proposed Action is *not likely to adversely affect* Atlantic sturgeon, with the exception of monitoring surveys, which are *likely to affect* this species and will have *no effect* on shortnose sturgeon. Further the BA finds that the Proposed Action is expected to have *no effect* on critical habitat designated for Atlantic sturgeon. Consultation with NMFS pursuant to Section 7 of the ESA is ongoing, and results of the consultation are presented in this Final EIS.

#### *Invertebrates*

Marine invertebrates serve broad ecosystem roles including being part of the marine forage (i.e., food/prey) base and maintaining water quality (e.g., sequestering excess nutrients through filter feeding) (Anderson et al. 2011). Marine invertebrate communities within the Northeast U.S. WEAs were described by Guida et al. (2017) from a 14-year (2003–2016) subset of NEFSC's bottom trawl survey data, recent benthic grab samples taken by BOEM and sponsored by NEFSC in the Northeast U.S. WEAs, and drop camera surveys conducted by the University of Massachusetts Dartmouth School for Marine Science and Technology.

Invertebrate species can be categorized according to their habitat associations: benthic/demersal and pelagic. The broad benthic/demersal category can be further subdivided into "soft bottom" (e.g., sand, silt, clay sediment) and "hard bottom" (i.e., habitats such as reefs, boulders, cobble, or coarse gravel) associated species (BOEM 2021a). Soft-bottom habitat is the most commonly occurring within the geographic analysis area. Invertebrate communities associated with soft-bottom habitats of the Northeast U.S. WEAs include infaunal (i.e., burrowing) or surficial (i.e., on the seabed) organisms such as annelid worms (Oligochaeta and Polychaeta), flatworms (Platyhelminthes), and nematodes (Nematoda) (BOEM 2021a). Common soft-bottom crustaceans (Crustacea) include amphipods (Amphipoda), mysids (Mysida), copepods (Copepoda), and crabs (Brachyura) (BOEM 2021a). Echinoderms are another abundant soft-bottom group in the geographic analysis area that includes sand dollars (Clypeasteroida), starfishes (Asteroidea), and sea urchins (Echinoidea). Other soft-bottom invertebrates include commercially important shellfishes such as Atlantic surfclam (*Spisula solidissima*), ocean quahog (*Arctica islandica*), bay scallop (*Argopecten irradians*), and horseshoe crab (*Limulus polyphemus*) (BOEM 2021a; Cargnelli et al. 1999). Within the New Jersey WEA, the soft-bottom infaunal community is dominated by polychaetes; the surficial faunal community is dominated by sand shrimp, sea slugs, and sand dollars (Guida et al. 2017). Atlantic surfclam are present within the New Jersey WEA and the Offshore Project area (Guida et al. 2017).

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

Pelagic invertebrates in the geographic analysis area include commercially important squids (longfin [*Doryteuthis pealeii*] and shortfin [*Illex illecebrosus*]) (BOEM 2021a). Pelagic mesozooplankton includes pelagic forms of copepods, amphipods, and water fleas (Cladocera) and pelagic early life stages of other invertebrates. Species in this group contribute to a major forage base in estuaries where they are preyed upon by intermittently abundant pelagic jellyfishes including comb jellies (Ctenophora) and medusae (Medusozoa) (Slater et al. 2020; Condon et al. 2013). Pelagic mesozooplankton and jellyfishes (Cnidaria) are also present in the shelf waters of the geographic analysis area but are not well documented. Within the New Jersey WEA, longfin squid are a common pelagic invertebrate species (Guida et al. 2017). Spatial and population dynamics of pelagic invertebrates and the pelagic early life stages of other invertebrates are influenced by ocean currents and conditions. Based on recent trawl surveys, longfin squid are a common pelagic invertebrate species in the Offshore Project area (COP Volume II, Section 4.6.1.4; Atlantic Shores 2024).

Benthic monitoring within the Lease Area identified sand dollars as the dominant taxa (Integral 2020). Other common taxa included large and small amphipod and polychaete tube mats, *Diopatra* polychaetes, burrowing anemones, hermit crabs (Paguroidea), nassariid snails, and mobile decapods (Integral 2020). Further benthic monitoring has been planned within the Offshore Project area (COP Volume II, Appendix II-H; Atlantic Shores 2024).

No ESA-listed invertebrate species occur within the geographic analysis area.

### *Essential Fish Habitat*

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (50 CFR Part 600). BOEM has prepared an expanded EFH Assessment for the

Proposed Action in consultation with NMFS, and the results of this consultation are included in the discussions of this section (BOEM 2023b).

Of the 101 finfish and invertebrate species identified in NEFSC bottom trawl surveys (Guida et al. 2017), 43 species have designated EFH for at least one life stage in the Offshore Project area (COP Volume II, Appendix II-J2; Atlantic Shores 2024). Dominant species in the bottom trawl surveys in both cold (winter/spring) and warm seasons (fall) include skates (e.g., clearnose skate, little skate, winter skate) and silver hake (*Merluccius bilinearis*). Summer-/fall-dominant species included Atlantic butterfish, longfin squid, red hake, scup, and spiny dogfish, while winter-dominant species included Atlantic herring. All these species have designated EFH within the Project area. Several highly migratory species have EFH in the Project area, including tunas (e.g., albacore tuna [*Thunnus alalonga*], bluefin tuna, skipjack tuna [*Katsuwonus pelamis*], and yellowfin tuna), swordfish, and sharks (e.g., blue shark, common thresher shark, dusky shark [*Carcharhinus obscurus*], sandbar shark [*C. plumbeus*], sand tiger shark [*Carcharhinus taurus*], and shortfin mako). The Project area also contains finfish and invertebrates that are not federally managed (i.e., no EFH), but that provide a valuable forage resource for species that do have designated EFH in the area.

The Project area provides three general types of EFH that support managed species and their prey: water column, soft bottom, and hard bottom. All waters from the surface to the ocean floor are part of the water column. The water column is particularly important for planktonic eggs and larvae, planktivorous or filter-feeding species/life stages, and migratory pelagic species (NOAA Fisheries 2017; NEFMC 2017). The most numerically abundant component of the pelagic fish community in the open waters of the Project area is the ichthyoplankton assemblage. Soft-bottom habitats include unconsolidated rocks, gravel, cobble, pebbles, sand, clay, mud, silt, and shell fragments as well as the water-sediment interface. EFH for 43 species is present within the Offshore Project area (COP Volume II, Appendix II-J2; Atlantic Shores 2024). EFH species include New England finfish (e.g., Atlantic cod, monkfish, winter flounder), mid-Atlantic finfish (e.g., black sea bass, bluefish, summer flounder), South Atlantic finfish (king mackerel and Spanish mackerel), New England invertebrates (Atlantic sea scallop), mid-Atlantic invertebrates (Atlantic surfclam, ocean quahog, longfin inshore and northern shortfin squid), and highly migratory species (tunas and sharks). In Project-related towed video monitoring, EFH species identified in the Project area include black sea bass, clearnose skate, silver hake (*Merluccius bilinearis*), summer flounder, windowpane flounder (*Scophthalmus aquosus*), and winter flounder (COP Volume II, Appendix II-G3; Atlantic Shores 2024). Also, Atlantic surfclams were present in benthic grab samples from a Project-related benthic assessment within the export cable corridors (Morandi et al. 2021). Habitat Areas of Particular Concern (HAPCs) are a component of EFH that are defined as high-priority areas for conservation, additional management focus, or research because they are rare, sensitive, stressed by development, or important to ecosystem function (50 CFR Part 600). The only HAPC potentially overlapping the Offshore Project area is for sandbar shark (COP Volume II, Appendix II-J2; Atlantic Shores 2024). Specifically, shallow coastal and estuarine habitats between Margate City, New Jersey and Great Bay, New Jersey, lower and middle Delaware Bay, Delaware, and lower Chesapeake Bay, Maryland, are HAPC for sandbar shark pups in the geographic analysis area. These habitats are important nursery grounds for pups in summer.

### 3.5.5.2 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

This Final EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of the alternatives, including the Proposed Action, as shown in Table 3.5.5-1. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

**Table 3.5.5-1. Impact level definitions for finfish, invertebrates, and essential fish habitat**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | Impacts on species or habitat would be so small as to be unmeasurable. |
| | Beneficial | No effect or no measurable effect. |
| Minor | Adverse | Most impacts on species would be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts that do occur would be temporary or short term in nature. |
| | Beneficial | A small and measurable beneficial impact on species or habitat. |
| Moderate | Adverse | Impacts on species would be unavoidable but would not result in population-level effects. Impacts on habitat may be short term, long term, or permanent, and may include impacts on sensitive habitats but would not result in population-level effects on species that rely on them. |
| | Beneficial | A notable and measurable beneficial impact on species or habitat. |
| Major | Adverse | Impacts would affect the viability of the population and would not be fully recoverable. Impacts on habitats would result in population-level impacts on species that rely on them. |
| | Beneficial | A regional or population-level beneficial impact on species or habitat. |

### 3.5.5.3 Impacts of Alternative A – No Action on Finfish, Invertebrates, and Essential Fish Habitat

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

#### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH described in Section 3.5.5.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Impacts on finfish, invertebrates, and EFH within the geographic analysis area include ongoing and planned activities and global climate change. Ongoing non-offshore wind activities that contribute to impacts on finfish, invertebrates, and EFH include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); marine minerals use military use; marine transportation; fisheries use and management; research, monitoring, and survey activities;

and oil and gas activities. See Appendix D, Table D.A1-10 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for finfish, invertebrates, and EFH.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH (based on the scenario shown in Appendix D) include:

- Continued O&M of the BIWF Project (5 WTGs) installed in state waters;
- Continued O&M of the CVOW pilot Project (2 WTGs) installed in OCS-00497; and
- Ongoing construction of six offshore wind projects: the Vineyard Wind 1 Project (62 WTGs and 1 OSS) in OCS-A 0501, SFWF Project (12 WTGs and 1 OSS) in OCS-A 0517, the Ocean Wind 1 Project (98 WTGs and 3 OSSs) in OCS-A 0498, the Revolution Wind Project (65 WTGs and 2 OSSs) in OCS-A 0486, the Empire Wind Project (147 WTGs and 2 OSSs) in OCS-A 512, and the CVOW-C Project (202 WTGs and 3 OSSs) in OCS-A 0483.

Impacts for ongoing activities, regulated fishing, and global climate change would continue to affect finfish, invertebrates, and EFH in the absence of the Proposed Action. Global climate change is an ongoing and developing phenomenon that would continue to occur and would cause ocean acidification, increasing ocean surface and bottom temperatures, and changes in ocean circulation patterns. The impacts of climate change are expected to affect habitat suitability for and distributions of finfish and invertebrates in the geographic analysis area, including several EFH species. In particular, increases in sea temperature within the geographic analysis area are thought to be responsible for documented northward shifts in species distributions (Gaichas et al. 2015; Hare et al. 2016; Lucey and Nye 2010; Friedland and Hare 2007). The impacts of global climate change could range from minor to major depending on species. While some effects of climate change on marine resources have already been documented, continued trends in rising sea temperatures and a continuing changing climate would have uncertain impacts on resources.

Regulated fishing would continue to affect finfish, invertebrates, and EFH through its influence on the nature, distribution, and intensity of fishing effort and its associated impacts (e.g., mortality, bottom disturbance). Negative impacts from fishing could be expected in the future. For example, regulated fishing pressure has resulted in stock crashes in the past. Impacts of regulated fishing on finfish and invertebrates would range from minor to major and could also have synergistic effects with global climate change.

In the absence of the Proposed Action, ESA-listed species would continue to experience existing stressors and continue current trends in stocks. For example, the most significant threats to Atlantic sturgeon including bycatch mortality, water quality, lack of adequate regulations, and dredging activities would continue (ASSRT 2007). Changes in intensity of these stressors would occur independent of the Proposed Action. Increases in offshore wind development-related vessel activity could increase the vessel collision stressor identified by ASSRT (2007), which is discussed in this section and Section 3.5.5.5.

Ongoing activities would affect finfish, invertebrates, and EFH through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, discharges/intakes, electric and magnetic fields and cable heat, gear utilization, lighting, noise, and presence of structures. There are eight ongoing offshore wind projects in the geographic analysis area for which activities would have the same type of impacts from these IPFs that are described in detail in *Cumulative Impacts of Alternative A – No Action* for planned offshore wind activities but the impacts would be of lower intensity.

**Accidental releases:** Accidental releases of fuel, fluids, and hazardous materials, as well as the introduction of invasive species due to ongoing activities in the geographic analysis area, are chronic and frequent, and the risk of such accidental releases is expected to continue. Impacts of accidental releases of fuel, fluids, and hazardous materials can include mortality, decreased fitness, and contamination of habitat, but these impacts are anticipated to be negligible, localized, and temporary and are not expected to produce population-level effects. Impacts of accidental releases of invasive species can be widespread and permanent in instances when invasive species are able to establish populations, possibly leading to minor impacts on finfish, invertebrates, and EFH.

**Anchoring:** Anchoring activity would continue from vessel operations associated with ongoing military use, marine transportation, and fisheries use and management. Impacts of anchoring can be temporary to permanent and include increased turbidity levels, mortality of finfish and invertebrates, and degradation of sensitive habitat in areas where anchors and chains meet the seafloor. Impacts of anchoring on finfish, invertebrates and EFH are expected to range from negligible to minor.

**Cable emplacement and maintenance:** Cable emplacement and maintenance activities would continue to disturb bottom sediment, resulting in temporary increases in suspended sediment concentrations and short-term to long-term impacts from disturbance, displacement, injury, and habitat alteration. Cable emplacement activities would have moderate impacts on finfish, invertebrates, and EFH, while impacts from less intense and infrequent cable maintenance activities are expected to be minor.

**Lighting:** Vessels and anthropogenic structures from ongoing activities would continue to generate artificial light at night, which may cause temporary attraction, avoidance, or other behavioral responses in some finfish and invertebrate species, potentially affecting localized animal distributions near the light source. Artificial light may also disrupt natural cycles (e.g., spawning), possibly leading to short-term impacts. Continued use of artificial light at night is expected to have negligible to minor impacts on finfish, invertebrates, and EFH.

**Noise:** Anthropogenic noise associated with ongoing aircraft, G&G surveys, offshore WTGs, and vessels is expected to continue. These noise sources have varying impacts on finfish, invertebrates, and EFH that are discussed below in *Cumulative Impacts of Alternative A – No Action*. Those impacts are expected to range from negligible to minor.

**Presence of structures:** Undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; military activities; and oil and gas activities would continue to exist on the OCS. Impacts from the presence of these structures range from short term to permanent and include entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation, "stepping stones" for non-indigenous species, habitat conversion, and migration disturbances. Impacts due to the presence of structures would range from minor to moderate depending on the type of effects they generate (e.g., habitat alteration, reef effect). These effects are discussed in the section for *Cumulative Impacts of Alternative A – No Action*.

**Traffic:** Continued or increased utilization of U.S. ports would result in more vessel activity and the need for port expansions at some locations. Vessel traffic would continue to pose a threat to some fish species due to vessel collisions resulting in minor impacts.

### *Cumulative Impacts of Alternative A – No Action*

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative, inclusive of ongoing activities, in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned activities are expected to contribute to impacts on finfish, invertebrates, and EFH in the absence of the Proposed Action. Planned activities not related to the Proposed Action include cable emplacement and maintenance, navigation channel dredging, and installation for planned offshore oil and gas infrastructure. Planned activities also include tidal energy projects, navigation channel maintenance dredging, reconnaissance studies for future sand resource use, offshore dredge material disposal, oil and gas projects, and planned onshore development.

Under the No Action Alternative, existing environmental trends within the geographic analysis area would continue, influenced by ongoing and planned activities and by other offshore wind and renewable energy projects and the associated port development that would support this industry. The Project-defined IPFs in this section are discussed in context of cumulative impacts from ongoing and planned offshore wind activities in the geographic analysis area absent the Proposed Action.

In addition to the eight ongoing offshore wind projects, 25 additional offshore wind projects are planned to be constructed in the geographic analysis area. These 33 projects would result in an additional 2,810 WTGs and 56 OSSs/ESPs and met towers in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). The impacts of the ongoing and planned offshore wind projects are discussed in the subsections below.

BOEM expects planned offshore wind development activities to affect finfish, invertebrates, and essential fish habitats through the following primary IPFs.

**Accidental releases:** Offshore wind development is expected to increase vessel traffic and presence within the geographic analysis area. Increased vessel traffic presents a greater risk of accidental releases of fuel, fluids, and hazardous materials, as well as a greater risk of introducing nonnative marine organisms. Furthermore, construction activities could also increase the risks of releases of contaminants and trash and debris. Some accidentally released pollutants may bioaccumulate in food webs if ingested by forage/prey species. The highest increases in vessel traffic would occur during the construction and decommissioning phases of each project. Impacts of such releases can include decreased condition or mortality of organisms and contamination of habitats, but these impacts are localized and short term and are not expected to produce population-level effects.

Approximately 29.5 million gallons (111.7 million liters) of fuel, fluids, and hazardous materials are expected to be contained in offshore wind facilities (Appendix D, Table D.A2-3). The risk of accidental releases would be highest during construction phases but would also be possible during the O&M and decommissioning phases (BOEM 2021a). Modeled rates of accidental releases have been estimated at 128 thousand gallons (434,533 liters) every 5 to 20 years, which is considered relatively low (BOEM 2021a). The risk of concurrent accidental releases from multiple facilities is lower still. Spills larger than 2,000 gallons (7,571 liters) are not expected to occur. Based on the low risk of accidental releases of fuel, fluids, and hazardous materials from offshore wind-related activities, BOEM anticipates negligible to minor impacts on finfish, invertebrates, and EFH.

Ballast water and bilge water discharges from offshore wind vessel traffic would elevate the risk of accidental releases of invasive species into the aquatic environment. Successful establishment of introduced species depends on species characteristics that are favorable for survival, such as variability in life-history traits, high production, and wide-ranging tolerances to environmental conditions. Introductions of nonnative species do not always result in the establishment of viable populations; however, the establishment of a nonnative species resulting from offshore wind activity has been documented. The colonial tunicate, *Didemnum vexillum*, is one of the first examples of an invasive species utilizing offshore wind infrastructure (HDR 2020). *Didemnum vexillum* may spread via drift of viable fragmented colonies (Valentine et al. 2007), which may be vulnerable to being pumped into ballast or bilges that are later released at different locations. This invasive tunicate also reproduces sexually and releases larvae into the water column (Valentine et al. 2009), which also may potentially spread via ballast and bilge. Vessel discharges may spread other invasive species that can be entrained into ballast or bilges at adult or early life stages (Bailey 2015; Briski et al. 2012). Additional introductions could have adverse impacts on existing finfish and invertebrate communities and EFH, including increased competition with native fauna or adverse habitat alteration. These impacts may be widespread and permanent in instances where invasive species are able to establish populations.

Accidental releases of trash and debris during construction periods are potentially hazardous to finfish and possibly some macroinvertebrates. Trash and debris pose entanglement and ingestion threats to marine life (Gall and Thompson 2015). Debris may also attract organisms (i.e., “rafting”) putting them in a non-natural habitat. Entanglements typically result in direct harm or death to organisms while ingestion disproportionately results in indirect harm or death compared to entanglements (Gall and Thompson 2015). BOEM expects that that vessels would comply with laws and regulations to minimize accidental releases of trash and debris.

Impacts from accidental releases and discharges from ongoing and planned offshore wind activities are anticipated to be negligible as risks of accidental releases would be low and measures are expected to minimize those risks.

**Anchoring:** Vessel anchoring from offshore wind-related activities would mostly occur within WTG array and export cable areas. Vessel activities related to construction of up to 2,810 WTGs and 56 OSSs/ESPs and met towers are planned within the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). Anchoring activities would be highest during construction and demolition phases. Anchoring would also occur during O&M and during biological monitoring efforts related to wind development. Anchoring may be minimized by use of dynamic positioning systems.

Anchoring impacts on finfish, invertebrates, and EFH may include degradation of sensitive habitat, mortality of finfish and invertebrates, and increased turbidity. Impacts of anchoring are expected to be greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish). Anchor and chain contact with the seafloor would result in direct impacts on habitat, including EFH, and benthic organisms but would be limited to an approximate area of 6,020 acres (2,841 hectares) within the geographic analysis area (Appendix D, Table D.A2-2). Direct disturbance of the seafloor would be limited to surficial sediments including complex bedforms that are created by wave movement (e.g., sand ripples and sand waves). Impacts on seafloor habitats may be permanent if they occur on hard bottom. Mortality of organisms may also occur, but studies have demonstrated the ability of benthic habitats and communities to recover following physical disturbances (Wilber and Clarke 2007). Indirect impacts include increased turbidity from resuspension of sediments and burial from redeposition. Dispersal distances of resuspended sediments depend on bottom currents. Dilution of sediments would increase with increasing dispersal distances. Mobile organisms may avoid burial by repositioning in the sediments or by avoiding sediment plumes. Burial of hard-bottom habitat is possible and potentially permanent. Recovery of non-permanent impacts is expected to be rapid. Anchoring impacts could be reduced if project vessels use dynamic positioning systems. All anchoring impacts are expected to be localized. Impacts from increased turbidity would be short term and impacts from physical contact would be short term, whereas impacts from degradation of sensitive habitats could be long term. Given that the affected area is relatively much smaller than that of the geographic analysis area, BOEM anticipates that impacts on finfish, invertebrates, and EFH from planned offshore wind-related anchoring activity are anticipated to be negligible to minor.

**Cable emplacement and maintenance:** Offshore wind development would place hundreds of miles of buried or armored cable along transmission corridors and interarray connections, disturbing more than 63,933 acres (25,873 hectares) of seafloor habitats (Appendix D, Table D.A2-2). New cable emplacement and maintenance would disturb, displace, and injure or kill finfish and invertebrates, release sediment into the water column, and cause habitat alterations. The width of the disturbed bottom along cable routes, however, would be 33 feet (10 meters) or less (Appendix D, Table D.A2-1).

Cable installation would require trenching, laying, and burial. Trenching can be done using a cutting wheel in hard-bottom habitat or plowing or water jetting in soft-bottom habitat (Taormina et al. 2018). Impacts include disturbance of complex habitats that range from gravelly sand mixed sediments to reef structures. Sand mixed bottom habitats, including gravelly sand, are expected to recover following cable installation disturbances; however, fixed complex habitats such as reefs could potentially be permanently damaged or changed.

Cable installation is expected to resuspend sediments that may redeposit on other habitats. Plowing is designed to minimize resuspension of sediments by trenching, laying, and burying all in successive steps. Water jetting would entrain and possibly injure or kill small organisms, but this impact would be relatively small and localized.

Cable emplacement and maintenance activities (including dredging) would disturb sediments and cause sediment suspension, which could disturb, displace, and directly injure finfish species and EFH. Short-term disturbance of seafloor habitats could disturb, displace, and directly injure or result in mortality of invertebrates in the immediate vicinity of the cable emplacement activities. Sediment disturbance and resettlement could also affect eggs and larvae, particularly demersal eggs such as longfin squid eggs, which have high rates of mortality if egg masses are exposed to abrasion. When new cable emplacement and maintenance cause resuspension of sediments, increased turbidity could have an adverse impact on filter-feeding fauna such as bivalves. Depending on the substrate being disturbed, invertebrates could be exposed to contaminants via the water column or resuspended sediments, but effects would depend on the degree of exposure.

Cable emplacement methods may include dredging equipment including mechanical dredging or hydraulic dredging (trailing suction hopper or cutterhead). Mobile finfish and invertebrates are expected to move away from cable-laying equipment, but immobile or slow-moving demersal species and life stages (e.g., eggs, larvae) may be injured or killed by the equipment. Atlantic sturgeon have not been observed to avoid dredging activities potentially placing them in direct interaction with dredging equipment (Balazik et al. 2012a). Consequently, the lack of response to dredging activities by Atlantic sturgeon also suggests that migration is not affected (Balazik et al. 2020). Direct interactions of Atlantic sturgeon with dredging equipment may include entrainment. Instances of entrainment of Atlantic sturgeon by hopper dredges have been recorded during navigation channel dredging projects resulting in injuries or mortalities (Reine et al. 2014). Sturgeon would be most vulnerable to injury, mortality, reduced fecundity, and delayed or aborted spawning migration from impacts due to cable emplacement and associated dredging activities during their spring-summer spawning migration periods. Cable emplacement activities may also injure or kill benthic prey of sturgeon species. Juvenile and adult sturgeon rely on benthic prey including worms, crustaceans, and mollusks (Dadswell 2006). Other benthic species such as surfclams have been demonstrated to have high survival rates (99 percent) following mechanical disturbance by trawls (Sabatini 2007), suggesting that shelled mollusks may be similarly tolerant of other disturbances, including those from cable-laying equipment. Benthic communities typically recover within one year following dredging activities that generate similar impacts to cable emplacement (Wilber and Clarke 2007).

Burial of habitats and organisms from redeposition of sediments would occur during offshore wind activities, specifically during dredging and cable emplacement. When disturbed sediments are resuspended into the water column, they may drift or disperse to other locations before settling, including areas of complex bottom and EFH habitats. Dispersal distance and rate of suspended sediments depends on currents. As dispersal distance increases, dilution of suspended sediments may increase, reducing impacts from redeposition and burial. Redeposition of disturbed sediments may temporarily or permanently alter nearby complex hard-bottom habitats and organisms. Long-term, chronic increases in suspended sediment can cause physiological stress to sessile organisms; however, most fish and invertebrate organisms are able to mediate short-term turbidity plumes by expelling filtered sediments or reducing filtration rates (NYSERDA 2017; Bergstrom et al. 2013; Clarke and Wilber 2000). Sediment plumes from cable emplacement activities are not expected to impact Atlantic sturgeon. Survival and swimming performance of juvenile Atlantic sturgeon were not found to be affected by sediment plumes in a laboratory setting (Wilkens et al. 2015). Based on swimming performance measurements by Wilkens et al. (2015), juvenile Atlantic sturgeon are expected to have the ability to avoid sediment plumes in the natural environment where they are not confined within laboratory tanks. In response to moderate sediment deposition, infaunal organisms (e.g., marine worms) may reposition in the sediments to avoid smothering (Hinchey et al. 2006), while mobile organisms (e.g., fishes, crustaceans) are able to avoid areas. However, some demersal eggs and larvae (e.g., longfin squid, winter flounder, ocean pout) may be unable to avoid burial by redeposited sediments. Impacts from displacement and mortality on finfish, invertebrates, and EFH are expected to be short term and localized to the emplacement corridor and are expected to vary based on the time of year during which sediment-disturbing activities occur.

Cable laying and burial may require dredging in some areas where jet plowing is insufficient to achieve target cable burial depths. This can alter habitats, including short-term alterations of sand waves that provide vertically structured habitat for finfish and invertebrates. Tidal and wind-forced bottom currents are expected to reform most sand wave areas within days to weeks following disturbance, as they are known to migrate at rates up to 21 to 66 feet (6.5 to 20 meters) per year (van Dijk and Kleinhans 2005). Although some sand waves may not recover to the same height and width as pre-disturbance, habitat function is expected to fully recover.

Hard-bottom habitat would only be introduced in areas where target burial depths are not achieved, and cable armoring is required for protection. Protective cable armoring would create hard-bottom habitat up to 16 feet (5 meters) wide along cable corridors. The continuous hard-bottom habitat may fragment soft-bottom habitat communities, especially infaunal communities, while presenting habitat opportunities for complex benthic communities (e.g., biofouling communities that include anemones and barnacles). Fish species associated with complex structure (e.g., black sea bass) would be attracted to cable armoring substrate (Harrison and Rousseau 2020; Stevens et al. 2019). Cable armoring impacts could be permanent in most areas, but some re-sedimentation may occur and cover armoring material. Along cable routes, impacts on finfish, invertebrates, and EFH due to cable emplacement and maintenance are anticipated to be moderate.

The resuspension of sediments may also release chemical and nutrient contaminants into the water column (Miro et al. 2022; Chen et al. 2020); however, impacts on biological communities may not be significant (Miro et al. 2022). The process of resuspension and transport of sediments that is discussed could disperse contaminated sediments in the water column and to other locations (Miro et al. 2022), especially when sediments are disturbed near potentially large coastal human population centers (Dong et al. 2012; Bay et al. 2003; Cearreta et al. 2000). Potential contaminants include heavy metals, hydrocarbons, and pesticides, which have been documented to affect survival, growth, metabolism, development, reproduction, immune response, and behavior of marine organisms (Austin 1999).

Environmental contaminants may also increase vulnerability of aquatic organisms to disease (Austin 1999). Non-lethal impacts include concentration of contaminants in marine food webs (Pacheco 1988). Benthic organisms are particularly exposed to contaminants (Pacheco 1988). Contaminants then transfer into food webs as benthic organisms are typically prey to organisms higher on the food web. Suction dredging methods produce relatively less suspended sediments and contaminants compared to mechanical dredging methods (Chen et al. 2020).

Cable emplacement and maintenance activities could result in short-term impacts and over time may result in long-term habitat alterations. The intensity of impacts would be dependent on multiple factors, including time of year, sediment type, and habitat type being affected where activities occur. For example, sand is the predominant sediment type within the New Jersey WEA (Guida et al. 2017), so disturbed sediments would be expected to settle out of the water column relatively quickly and travel shorter distances than if the seabed was dominated by finer sediments (mud).

BOEM expects localized adverse impacts from cable emplacement to be short term and moderate. Minor adverse impacts from cable maintenance activities could be long term but intermittent.

**Discharges/intakes:** Increases in vessel discharges would occur during construction and installation, O&M, and decommissioning of offshore wind development. Offshore permitted discharges include uncontaminated bilge water and treated liquid wastes. Increases would be greatest during construction and decommissioning of offshore wind projects. Discharge rates would be staggered according to project schedules and localized. Certain discharges are required to comply with permitting standards that are established to minimize potential impacts on the environment.

Entrainment and impingement of organisms are expected to occur at cooling water intakes for HVDC converters. Additionally, entrainment and impingement would occur at intakes for cable-laying equipment. Impacts on finfish, invertebrates, and EFH from entrainment and impingement at intakes are expected to be localized. Further, as discussed under the *Cable emplacement and maintenance* IPF, entrainment and impingement at cable-laying equipment intakes are expected to be short term.

Impacts on finfish, invertebrates, and EFH from discharge volumes and intakes from offshore wind activities are expected to be negligible.

**Electric and magnetic fields and cable heat:** Up to 12,292 miles (19,782 kilometers) of export and interarray cables would be installed in offshore wind development planned in the geographic analysis area and would increase the presence of EMF in the geographic analysis area (Appendix D, Table D.A2-1). The electric field component of EMF from offshore wind cables would be largely or completely contained by use of shielding (Gill et al. 2012b). The strength of the magnetic component of EMF rapidly decreases with distance (Nyqvist et al. 2020). Magnetic fields capable of eliciting behavioral responses in marine organisms are expected to extend less than 50 feet (15.2 meters) from cables. Offshore wind projects are expected to bury export and interarray cables in accordance with best practices. While burial increases the distance between cables and the exposed surficial sediments or water column, the magnetic field component of EMF is not eliminated or reduced when cables are buried or contained in a shield (Hutchison et al. 2021). Source EMF strength depends on factors including cable voltage, current, and type of cable. EMF strength is higher from HVDC than from HVAC cables. Offshore wind projects are expected to used HVAC for interarray cables and either HVAC or HVDC for export cables. Parallel cables may also influence EMF strength. Depending on distance between parallel cables, EMF may by reduced via canceling or magnified (CMACS 2003). Further research is needed to better understand these effects, however (Gill et al. 2012a). Offshore wind projects are also expected to bundle cables (i.e., multiple cables within the same sheathing bundle), which would not only decrease source EMF levels, but EMF strength would also decrease at a faster rate with distance (Snoek et al. 2016; CMACS 2003). EMF would persist continuously over the operating life of each project.

Studies on EMF impacts largely focus on the magnetic field component while still referring to it as EMF; therefore, the evaluation of EMF impacts in this section focuses on magnetic fields. Many marine species are electromagnetic-sensitive and have been shown to respond to EMF from HVAC (Nyqvist et al. 2020; Gill et al. 2014, 2012a). EMFs from HVAC cables are emitted more efficiently into the marine environment than from HVDC cables (Gill et al. 2012b). Although past studies have found mixed, and sometimes conflicting, results (Albert et al. 2020; Hutchison et al. 2020b), growing research on responses of marine animals to EMF have identified potential negative impacts of EMF (Klimley et al. 2021). Behavioral responses to EMF have been documented in decapods (e.g., lobsters and crabs) (Scott et al. 2018, 2021; Hutchison et al. 2018, 2020a; Ernst and Lohmann 2018) and finfish (Hutchison et al. 2020a; Scanlan et al. 2018), including migratory finfish (Minkoff et al. 2020; Klimley et al. 2017). Attraction to EMF exposed shelters was observed in the edible crab *Cancer pagurus* (Scott et al. 2018, 2021), while another decapod, the spiny lobster *Panulirus argus*, was observed to avoid EMF shelters (Ernst and Lohmann 2018). Other behavior impacts of EMF on decapods include changes in movement patterns and position above the seabed noted in a study on the American lobster *Homarus americanus* (Hutchison et al. 2020a). EMF impacts on behavior patterns of little skate have been observed (Hutchison et al. 2018), and other elasmobranchs potentially would have similar responses due to the group's sensitivity to EMFs (Hutchison et al. 2021; Gill et al. 2014). In other finfishes, results have been mixed or contradictory, even between species in the same genus (Gillson et al. 2022; Hutchison et al. 2020a; Scanlan et al. 2018; Öhman et al. 2007). For example, responses to magnetic fields were observed in migratory Atlantic salmon (Minkoff et al. 2020; Scanlan et al. 2018). However, mixed and contradictory responses in movements to EMF were observed in a similar species, Chinook salmon (*Oncorhynchus tshawytscha*) (Wyman et al. 2018). In a separate study, juvenile Chinook salmon migrations were not impeded by magnetic fields (Klimley et al. 2017). Migrations of green sturgeon (*Acipenser medirostris*), a species related to the ESA-listed Atlantic and shortnose sturgeons, also have been found to not be impeded by magnetic fields (Klimley et al. 2017). Furthermore, Atlantic sturgeon juveniles did not exhibit behavioral responses to direct exposure to EMFs ranging up to 1,000 micro-Tesla in a laboratory setting (McIntyre 2017). EMFs were also not found to influence spatial distribution and behavior of lesser sandeel larvae (*Ammodytes marinus*) (Cresci et al. 2022). Further research and monitoring are needed to better understand the impacts of EMF on fish behavior (Klimley et al. 2021).

Recent studies have also identified physiological impacts of EMF on marine worms (Jakubowska et al. 2019; Stankevičiūtė et al. 2019), decapods (Scott et al. 2018), bivalves (Jakubowska et al. 2022; Stankevičiūtė et al. 2019), and finfish (Stankevičiūtė et al. 2019). Reduced rate of ammonia excretion in response to EMF was detected in the marine worm *Hediste diversicolor* (Jakubowska et al. 2019, Stankevičiūtė et al. 2019), the common bivalve *Cerastoderma glaucum* (Jakubowska et al. 2022), and the rainbow trout *Oncorhynchus mykiss* (Stankevičiūtė et al. 2019). Albert et al. (2022) did not observe EMF impairing feeding in blue mussel (*Mytilus edulis*), though the study did not explore ammonia excretion. Other physiological effects of EMF that have been observed include cytotoxicity in *H. diversicolor*, rainbow trout, and the Baltic clam *Limecola balthica* (Stankevičiūtė et al. 2019) and disruptions in the circadian rhythm of blood sugars associated with rest and activity in edible crab (Scott et al. 2018).

Future research is needed to explore the cumulative and population-level impacts of EMF on marine organisms (Hutchison et al. 2020b). A recent study found behavioral and developmental impacts of EMF on European lobster (*Homarus gammarus*) and edible crab that would potentially have population-level impacts (Harsanyi et al. 2022).

Offshore cables would emit heat along cable routes. Heat generated by cables varies depending on cable type, cable voltage, capacity, and cable length (BOEM 2023c). Cables from alternating current transmission generate higher heat than from direct current cables (OSPAR 2012; Taormina et al. 2018). Heat increases as a function of transmission rate (Sharples 2011).

The surrounding environment is also a factor in heat dissipation from underwater cables. Environmental factors on underwater cable heat include water temperature and sediments. Water dissipates heat through absorption and absorption is higher in colder water (BOEM 2023c; Brewer and Peltzer 2019; Taormina et al. 2018). Colder water such as the cold bottom water formed by stratification as in the mid-Atlantic cold pool is expected to dissipate heat generated from cables. Heat transfer in fine sediments such as clays is conductive (i.e., heat transfers through the sediments) while transfer is convective (i.e., heat flow through interstitial water within the sediments) in coarse sediments such as sands (Emeana et al. 2016); therefore, heat from buried cables is expected to transfer greater distances within coarse sediments. However, modeled temperatures reaching the seafloor surface from heating elements to simulate buried cables at 39.4 inches (100 centimeters) are expected to be below 10°C above ambient temperatures based (Emeana et al. 2016). Based on the same controlled experiments, Emeana et al. (2016) measured greater than 10°C increases within sediments at distances ranging from 16 inches (40 centimeters) to over 3.3 feet (1 meter) from cable sources that varied depending on sediment substrate and source temperature.

Infaunal fishes (e.g., sand lances) and invertebrates may be vulnerable to heat produced by the export or interarray cables, but studies on the potential thermal effects in the context of heat produced by subsea transmission cables are limited. Cable heat may cause changes in sediment chemistry including decreases in dissolved oxygen concentration profiles, thereby affecting infaunal communities (Meißner and Sordyl 2006). Benthic communities may change if heat-sensitive species avoid cable corridors due to heat (Taormina et al. 2018). Impacts on finfish and invertebrates from cable heat are anticipated to be negligible, considering that most cables from offshore wind development are expected to be buried and heat from above-sediment cables would be immediately cooled by water (BOEM 2023c; Taormina et al. 2018).

Potential impacts of EMF on finfish, invertebrates, and EFH would not be minimized or eliminated by installing transmission cables with shielding or by burying them. However, cable burial depth could mitigate impacts of heat emission from cables. Minor to moderate adverse impacts on finfish, invertebrates, and EFH are expected from EMF and heat emission associated with cables from offshore wind development, though further research is needed to fully understand the impacts of EMF on finfish, invertebrates, and EFH.

**Gear utilization:** Biological monitoring information is required to be collected as part of wind energy development projects under 30 CFR Part 585 Subpart F. BOEM (2019b, 2019c) has outlined recommended approaches for developing benthic and fisheries biological monitoring programs. The purpose of the recommended monitoring programs is to establish pre-construction baselines and to assess changes/disturbances to resources in post-construction periods associated with operations. Monitoring during early operation periods may also serve to assess changes/disturbances that occurred due to construction activities.

Recommended gear types for biological monitoring include benthic grabs (e.g., Hamon grab, Van Veen grab, and benthic sled), otter trawls, underwater video imagery, and sediment profile imaging. Monitoring surveys that use underwater video imagery are not expected to produce any or noticeable impacts on habitats or benthic or fish resources (Beisiegel et al. 2017; Mallet and Pelletier 2014). Sediment profile imaging methods produce minimal disturbance to bottom habitats while providing data on habitat and biological fauna (Germano et al. 2011). However, trawling and benthic grab sampling gears are expected to have some level of measurable adverse impacts on benthic finfish and invertebrates and their benthic habitats (Jac et al. 2021; Kaiser 2019; Kaiser et al. 2002; Collie et al. 2000; Schwinghamer et al. 1996). Trawls and benthic grabs produce adverse impacts by removal of fauna and disturbance to bottom habitats (Jac et al. 2021; Collie et al. 2000; Kaiser et al. 2000; Clark 1999; Auster et al. 1996).

Active fishing gears such as trawls are known to reduce biomass and/or abundance of biological communities at the local spatial scale (i.e., within gear footprints) and at short, intermediate, or long-term time scales, with some changes potentially being permanent (Kaiser et al. 2000). This includes declines in biomass and/or abundance of targeted finfish or invertebrate species and epi- and infaunal communities impacted by habitat disturbances (Jennings et al. 2001, 2002; Collie et al. 2000; Kaiser et al. 2000). Declines in abundance or changes to community composition may also result in ecological community function with desired or targeted species being replaced with organisms not vulnerable to trawling (de Juan et al. 2007). Trawl gear, including otter trawls, leave behind notable tracks that are evidence of direct disturbance to bottom habitats (Smith et al. 2003; Auster et al. 1996; Schwinghamer et al. 1996). Sensitive habitats are vulnerable to bottom disturbances from trawling activity (Clark 1999). Direct disturbance of soft-bottom habitats from trawling could also result in sediment plumes and resuspension of nutrients and/or contaminants with potential biogeochemical consequences (Breimann et al. 2022; Palanques et al. 2022; Paradis et al. 2021; Pilskaln et al. 1998; Jones 1992; Churchill 1989). Other potential impacts on communities from trawling could include declines in production processes and overall community size spectra in benthic habitats (Queiros et al. 2006; Jennings et al. 2001, 2002).

Finfish and invertebrates are susceptible to capture, injury, and mortality from offshore wind-related biological monitoring surveys including from trawling, trapping, and clam dredges. ESA-listed species including Atlantic sturgeon are also vulnerable to impacts due to utilization of monitoring gears.

Future recommendations for biological monitoring include a combination of imagery surveys to supplement or limit the use of trawling methods, though imagery methods are not considered sufficient to replace trawling altogether (Jac et al. 2021; Trenkel et al. 2019; Beisiegel et al. 2017). Imagery approaches, however, have some advantages to other gears in some habitats (Beisiegel et al. 2018), and the combined approach is recommended in guidelines for offshore wind development biological monitoring programs (BOEM 2019a; BOEM 2019b). Water samples for eDNA analysis is another suggested approach for biological monitoring programs that would have limited impacts on underwater fauna and habitats (Trenkel et al. 2019). If active sampling gear methods such as trawling and dredges are used in offshore wind–related biological monitoring programs, impacts on finfish, invertebrates, and EFH are expected to be minor to moderate.

**Lighting:** Construction of up to 2,810 WTGs and 56 OSSs/ESPs and met towers are planned in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). Emissions of artificial light are expected to increase in the geographic analysis area due to construction and operation activities from offshore wind development. According to regulatory guidelines, each offshore structure would have flashing navigational and hazard lights (BOEM 2021d). Artificial lights from offshore wind structures would persist during the operating life of each project. Light sources from these activities include vessels, buoys, towers, and WTG structures. Lights would be from above-water sources, but light easily propagates through air and transitions through water. Further, the blue light spectrum tends to penetrate deeper as red light is attenuated at upper layers of the water column (Davies et al. 2014). The pelagic environment is expected to be the most affected as above-water artificial light from offshore oil rigs has been measured to penetrate up to 66 feet (20 meters) from the surface (Keenan et al. 2007). Artificial light has been documented to penetrate to maximum depths of up to 2,100 to 2,297 feet (640 to 700 meters) (Busby 1967). However, propagation of light through water is limited by attenuation factors including temperature and salinity (Korotkova 2019; Yao et al. 2019) and primary productivity (Lee 1999; Bricaud and Morel 1986), and can vary over tidal and seasonal cycles (Smyth et al. 2022).

Nighttime operation of vessels requires the use of navigational lights, which would emit light during transit as well as during construction activities. Vessel activity during O&M and biological monitoring efforts, which may occur at night, would also be a source of light. Increases in light emissions would be highest during construction and decommissioning phases when vessel deck lights, and possibly spotlights, could be utilized. BOEM has issued guidance for minimizing impacts from offshore wind-related artificial lights including minimizing the number of lights, using lower-intensity or strobe lighting, and avoiding white lights (Orr et al. 2013).

Marine organisms may be attracted to light (e.g., Cooke et al. 2017) while other organisms avoid nighttime artificial lights (e.g., Geoffroy et al. 2021). Consequences of attraction or avoidance of artificial light may influence natural nighttime behavior (O'Connor et al. 2019), hormone levels (Sánchez-Vazquez et al. 2019; Mommsen et al. 1999), and predator-prey interactions (Underwood et al. 2017) and food webs (Brown et al. 2010; Mazur and Beauchamp 2006), diel migrations (Martin et al. 2021; Ludvigsen et al. 2018), and other migration patterns (Ono and Simenstad 2014).

The presence of artificial light can impact the behavior of fishes at different life stages with negative potential outcomes. For example, artificial light at night may cause hyperactivity in larval reef fish (O'Connor et al. 2019). The physiological stress of hyperactivity in turn increases vulnerability to predation risk (O'Connor et al. 2019). In intermediate level predator adult fish, overwater artificial light presents nighttime feeding opportunities while also increasing predation risks by larger predators (Brown et al. 2010). Predator-prey interactions and diel movements of fish are thus directly influenced by above water light penetration (Brown et al. 2010). Keenan et al. (2007) observed similar predator-prey-risk relationships in larval, juvenile, and adult fishes. Similar predator-prey interactions in response to artificial light have also been observed in benthic (Garratt et al. 2019; Underwood et al. 2017) and pelagic (Berge et al. 2020; Ludvigsen et al. 2018) invertebrates.

Artificial light at night may also disrupt the natural circadian rhythms in marine organisms as indicated by measurements of decreased melatonin levels (Grubisic et al. 2019; Bayarri et al 2004; Migaud et al. 2007) and increased cortisol (Closs et al. 2023; Newman et al. 2015) at night. Physiological effects of artificial light at night could have consequences to fitness and survival and reproductive success (Closs et al. 2023; Sánchez-Vázquez et al. 2019).

Based on rearing studies, other effects of artificial light include changes to early development (Litvak et al. 2020; Villamizar et al. 2011) and immunity (Giannetto et al. 2014) of fishes. Overall impacts of artificial light on marine communities can be seen across trophic levels (Bolton et al. 2017).

Lights from offshore wind development could produce local, minor impacts on finfish, invertebrates, and EFH. Overall, impacts within the geographic analysis area are expected to be negligible, given that affected areas are relatively small.

**Noise:** Noise is expected to increase in the geographic analysis area from offshore wind activities. Up to 2,810 WTGs and 56 OSSs/ESPs and met towers are expected to be constructed in offshore wind development between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2). Noise sources related to construction of these structures include aircraft, vessels, seismic G&G surveys, pile driving, WTG operation, and overall construction activities. A description of the physical qualities of these sound sources can be found in Appendix B, Section B.5, *Underwater Acoustics*.

Many fishes and invertebrates produce sounds for basic biological functions like attracting a mate and defending territory. A recent study revealed that sound production in fishes has evolved at least 33 times throughout evolutionary time, and that the majority of ray-finned fishes are capable of producing sounds (Rice et al. 2022). Fish may produce sounds through a variety of mechanisms, such as vibrating muscles near the swim bladder, rubbing parts of their skeleton together, or snapping their pectoral fin tendons (Rice et al. 2022; Ladich and Bass 2011). Similarly, many marine invertebrates produce sounds, ranging from the ubiquitous snapping shrimp "snaps" (Johnson et al. 1947) to spiny lobster "rasps" (Patek 2002) to mantis shrimp "rumbles" (Staaterman et al. 2011). Some sounds are also produced as a byproduct of other activities, such as the scraping sound of urchins feeding (Radford et al.

2008a) and even a "coughing" sound made when scallops open and close their shells (Di Iorio et al. 2012).

All fishes and invertebrates are capable of sensing the particle motion component of a sound wave (for information about particle motion see Appendix B, Section B.5). The inner ear of fishes is similar to that of all vertebrates. Each ear has three otolithic end organs, which contain a sensory epithelium lined with hair cells, as well as a dense structure called an otolith (Popper et al. 2022). As the back-and-forth particle motion moves the body of the fish (which has a density similar to seawater), the denser otoliths lag behind, creating a shearing force on the hair cells, which sends a signal to the brain via the auditory nerve (Fay and Popper 2000). Many invertebrates have structures called statocysts which, similar to fish ears, act like accelerometers: a dense statolith sits within a body of hair cells, and when the animal is moved by particle motion, it results in a shearing force on the hair cells (Budelmann 1992; Mooney et al. 2010). Some invertebrates also have sensory hairs on the exterior of their bodies, allowing them to sense changes in the particle motion field around them (Budelmann 1992), and the lateral line in fishes also plays a role in hearing (McCormick 2011). The research thus far shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper et al. 2022).

In addition to particle motion detection, which is shared across all fishes, some species are also capable of detecting acoustic pressure (Fay and Popper 2000); some sharks possibly detect both particle motion and acoustic pressure (Poppelier et al. 2022; van Den Berg and Schuijf 1983). Special adaptations of the swim bladder (e.g., anterior projections, additional gas bubbles, or bony parts) bring it in close proximity to the ear; as the swim bladder expands and contracts, pressure signals are radiated within the body of the fish, making their way to the ear in the form of particle motion (Popper et al. 2022). These species can typically detect a broader range of acoustic frequencies (up to 3–4 kHz) (Wiernicki et al. 2020) and are therefore considered to be more sensitive to underwater sound than those only detecting particle motion. Hearing sensitivity in fishes is generally considered to fall along a spectrum: the least-sensitive (sometimes called "hearing generalists") are those that do not possess a swim bladder and cannot detect sound above 1 kHz, while the most sensitive ("hearing specialists") possess specialized structures enabling pressure detection (Popper et al. 2022). Some fish species, including sturgeons (*Acipenseriformes*), have swim bladders that are not involved in hearing due to a disassociation between the swim bladder and the inner ear (Popper 2005). These fishes are not sensitive to sound pressure (Lovell et al. 2005). However, these species have well-developed ear structures and are able to hear in the 50 to 700 Hz sound range (Meyer et al. 2010; Popper 2005). Lake sturgeon (*Acipenser fulvescens*) have a lower hearing threshold of 200 to 300 Hz and a higher threshold of 100 to 500 Hz (Lovell et al. 2005). A few species in the herring family can detect ultrasonic (> 20 kHz) sounds (Mann et al. 2001), but this is considered to be very rare among the bony fishes, as more fishes detect sound in the infrasound range (Enger et al. 1993) and most fishes in the audible range (Ladich and Fay 2013). Another important distinction for species that do possess swim bladders is whether it is "open" or "closed": species with open swim bladders can release pressure via a connection to the gut, while those with closed swim bladders can only release pressure very slowly, making them more prone to injury when experiencing rapid changes in pressure (Popper et al. 2019). It should also be noted that hearing sensitivity can change with age; in some species like black sea bass, the closer proximity between the ear and the swim bladder in smaller fish can mean that younger individuals are more sensitive to sound than older fish (Stanley et al. 2020). In other species, hearing sensitivity seems to improve with age (Enger and Mann 2005; Kenyon 1996).

Fishes experience TTS, and when very close to impulsive sound sources or explosions they could experience barotrauma, a term that refers to a class of injuries ranging from recoverable bruises to organ damage (which could ultimately lead to death) (Popper et al. 2014; Stephenson et al. 2010). When the air-filled swim bladder inside the body of the fish quickly expands and contracts due to a rapid change in pressure, it can cause internal injuries to the nearby tissues (Halvorsen et al. 2011). The greater the difference between the static pressure at the site of the fish and the positive/negative pressures associated with the sound source, the greater the risk of barotrauma. This means that impulsive sounds like those generated by impact pile driving may present a risk of injury due to the rapid changes in acoustic pressure (Hamernik and Hsueh 1991). Damage to invertebrate statocysts has been observed in response to sound exposure, but it is unclear whether the hair cells can regenerate, like they do in fishes (Solé et al. 2013, 2017). Continuous, lower-level sources (e.g., vessel noise) are not expected to result in auditory injury but could induce changes in behavior or acoustic masking. A discussion of hearing thresholds used in fishes can be found in Appendix B, Section B.5.

Offshore wind activities may include the use of helicopters for transporting workers to construction sites and structures. The most intense helicopter activity is expected to occur during work shift changes and be limited during construction phases. Aircraft noise, including noise from helicopters, would not propagate efficiently as it transitions from through air into the water, diminishing impact levels. Near-surface pelagic organisms may detect decreased aircraft noise levels as they transition from through-air to through-water, but impacts are not expected (BOEM 2021a). Noise levels from aircraft would be greatly diminished when they reach benthic/demersal habitats and may be at least partially masked by ambient ocean noise. Therefore, noise from aircrafts is expected to have negligible impacts on finfish, invertebrates, and EFH.

Increased vessel noise from offshore wind activities would occur, especially during construction phases. A description of the physical qualities of vessel noise can be found in Appendix B, Section B.5. Most construction vessels produce noise while stationary as well as during transit. Transiting vessels generate continuous sound from their engines, propeller cavitation, onboard machinery, and hydrodynamics of water flows (Ross 1976). The actual radiated sound depends on several factors, including the type of machinery on the ship, the material conditions of the hull, how recently the hull has been cleaned, interactions with the sea surface, and shielding from the hull, which reduces sound levels in front of the ship.

In general, vessel noise increases with ship size, power, speed, propeller blade size, number of blades, and rotations per minute. Source levels for large container ships can range from 177 to 188 dB re 1 µPa-m (McKenna et al. 2013) with most energy below 1 kHz. Smaller vessels typically produce higher-frequency sound concentrated in the 1–5 kHz range. Kipple and Gabriele (2003) measured underwater sound from vessels ranging from 14 to 65 feet (4.3 to 19.8 meters) long (25 to 420 horsepower) and back-calculated source levels to be 157–181 dB re 1 µPa-m. Similar levels are reported by Jiménez-

Arranz et al. (2020), who provide a review of measurements for support and crew vessels, tugs, inflatable RIHBs, icebreakers, cargo ships, oil tankers, and more.

During transit to and from shore bases, survey vessels typically travel at speeds that optimize efficiency, except in areas where transit speed is restricted. The vessel strike speed restrictions that are in place along the Atlantic OCS are expected to offer a secondary benefit of underwater noise reduction. For example, recordings from a speed reduction program in the Port of Vancouver (689- to 820-foot [210- to 250-meter] water depths) showed that reducing speeds to 11 knots reduced vessel source levels by 5.9 to 11.5 dB, depending on the vessel type (MacGillivray et al. 2019). Vessel noise is also expected to be lower during geological and geophysical surveys, as they typically travel around 5 knots when towing instruments.

Avoidance of vessels and vessel noise has been observed in several pelagic, schooling fishes, including Atlantic herring (Vabø et al. 2002), Atlantic cod (Handegard 2003), and others (reviewed in De Robertis and Handegard 2013). In response to vessels, fish may dive toward the seafloor, move horizontally out of the vessel's path, or disperse from their school (De Robertis and Handegard 2013; Misund and Aglen 1992). These responses in schooling behavior may increase individual-fish vulnerability to predation; however, population-level effects are not expected. A body of recent work has documented other, more subtle behaviors in response to vessel noise, but has focused solely on tropical reef-dwelling fish. For example, predator avoidance responses in damselfish (Ferrari et al. 2018; Simpson et al. 2016) and boldness (Holmes et al. 2017) seem to decrease in the presence of vessel noise, while nest-guarding behaviors seem to increase (Nedelec et al. 2017). Habituation to extended exposure to vessel sound has been observed in the domino damselfish (Nedelec et al. 2016). After 2 days of exposure to vessel sound playback, domino damselfish increased hiding behavior and ventilation rates, but responses diminished after 1 to 2 weeks, indicating habituation (Nedelec et al. 2016).

Vessel noise may also induce physiological stress or acoustic masking in hearing abilities of fishes. Studies have shown an increase in cortisol, a stress hormone, after playbacks of vessel noise (Celi et al. 2016; Nichols et al. 2015; Wysocki et al. 2006). However, recent studies suggest that stress from handling during experiments is greater than stress from acoustic stimulus, possibly confounding the results from the earlier studies (Harding et al. 2020; Staaterman et al. 2020). The cavitation of vessel propellors produces low-frequency, nearly continuous sound that is audible by most fishes and invertebrates and could mask important auditory cues, including conspecific communication (Haver et al. 2021; Parsons et al. 2021). Stanley et al. (2017) demonstrated that the communication range of both haddock and cod (species with swim bladders but lacking connections to the ear) would be significantly reduced in the presence of vessel noise, which is frequent in their habitat in Cape Cod Bay. In general, fish species that are sensitive to acoustic pressure would experience masking at greater distances than those that are only sensitive to particle motion.

Limited research on invertebrate responses to vessel noise has yielded inconsistent findings. Some crustaceans seem to have physiological responses to vessel noise. For example, increases in oxygen consumption are apparent in crabs (Wale et al. 2013). Other physiological responses include increases in some hemolymph (an invertebrate analog to blood) biomarkers like glucose and heat-shock proteins in spiny lobsters, which are indicators of stress (Filiciotto et al. 2014). Changes in hemolymph biomarkers in response to vessel noise were not observed in other crustaceans, including American lobsters and blue crabs (Hudson et al. 2022). However, these species exhibited behavioral changes in response to vessel noise including decreases in food handling time, defending food, and initiating fights with competitors (Hudson et al. 2022). Note that the research discussed in this paragraph is limited to laboratory studies, and in most cases, did not consider particle motion as a relevant cue; therefore, it is difficult to draw conclusions from the limited breadth of this work.

The planktonic larvae of fishes and invertebrates may experience acoustic masking from continuous sound sources like vessels. Several studies have shown that larvae are sensitive to acoustic cues and may use these signals to navigate to suitable settlement habitat (Montgomery 2006; Simpson et al. 2005), initiate metamorphosis into the juvenile stage (Stanley et al. 2012), or to maintain group cohesion during their pelagic transport (Staaterman et al. 2014). However, given the short range of such biologically relevant signals for particle motion-sensitive animals (Kaplan and Mooney 2016), the spatial scale at which these cues are relevant is rather small. If vessel transit areas overlap with settlement habitat, it is possible that vessel noise could mask some biologically relevant sounds (e.g., Holles et al. 2013), but these effects are expected to be short term and would occur over a small spatial area.

Several offshore wind projects have proposed use of dynamic positioning to avoid anchoring impacts. Many studies have found that the measured sound levels of dynamic positioning alone are, counterintuitively, higher than those of dynamic positioning combined with the intended activities such as drilling (Jiménez-Arranz et al. 2020; Kyhn et al. 2011) and coring (Warner and McCrodan 2011). Kyhn et al. (2011) reported close-range periodic noise from a drillship identified to originate from dynamic positioning thruster blades with most energy between 20 and 35 kHz. The received SPL measured at 328 feet (100 meters) from the vessel was 188 dB re 1 µPa. Warner and McCrodan (2011) found that most dynamic positioning related sounds from the self-propelled drill ship, *R/V Fugro Synergy* were in the 110–140 Hz range, with an estimated source level of 169 dB re 1 µPa-m. Sounds in this frequency range varied by 12 dB during dynamic positioning, while the broadband levels, which also included diesel generators and other equipment sounds, varied by only 5 dB over the same time period. Sound levels from dynamic positioning have high variability with time due in part to the intermittent usage and relatively slow rotation rates of thrusters. It is also difficult to provide a realistic range of source levels from the data thus far because most reports do not identify the direction from which sound was measured relative to the vessel, and dynamic positioning thrusters are highly directional systems.

The active acoustic positioning systems used in dynamic positioning also generate high frequency sound. These systems usually consist of a transducer mounted through the vessel's hull and one or more transponders affixed to the seabed. Kongsberg High Precision Acoustic Positioning systems produce pings in the 10–32 kHz frequency range. The hull-mounted transducers have source levels of 188–206 dB re 1 µPa-m depending on adjustable power settings (Kongsberg Maritime AS 2013). The fixed transponders have maximum source levels of 186–206 dB re 1 µPa-m depending on model and beam width settings from 15 to 90° (Jiménez-Arranz et al. 2020). These systems have high source levels, but beyond 1.2 miles (2 kilometers), they are generally quieter than other components of the sound from dynamic positioning vessels for various reasons, including their pulses are produced in narrowly directed beams, each individual pulse is very short, and their high frequency content leads to faster attenuation. Specific impacts from dynamic positioning thruster and transponder noise on finfish, invertebrates, and EFH have not been studied. Impacts from vessel noise are expected to be localized, short term, and minor.

Some offshore wind development projects may require G&G surveys, which introduces noise while active acoustic sources are in use. Project-specific G&G surveys would occur during site assessments. Where possible, existing survey information would be reprocessed for offshore wind development, possibly limiting G&G surveys at some WEAs (BOEM 2014). Of the sources that may be used in geophysical surveys for offshore wind, only a handful (e.g., boomers, sparkers, bubble guns, and some SBPs) emit sounds at frequencies that are within the hearing range of most fishes and invertebrates (see Appendix B, Section B.5 for more detail on these sources [Crocker and Fratantonio 2016; Ruppel et al. 2022]). This means that side-scan sonars, multibeam echosounders, and some SBPs would not be audible, and thus would not affect them. For the sources that are audible, it is important to consider other factors such as source level, beamwidth, and duty cycle (Ruppel et al. 2022). Boomers, sparkers, hull-mounted SBPs, and bubble guns have source levels close to the threshold for injury for pressure-sensitive fishes, so unless a fish was within a few meters of the source, injury is not expected to occur (Crocker and Fratantonio 2016; Popper et al. 2014). Behavioral impacts could occur over slightly larger spatial scales. For example, if one assumes an SPL threshold of 150 dB re 1 µPa for behavioral disturbance (GARFO 2020) and spherical spreading loss, sounds with source levels of 190 dB re µPa-m would fall below this threshold approximately 328 feet (100 meters) from the source (assuming cylindrical spreading, this would be approximately 0.6 mile [1 kilometer]). This means that the lowest-powered sparkers, boomers, and bubble guns would not result in behavioral disturbance beyond approximately 328 feet (100 meters) in a deep-water oceanic environment (Crocker and Fratantonio 2016). Towed SBPs are generally lower in power than hull-mounted systems, so behavioral impacts are expected to occur over even smaller scales. It should be noted that these numbers are reported in terms of acoustic pressure because there are currently no behavioral disturbance thresholds for particle motion. It is expected that behavioral impact ranges would be even smaller for particle motion-sensitive species, including invertebrates. Because most HRG sources are typically “on” for short periods with silence in between, only a few “pings” emitted from a moving vessel towing an active acoustic source would reach fish or invertebrates below, so behavioral effects would be intermittent and temporary. Overall, the level of disturbance from G&G surveys is expected to be negligible for fishes and invertebrates due to the frequency range, the small spatial extent of sound propagation, and the short duration of exposure.

Low-frequency noise from WTG operation would persist during the operational life of each offshore wind project. A description of the physical qualities of vessel noise can be found in Appendix B, Section B.5. Elliot et al. (2019) compared field measurements during offshore wind operations from the BIWF to the published audiograms of a few fish species. They found that, even at 164 feet (50 meters) from an operating turbine, particle acceleration levels were below the hearing thresholds of several fish species, meaning that it would not be audible at this distance. Pressure-sensitive species may be able to detect operational noise at greater distances, though this will depend on other characteristics of the acoustic environment (e.g., sea state). Nonetheless, operational noise is not expected to be audible to animals beyond those that live in close vicinity to the pile (i.e., those that have settled there due to the structure it provides), and even if it is audible, it may not be bothersome. Noise is also expected during maintenance (e.g., vessel noise, repairs) but would be infrequent. Impacts of noise from O&M would be localized (i.e., restricted to the general WEAs), and noise levels are anticipated to range from low to moderate. No studies have identified behavioral impacts of WTG operation on finfish, invertebrates, and EFH (Thomsen et al. 2015).

Impact and vibratory pile-driving noise is expected to occur as part of the construction and installation of each of the planned offshore wind projects in the geographic analysis area. A description of the physical qualities of pile-driving noise can be found in Appendix B, Section B.5. Impulsive, high-source-level noise, such as pile-driving noise, may injure, kill, or otherwise disrupt development in early life stages of fish and invertebrates (Weilgart 2018; Hawkins and Popper 2017). Closer investigations into the effects of the particle motion component of noise on fish have been recommended (Weilgart 2018; Hawkins and Popper 2017).

Dead fish observed within 32.8 feet (10 meters) of a bridge construction project were attributed to pile-driving activity, suggesting that pile-driving noise could cause fish mortality (Abbott and Reyff 2004). Only one other field study measured potential fish mortality near pile-driving operations (Debusschere et al. 2014). That study found no increase in mortality of juvenile European seabass (a species with a closed swim bladder) from pile-driving noise at received peak pressures of 210–211 dB re 1 µPa within 147.5 feet (45 meters) of a pile (Debusschere et al. 2014). Because little empirical work has examined the potential for non-recoverable injury (i.e., injuries that would lead to mortality), acoustic modeling can be combined with the given acoustic thresholds to predict potential effects. For example, Ainslie et al. (2020) used a damped cylindrical spreading model informed by empirical measurements from the North Sea (pile diameter ranging from 11.1 to 23 feet [3.4 to 7.0 meters]) to derive effect ranges for fishes based on Sound Exposure Guidelines outlined in Popper et al. (2014). Based on a model scenario of 7,000 strikes to drive a 19.7-foot (6-meter) diameter pile at a depth of 92 feet (28 meters) and 10 dB noise abatement, fish without a swim bladder could experience mortal injury up to 128 feet (39 meters) from a source and recoverable injury up to 253 feet (77 meters) from a source. For fish that have a swim bladder involved in hearing, mortal injury could occur within 0.33 mile (533 meters) from the source and recoverable injury could occur up to 0.75 miles (1.2 kilometers) from the source. In similar water depths of the Western Atlantic, modeling predictions for installing a 36-foot (11-meter) diameter monopile (assuming 2,202 strikes), using a 4,000-kJ hammer with 10 dB of attenuation yielded similar exposure ranges. Fish without a swim bladder could experience recoverable injury at 722 feet (220 meters), while fish with a swim bladder involved in hearing could experience recoverable injury up to 0.94 mile (1.52 kilometers) away (Ocean Wind 2023). It is generally safe to assume that fishes without a swim bladder, as well as invertebrates, could experience recoverable injury on the order of tens to hundreds of meters, while fishes with swim bladders involved in hearing may experience effects on the order of one to two kilometers; these distances assume 10 dB of attenuation at the source.

The estimates given above are based on acoustic modeling and are described in terms of acoustic pressure, which is relevant for fishes with swim bladders, but for other species, particle motion is the more appropriate cue. Field work by Amaral et al. (2018) measured particle acceleration during impact pile driving of jacket foundations with 4.3-foot (1.3-meter) diameter piles. At 0.3 mile (500 meters) from the pile, in-water particle acceleration ranged from 30 to 65 dB re 1 µm/s2 in the 10–1000 Hz range, but closer to the seabed it was significantly higher, at 50–80 dB re 1 µm/s2. When comparing these received levels to the published hearing thresholds of several fish species, the authors surmised that in-water particle acceleration would be barely audible at this distance, while levels near the seabed would indeed be detectable (Amaral et al. 2018). These field measurements of particle motion are critical for putting other experimental research into context; most of the studies described have focused on acoustic pressure, which is relevant for only a sub-set of fishes. It also underscores the fact that species that lack hearing specializations are not expected to experience significant effects from impact pile driving beyond a few hundred meters from the source, for similar-size piles and water depths.

A suite of empirical studies has examined other behavioral and physiological effects in fishes—beyond injury—and are described briefly here. Most of this work has focused on commercially important species like the European seabass, which lacks hearing specializations and has a closed swim bladder. Adult seabass generally dive deeper and increase swimming speed and group cohesion when exposed to intermittent and impulsive sounds like pile driving (Neo et al. 2014, 2018), but juveniles become less cohesive (Herbert-Read et al. 2017) and generally seem to be more sensitive to pile-driving noise than adults (Kastelein et al. 2017). There is also some evidence that respiration rates may be affected by pile-driving noise (Spiga et al. 2017). Importantly, a number of studies have shown that European seabass habituate to pile-driving sounds over repeated exposure (e.g., Bruintjes et al. 2016; Neo et al. 2016; Radford et al. 2016). Together, this research suggests that European seabass, and probably other species with similar hearing anatomy, would exhibit short-term behavioral or physiological responses but would recover quickly once pile driving is complete.

In field-based studies that can better represent the acoustic conditions that fish would experience near real pile-driving operations, Mueller-Blenkle et al. (2010) showed that free-swimming cod and sole both exhibited changes in swimming behavior in response to pile-driving sounds. Hawkins et al. (2014) found that schools of sprat were more likely to disperse, while mackerel were more likely to change water depth in response to pile-driving sounds. Despite different hearing anatomies, both species exhibited behavioral responses 50 percent of the time to sound levels at 163 dB re 1 µPa Lpk-pk, which could be expected tens of kilometers from the source (Hawkins et al. 2014). Iafrate et al. (2016) did not observe significant displacement in tagged grey snapper, a species with high site fidelity, residing within hundreds of meters of real pile-driving operations, while Krebs et al. (2016) observed that Atlantic sturgeon seemed to avoid certain areas when pile driving was taking place, suggesting that they would not remain in the area long enough to experience detrimental physiological effects. These field studies indicate that fishes may be startled, temporarily displaced, or change their schooling behaviors during pile-driving noise, but that when the sound is over, they are expected to resume normal behaviors relatively quickly.

Overall, the research thus far indicates that fishes will exhibit short-term behavioral or physiological responses to impulsive sounds like impact pile driving. Species with more sensitive hearing would be more susceptible to TTS and behavioral disturbance, and at greater distances, than those with less sensitive hearing. Aside from hearing anatomy, impacts are expected to differ between species based on other contextual factors, such as time of year or time of day. For example, impacts from noise would be greater if it occurs during spawning periods or within spawning habitat, particularly for species that are known to aggregate in specific locations to spawn, use sound to communicate, or spawn only once in their lifetime. Fish that avoid an area during pile driving are expected to return following completion of pile-driving activity.

Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not expected to experience barotrauma from pile driving. Very few studies have examined the effects of substrate vibrations from pile driving, yet many have recently acknowledged that this is a field of urgently needed research (Hawkins et al. 2021; Popper et al. 2022; Wale et al. 2021). Most of the research thus far has focused on water-borne particle motion, or even acoustic pressure, and is discussed briefly below.

Sessile marine invertebrates like bivalves are sensitive to substrate-borne vibrations and may be affected by pile driving noise (Day et al. 2017; Roberts et al. 2015; Spiga et al. 2016). A recent study by Jézéquel et al. (2022) exposed scallops to a real pile-driving event at distances of 26 to 164 feet (8 and 50 meters) from the pile. Measured peak particle acceleration was 110 dB re 1 $\mu m/s^2$ at the close site and 87 dB re 1 $\mu m/s^2$ at the farther site. Exposed scallops did not exhibit swimming behavior, an energetically expensive escape response. At the experimental site 26 feet (8 meters) from the pile, scallops increased valve closures during pile-driving noise and did not show any acclimatization to repeated sound exposure. However, they returned to their pre-exposure behaviors within 15 minutes after exposure. Increased time spent with closed valves could reduce feeding opportunities and thus have energetic consequences, though the biological consequences of this effect have not been studied.

Cephalopods can detect low-frequency sounds by sensing particle motion with their statocysts (Mooney et al. 2010), which, similar to the fish ear, act like three-dimensional accelerometers and could be injured from high sound exposures. Indeed, damage to cephalopod statocysts has been observed in several tank-based studies (André et al. 2011; Sole et al. 2022). Jones et al. (2020) observed alarm response behavior, such as inking and jetting, in longfin squid exposed to pile-driving noise at median peak particle velocities of 40 dB re 1 m/s within a tank. While their initial responses diminished quickly, after 24 hours, the squid were re-sensitized to the noise. A follow-up field study with small-scale pile driving looked at the behavior of the same species held in cages at different distances (26 and 164 feet [8 and 50 meters]) and found similar results: alarm behaviors occurred with the first acoustic stimulus but diminished quickly (within ~4 seconds). Responses were only observed in squid at the near site, suggesting alarm responses are not expected at greater distances from pile driving sound sources (Cones et al. 2022). Another tank experiment examined predatory feeding behavior of longfin squid (Jones et al. 2021). Within the tank, peak particle acceleration during the playbacks were 130 to 150 dB re 1 $\mu m/s^2$ (160–180 dB re 1 μPa Lpk), which the authors surmise is similar to field conditions within 0.3 miles (500 meters) of a 4.3-foot (1.3-meter) diameter steel pile. In the presence of pile-driving noise, there was a reduction in squid feeding success, and the introduction of pile-driving noise caused the squid to abandon predation attempts. Interestingly, additional work showed that interactions between males, and reproductive behaviors between males and females were unaffected by pile-driving noise, suggesting that the motivation to mate exceeds the potential stress that noise may introduce (BOEM-funded report, in press). This work underscores that squid (and possibly all cephalopods) are sensitive to low-frequency sound but may recover quickly. When pile-driving noise co-occurs with feeding periods, it could negatively affect feeding, but is not expected to affect reproductive success.

Like other marine invertebrates, crustaceans are capable of sensing low-frequency sound through particle motion in the water or in the substrate (Popper et al. 2001; Roberts and Breithaupt 2016). Most research on impacts of seismic airguns on crustaceans does not demonstrate widespread mortality, but physiological harm from seismic noise has been observed (e.g., American lobsters: Payne et al. 2007; rock lobsters: Day et al. 2016, 2019; spiny lobster: Fitzgibbon et al. 2017; snow crabs: Christian et al. 2003; Cote et al. 2020; Morris et al. 2020), though sub-lethal effects on hemolymph biochemistry observed in these studies could have biological consequences, including on nutrition and immunity, but have not been directly studied. Physio-morphological harm to sensory organs such as statocyst hairs in lobster exposed to seismic air gun noise has also been reported (Day et al. 2019). This damage was apparently permanent as improvement was not observed after 365 days. An observed consequence of damage to statocyst hairs was impairment of righting orientation behavior. In another recent study, in situ experiments exposing zooplankton communities to seismic airgun noise demonstrated significant declines in zooplankton abundance and mortality above unexposed mortality rates (McCauley et al. 2017). The findings of that study provide evidence that seismic surveys could negatively impact zooplankton communities.

Pile-driving sounds have been shown to affect certain behaviors in crustaceans, such as reducing locomotor activity (Norway lobster: Solan et al. 2016), decreasing feeding activity (crabs: Corbett 2018), or inhibiting attraction to chemical cues (hermit crabs: Roberts and Laidre 2019). The research thus far indicates that marine crustaceans may alter their natural behaviors in response to pile-driving sounds, but further work is required to understand the biological significance of these changes, and whether substrate-borne or water-borne particle motion has a greater influence on their behavior. Disentangling these effects is important for understanding the spatial scale at which they may be affected by pile-driving noise.

Pile-driving activities would largely be scheduled during summer when favorable weather conditions for construction are more common (BOEM 2021b). Summer-spawning species would be vulnerable to impacts from pile-driving noise. In general, noise from pile-driving activities could cause moderate effects on finfish, invertebrates, and EFH; these effects are expected to be short term and localized.

Cable laying from offshore wind activities would occur along up to 12,292 miles (19,782 kilometers) of export and interarray cable corridors (Appendix D, Table D.A2-1). Cable-laying activities that produce noise include trenching, jet plowing, backfilling, and cable protection installation. Noise levels from cable laying would be minor, and noise is expected to be temporary and local. No impacts on finfish, invertebrates, and EFH from noise generated by cable-laying activities are expected (BOEM 2021b). Cable-laying activities would continuously move, and areas would be exposed to cable-laying noise for relatively short periods.

Some planned offshore wind projects may encounter UXO within lease areas or along cable installation corridors requiring removal or relocation. Relocation of UXOs could be done by "lift-and-shift" methods. Removal of UXOs may require detonation which would generate high pressure levels that could injure or kill fish and invertebrates. Explosive detonations cause mortalities in fishes from injuries ranging from lacerations to body disintegration (Coker and Hollis 1950). Injuries involving the air bladder commonly occur (Coker and Hollis 1950). Larval fishes are also vulnerable to impulse sound from explosive detonations (Govoni et al. 2008). Impact distances of explosive detonations depend on impulse intensity and are shorter at the bottom than at surface waters (Govoni et al. 2008). Studies suggest that marine invertebrates are insensitive to explosions; however, those findings are disputed as the methods used in those studies have been deemed inadequate (Keevin et al. 1999; Keevin and Hempen 1997). Further research is needed to carefully evaluate the impacts of explosive detonations on invertebrates.

Adverse impacts on finfish, invertebrates, and EFH due to noise are anticipated to be negligible to minor, localized, and mostly short term. Intermittent maintenance activities would occur over the long term but are anticipated to be negligible.

**Presence of structures:** Construction of new underwater structures from offshore wind development presents a risk of entanglement and loss of fishing gear. Planned offshore structures include WTG foundations (e.g., monopiles, lattice, gravity-based) and their scour protection, meteorological towers, cable armoring, buoys, and pilings. Fishing gear potentially entangled or lost on these structures includes mesh from trawls or other similar nets, traps, and angling gear (e.g., fishing line, hooks, lures with hooks). Entangled nets and fishing line and lost traps may trap or ensnare marine organisms, leading to injury or mortality. Lost hooks, sometimes baited, and lures may be ingested by marine organisms, possibly causing harm. Impacts on finfish, invertebrates, and EFH from lost gear are considered short term and localized, but the risk of gear loss due to offshore wind structures is expected to be long term, persisting during the operational life of the wind farm (BOEM 2021b).

Offshore wind development may construct up to 2,810 WTGs and 56 OSSs/ESPs and met towers in the geographic analysis area (Appendix D, Tables D.A2-1 and D.A2-2). Hydrodynamics around offshore WEAs can be affected by modifications to wind-driven waves and currents, and there can be direct impacts on ocean currents from offshore wind structure foundations (van Berkel et al. 2020). Based on hydrodynamic modeling studies, the presence of offshore wind arrays could potentially disrupt water flow at a fine scale within the interarray area and immediately downstream, but flows would return to normal at short distances from the array (Miles et al. 2017; Cazenave et al. 2016). Increases in turbulent flow immediately around offshore wind structure foundations would combine with reductions in wind-driven mixing downstream of structures to dynamically affect the hydrodynamic field within the local periphery of wind farms (Christiansen et al. 2022; Dorrell et al. 2022; van Berkel et al. 2020; Carpenter et al. 2016). Disruptions to flow around foundation structures were modeled to extend from 65.6 to 164 feet (20 to 50 meters) downstream and are proportional to the diameter of the foundation (Miles et al. 2017; Cazenave et al. 2016). In a shelf-scale model based on offshore wind structures in the Irish Sea, a 5-percent reduction in peak water velocities was estimated for an array totaling 297 turbines (Cazenave et al. 2016). The reductions in peak velocities in that study were modeled to extend up to 0.5 nautical mile (1 kilometer) downstream of monopiles. Strong vertical mixing of the water column has been identified in studies on impacts of subsurface infrastructure on hydrodynamic flow (van Berkel et al. 2020). Variation in depth of the mixing layer may also impact distributions of larval assemblages in the water column (Chen et al. 2021).

Studies have found that subsurface infrastructure induces strong vertical mixing in the water column and hydrodynamic flow (van Berkel et al. 2020). Vertical mixing could result in changes to carbon and nutrient cycling and phytoplankton and overall production (Dorrell et al. 2022; Gill 2005). Wind wake effects of vertical structures also may result in retention of nutrients and higher phytoplankton production (Hemery et al. 2020). The initial increase in primary production may decrease light penetration, resulting in overall lower phytoplankton production (Hemery et al. 2020; Floeter et al. 2017). Disruptions in nutrient dynamics may directly affect feeding and aggregation behavior of planktivorous species such as giant manta ray (McCauley et al. 2012). Effects of offshore wind structures on lower trophic levels would potentially transfer up the food web with uncertain consequences. For example, impacts on some planktivorous species that are prey, such as Atlantic menhaden and herring species, could affect predators. Variation in mixing layer depth may also affect distributions of larval assemblages in the water column (Chen et al. 2021).

Altered hydrodynamics can also result in seabed scour and sediment suspension around structures, resulting in sediment plumes. Sediment plumes are typically observed in structures in shallow water and high-current velocity systems and are not expected to occur offshore. Impacts of offshore wind structures on hydrodynamics are anticipated to be long term, persisting for the life of structures.

In addition to the direct effects of underwater offshore wind structures, hydrodynamic flow would also be affected by above-water turbine-induced reductions in wind speed. Turbines are expected to generate a leeward wind speed deficit that could extend up to 25 miles (40 kilometers) downwind of wind farms, but the extent depends on the number of turbines and array configuration (Christiansen et al. 2022; Akhtar et al. 2021; Platis et al. 2020). The wind speed deficit area is known as a *wind wake*. The extent of a wind wake increases with atmospheric stability and has been observed to extend up to 44 miles (70 kilometers) downwind under stable conditions (Cañadillas et al. 2020; Djath et al. 2018). Wind wakes reduce sea surface wind stress, transferring atmospheric changes to hydrodynamics (Paskyabi 2015). Based on modelling by Christiansen et al. (2022), wind speed and wind stress up to almost 31 miles (50 kilometers) from wind farms. Wind speed and wind stress did not return to normal between wind farms that were up to approximately 12 miles (20 kilometers) apart in the North Sea. At the sea surface, wave energy is reduced (Bärfuss et al. 2021). Other hydrodynamic processes that would be affected include surface flow, surface layer mixing, bottom shear stress, and water column stratification (Christiansen et al. 2022; Daewel et al. 2022). The most consequential impact of wind wake effects is on water column stratification (Christiansen et al. 2022). Increased mixing of water masses (e.g., mixed-layer intrusion into the upper layer and vice-versa) could have severe impacts on ecosystem processes that depend on summer stratification (Christiansen et al. 2022; Daewel et al. 2022). Water column mixing during summer stratification would introduce bottom nutrients to upper layers, thereby potentially depleting bottom nutrients (Christiansen et al. 2022). Wind turbine wakes could change local primary productivity up to 10 percent and increase zooplankton production by 12 percent (Daewel et al. 2022). These changes would transfer up trophic levels with unknown, possibly negative, consequences

(Daewel et al. 2022). Daewel et al. (2022) also identified reductions in bottom-dissolved oxygen, where concentrations are already low, and advective bottom currents. The combined effects of reduced advective currents and changes to primary and secondary production from wind wakes may result in adverse impacts on larval fish dispersal and spatio-temporal overlap with ideal or required feeding conditions for survival (Daewel et al. 2011, 2022).

It Is uncertain if underwater structures would lead to increased mixing during summer when the stratification of the Mid-Atlantic Cold Pool is highest (Miles et al. 2021). Nonetheless, the stability of the Mid-Atlantic Cold Pool is still expected to be at risk during the spring formation and fall dissipation phases when stratification is weaker (Miles et al. 2021). Hypothesized hydrodynamic disturbances to the Mid-Atlantic Cold Pool include changes in biogeochemistry, biodiversity, and the quality and quantity of populations (Hemery et al. 2020). The Mid-Atlantic Cold Pool is an important hydrographic feature to the dispersal and survival of early life stages of many fish and invertebrates (BOEM 2021a). The Cold Pool has been described by Chen et al. (2018) and Lentz (2017), but its year-to-year dynamics are yet to be fully understood. Research on the potential disruptions to the Cold Pool from offshore wind structures is ongoing (BOEM 2021a). Stratification, the key feature of the Mid-Atlantic Cold Pool, could be weakened by both wind wakes (Djath et al. 2018; Paskyabi 2015) and underwater structures (Carpenter et al. 2016) where wind farms overlap areas of stratification. A modeling study investigating the impacts of offshore wind structures on large-scale stratification, the principal feature of the Cold Pool, in the North Sea did not find a significant reduction in stratification from small-scale installations (i.e., modeled wind farm length of 5 miles [8 kilometers]) (Carpenter et al. 2016). This study, however, found significant reductions in stratification from modeled large-sale installations (i.e., modeled wind farm length of 62 miles [100 kilometers]). Localized reductions in stratification were similarly found in a modeling study that scaled single foundation impacts on a realistic wind farm scenario in the Irish Sea (Cazenave et al. 2016).

Some fish populations in the geographic analysis area are dependent on the Mid-Atlantic Cold Pool including yellowtail flounder (Xu et al. 2016; Miller et al. 2016), winter flounder (Able et al. 2014), and Atlantic surfclam (Hofmann et al. 2018; Timbs et al. 2018; Sha et al. 2015). These populations are potentially vulnerable to changes in the natural dynamics of the Mid-Atlantic Cold Pool. Predicted warming sea temperatures in the geographic analysis area, a phenomenon that offshore wind aims to help alleviate, is expected to increase the long-term uncertainty associated with the dynamics and presence of the Mid-Atlantic Cold Pool (Miles et al. 2021).

The operation of wind turbines potentially may change thermic conditions below turbine hubs (Siedersleben et al. 2018). Potential increases in atmospheric temperature below turbine hubs, and cooling immediately above, were identified from models (Siedersleben et al. 2018). The below-hub temperature increase may extend over a 28-mile (45-kilometer) wake (Siedersleben et al. 2018). This temperature stratification in turn generates a "lid" that captures water vapor below hub height as observed in earlier studies (Siedersleben et al. 2018; Hasager et al. 2013). The potential atmospheric conditions associated with operation of wind turbines could affect water conditions and hydrodynamics with undetermined effects on finfish, invertebrates, and EFH.

The addition of offshore wind structures would convert soft-bottom habitat to complex structured habitat. This conversion would occur within the footprint of WTGs and along cable routes. Approximately 5,274 acres (2,134 hectares) of soft-bottom habitat would be converted to hard-bottom habitat due to foundation footprints plus hard scour protection that would be installed around the foundations, and an additional 2,700 acres (1,093 hectares) of hard protection would be installed around the export and interarray cables where target depths are not achieved (Appendix D, Table D.A2-2). While hard structures from offshore wind development may fragment or displace soft-bottom communities, particularly infaunal communities, soft-bottom habitat is the most extensive habitat in the Georges Bank, Southern New England, and Mid-Atlantic Bight subregions of the LME; therefore, the presence of offshore wind structures would not significantly reduce the availability of this habitat for finfish and invertebrates. Due to the low availability of complex structured habitat in the Southern New England and Mid-Atlantic Bight subregions of the LME, offshore wind structures and protective cable armoring would have an artificial reef effect by providing new habitat for communities associated with this habitat type (Glarou et al. 2020).

Once installed, offshore wind structures and associated armoring would be rapidly colonized by fouling communities (e.g., macroalgae, mussels, barnacles) and epifaunal succession would proceed (Degraer et al. 2020; Coolen et al. 2020; De Mesel et al. 2015). Aggregations of decapods, gobies (Gobiidae), and pelagic predators have been documented to follow the colonization of fouling communities at wind turbine foundations (Hutchison et al. 2020; Krone et al. 2017). The physical foundation structures would provide shelter and foraging opportunities for fishes (Mavraki et al. 2021; Degraer et al. 2020; Krone et al. 2017). Fish communities, especially species associated with complex habitat, such as black sea bass, would aggregate around offshore wind structures (Wilber et al. 2022b). Mid-water (i.e., pelagic) predators would also be attracted to the new structure provided by WTG foundations (Glarou et al. 2020), but evidence of predation on smaller fish aggregates may be lower at artificial complex habitat, including at WTG foundations, compared to natural complex habitat (Mavraki et al. 2021; Love et al. 2019). Lower predation pressure on artificial reefs could lead to higher production of prey species compared to natural reefs (Claisse et al. 2014).

Structures may cause a localized increase in overall biomass and diversity (Causon and Gill 2018), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). Changes in conversion of soft-bottom habitat to hard-bottom and associated changes in benthic invertebrate communities may indirectly impact Atlantic sturgeon that feed on benthic prey; however, research is needed to determine the overall impacts. Fish abundance and biomass would increase around WTG foundations and associated armoring (Wilber et al. 2022b; Mavraki et al. 2021; Reubens et al. 2014). The initial increase in fish abundance/biomass is presumably from attraction and thus, redistribution of existing nearby fish populations (Degraer et al. 2020; Hutchison et al. 2020; Reubens et al. 2014). Therefore, the initial local increases of fish abundance/biomass at WTG foundations are not a regional or population-level increase (Reubens et al. 2014). Reubens et al. (2014) discussed the system-scale theoretical outcomes of fish redistribution in relation to artificial reefs: (1) fish are redistributed leading to declines in fish at source locations; (2) fish move and show preference to artificial reef habitats where suboptimal growth and mortality conditions exist and there is a net system reduction in carrying capacity, and therefore, reduction in abundance/biomass; and (3) fish are initially redistributed from source locations to artificial reefs where enhanced growth and mortality conditions lead to a higher system carrying capacity and therefore higher regional/population-scale abundance/biomass. There is some evidence against theoretical outcome 2 for some demersal fish species from studies at the BIWF (Wilber et al. 2022a). Currently documented increases in fish abundance and/or biomass at artificial reefs and WTG foundations are considered local (Wilber et al. 2022b; Mavraki et al. 2021; Reubens et al. 2014) and further studies are needed to understand region-scale impacts (Mavraki et al. 2021; Hutchison et al. 2020). However, Stevens et al. (2019) have provided some evidence that, for some species, such as black sea bass, the addition of structures and associated complex habitat has the potential to increase regional carrying capacity, possibly supporting positive population-level outcomes.

Some invertebrate species may benefit from the addition of new hard substrate habitat introduced by offshore wind structures including cable armoring. As mentioned in this section, rapid colonization of fouling invertebrate organisms would occur at offshore wind structures. This colonization of early successional organisms may then be followed by colonization by later successional organisms (e.g., bivalves and cephalopods) that are commercially and/or ecologically important (Todd et al. 2020, 2021). Other commercially and/or ecologically important invertebrates such as crabs would also eventually colonize artificial structures (Page et al. 1999); however, such colonization would be from the redistribution of existing populations and could be considered a negative impact on the population level as explained in the previous paragraph.

Another element to consider regarding habitat change due to the presence of offshore wind structures is the risk of expanding structural habitat suitability for non-indigenous species (Kerckhof et al. 2011). Offshore wind structures have been documented to aid the spread of non-indigenous species in Europe and recently in the BIWF in the United States (De Mesel et al. 2015; Kerckhof et al. 2011). The idea that new habitat provided by offshore wind structures aids the spread of non-indigenous species, discussed by Kerckhof et al. (2011), has been described as a "stepping stone" effect, first mentioned by Reubens et al. (2014) then discussed in greater detail by De Mesel et al. (2015). Their studies, however, were focused on fouling invertebrate communities for which there are several examples of the "stepping-stone" effect. Offshore wind structures may also serve as "stepping stones" for the expansion of nonnative structure-oriented fish species (e.g., lionfish species). The distribution of invasive lionfishes in the U.S. Atlantic coastal waters has expanded from Florida to relatively recent observations in New England (Grieve et al. 2016). Much of the research regarding the expansion potential of lionfishes has focused on temperature habitat suitability and how cold temperatures at higher latitudes may be limiting northward expansion (Barker et al. 2018; Whitfield et al. 2014; Cerino et al. 2013; Kimball et al. 2004). While temperature tolerance limits may be slowing the northward expansion of lionfishes (Barker et al. 2018), the species is present at higher latitudes (Grieve et al. 2016). There is a clear spatial gap in lionfish distribution with few to no observations between the latitudes of the Chesapeake Bay mouth and Lower New York Bay (Grieve et al. 2016). Another factor possibly limiting the expansion of lionfishes is lack of suitable structural habitat (Bacheler et al. 2022). Bacheler et al. (2022) found that high-relief structure habitat is the most important factor influencing fish communities and abundance, including lionfishes. The coastal shelf habitat between the Chesapeake Bay mouth and Lower New York Bay lacks high-relief structure that would be introduced by offshore wind development, possibly allowing lionfishes to expand further. On shorter time scales, individual lionfish were found to range up to a maximum area of 0.15 square mile (0.38 square kilometers) (Green et al. 2021). Although the movement range of lionfish reported by Green et al. (2021) was higher than in previous reports by Bacheler et al. (2015), the movement range is relatively small considering the planned distances between offshore wind structures within and between projects. However, larval dispersal potentially would allow lionfish to expand over greater distances.

Fish aggregations at offshore wind structures are viewed favorably by recreational anglers (Ferguson et al. 2021; Smythe et al. 2021). However, under theoretical hypotheses 1 and 2 discussed by Reubens et al. (2014) and summarized in the previous paragraph, fishing pressure at wind structures would have negative consequences on exploited fish populations. In those scenarios, fish populations would be more vulnerable to fishing pressure, as they are simply more concentrated at a particular location, rather than more abundant at the regional scale. As such, fish aggregations at WTG foundations may in some cases result in adverse impacts on some finfish species. Offshore wind structures would be constructed along migratory fish pathways including for striped bass and Atlantic sturgeon (Rothermel et al. 2020). It is too early to evaluate the effect of offshore wind structures on fish and invertebrate movements and migrations (Sparling et al. 2020); however, there is some evidence that offshore wind structures may create stopover locations for migratory fishes (Rothermel et al. 2020). Stopover locations may benefit migrating fish by providing feeding opportunities but may also disrupt or slow migrations (Rothermel et al. 2020). These behavioral effects may affect the migrations of individual fish, but they are not expected to have broad impacts on migration. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migrations (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018).

Cumulative impacts of habitat conversion from presence of structures on finfish and invertebrates are expected to be local and long term, continuing for the life of structures. Presence of structures from offshore wind development would have minor to moderate impacts on finfish, invertebrates, and EFH. Current evidence suggests that these impacts could mostly be localized.

**Traffic:** Both sturgeon species and giant manta ray would be at risk to vessel strikes. Atlantic sturgeon are known to occur seasonally where project vessels would be operating during construction and operations and maintenance (Balazik et al. 2020). Vessel-related injuries and mortalities of sturgeon have been documented in the Delaware and Chesapeake Estuaries (Balazik et al. 2012a; Brown and Murphy 2010); therefore, offshore wind-related vessel traffic would increase vessel strike risk compared to existing vessel traffic. Furthermore, a recent study by Fox et al. (2020) provides evidence that sturgeon vessel mortalities are underreported and underestimated. Balazik et al. (2012b) tracked the vertical location of Atlantic sturgeon in the James River in Virginia and found that they may spend from 15 to 78 percent of the time in vessel draft depths within 33- to 83-hour tracking periods.

Giant manta ray occur offshore in shelf waters and may occur in the vicinity of the Offshore Project area during warmer months (Farmer et al. 2022) where they could be at risk to vessel strikes including from offshore wind construction and maintenance/operation vessels. Vessel strike injuries have been documented to occur on manta rays (Pate and Marshall 2020; McGregor et al. 2019). Giant manta ray spend more time near the surface, where they are vulnerable to vessel collisions in the April to June period (Stewart et al. 2016).

Other fish with documented vessel collisions include ocean sunfish (*Mola mola*) and sharks (Schoeman et al. 2020). Vessel collisions with these species are considered rare or occur locally (e.g., basking shark (*Cetorhinus maximus*) collisions in coastal United Kingdom waters). Schooling fishes such as clupeiforms (e.g., Atlantic herring, Atlantic menhaden) spend significant time near the water surface. These fish, however, tend to avoid vessel interactions by scattering or diving behavior (Misund and Aglen 1992).

Vessel traffic from planned offshore wind projects is expected to have minor impacts on finfish, invertebrates, and EFH.

### *Conclusions*

**Impacts of Alternative A – No Action.** Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and finfish, invertebrates, and EFH would continue to be affected by natural and human-caused IPFs including accidental releases and discharges, anchoring, cable emplacement and maintenance, EMF, anthropogenic lighting, noise, and presence of structures. Impacts of existing and ongoing activities are expected to range from **negligible to moderate**.

**Cumulative Impacts of Alternative A – No Action.** IPFs associated with ongoing and planned construction and installation, O&M, and decommissioning offshore wind development activities under the No Action Alternative are anticipated to range from negligible to moderate adverse and minor beneficial impacts on finfish, invertebrates, and EFH. Impact determinations for each IPF are provided in the following paragraphs.

Negligible adverse impacts are expected from discharges/intakes of ongoing activities associated with the No Action Alternative because impacts on species or habitats would be too small to be measured. Negligible to minor adverse impacts of ongoing activities associated with the No Action Alternative include accidental releases, anchoring, lighting, and noise because impacts from these IPFs would range from too small to be measured to loss of few individuals. Of these impacts, lighting would have long-term impacts while the others are expected to be short term and localized. Introduction of invasive species from accidental releases could potentially be permanent. Vessel traffic would have minor impacts because losses of some individuals are expected, particularly from vessel collisions with sturgeon.

Adverse impacts from EMF and cable heat, gear utilization, and presence of structures are anticipated to range from minor to moderate because impacts would result in loss of few fish and invertebrate individuals and unavoidable permanent changes to habitats but are not expected to result in population-level impacts. Cable emplacement activities would have moderate impacts on finfish, invertebrates, and EFH because of unavoidable losses of individuals and habitat disturbances but are expected to be short term. Cable maintenance activities would have minor adverse impacts because of loss of a few individual finfish and invertebrates. Adverse impacts from EMF and cable heat, cable maintenance, and presence of structures are expected to be localized and long term. Adverse impacts from gear utilization are expected to be localized, occurring at time scales ranging from short term to potentially permanent. The presence of structures may also result in **minor beneficial** impacts due to measurable increases in abundance for some invertebrate species, but not finfish species.

BOEM anticipates that cumulative impacts on finfish, invertebrates, and EFH as a result of ongoing and planned activities associated with the No Action Alternative are anticipated to be **moderate** because of short-term impacts due to cable emplacement activities and long-term impacts due to presence of structures that would not result in population-level effects.

#### 3.5.5.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Number of WTGs, OSSs, and met tower (200 WTGs maximum combined number from Projects 1 and 2, up to 10 OSSs, and 1 met tower).
- Total length of export, interlink, and interarray cables (441 miles [710 kilometers]/37 miles [60 kilometers]/ 547 miles [880 kilometers]).
- The route of the interarray cables and offshore export cable, including the ability to reach target burial depth and the cable protection measures that are used when target burial depth is not achieved. The length and location of the cable route would determine the total amount of temporary habitat alteration resulting from installation of the cables and the total amount of long-term habitat alteration caused by the placement of cable protection.
- The time of year when construction activities occur in relation to migrations and spawning for finfish and invertebrates.

Below is a summary of potential variances in impacts based on the variability of the proposed Project design:

- WTG foundation number, type, and size: The number, type, and size of WTG foundations affects the magnitude of several of most impactful IPFs on finfish, invertebrates, and EFH, including pile-driving noise and the presence of structures. Variability in foundation types (piled, suction bucket, and gravity) would influence the magnitude of underwater noise impacts associated with pile driving. More WTG foundations would result in a longer duration of pile driving, and larger WTG foundations would result in a larger ensonified area. More WTG foundations would result in greater impacts associated with the presence of structures, including risk of entanglement of commercial fishing gear, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbance.

- The time of the year during which construction occurs: Migratory finfish and invertebrates exhibit seasonal variation in migration patterns, such that certain species and life stages are present in the Project area at certain times of the year. Time of year during which construction occurs may influence the magnitude of impacts (e.g., noise) on these species.

Although some variation is expected in the design parameters, the assessment of impacts on finfish, invertebrates, and EFH in this section considers the maximum-case scenario.

#### 3.5.5.5 Impacts of Alternative B – Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

As described in Chapter 2, *Alternatives*, the Proposed Action includes the construction of up to 200 WTGs, 10 OSSs, and 1 met tower, and the installation of up to 547 miles (880 kilometers) of interarray cables, 37 miles (60 kilometers) of interlink cables, and 441 miles (710 kilometers) of export cables between 2025 and 2028. The Proposed Action also includes 30 years of O&M over a 30-year commercial lifespan and decommissioning activities at the end of commercial life. This section describes the primary IPFs of the Proposed Action that BOEM expects to affect finfish, invertebrates, and EFH.

##### *Onshore Activities and Facilities*

Onshore construction and installation, O&M, and decommissioning activities for the Proposed Action would not cause any IPFs for finfish, invertebrates, and EFH. Impacts on ESA-listed species are considered for relevant IPFs and are consistent with the fully evaluated impacts on ESA-listed species in the NMFS BA for the Proposed Action.

##### *Offshore Activities and Facilities*

**Accidental releases:** The construction and installation and decommissioning phases of the Proposed Action may increase the risk of accidental releases of fuels, fluids, hazardous materials, and invasive species from construction and installation activities. As described under the No Action Alternative, accidental releases of fuel, fluids, and hazardous materials can cause short-term, localized impacts on finfish, invertebrates, and EFH, including increased mortality, decreased fitness, and contamination of habitat. Furthermore, accidental releases during discharges of ballast water and bilge water from marine vessels can release invasive species into the aquatic environment, which may have permanent, widespread impacts on native finfish, invertebrates, and EFH (e.g., increased competition, habitat alteration) if invasive populations are able to establish. The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste, further reducing the likelihood of an accidental release. Atlantic Shores has developed an OSRP (COP Volume I, Appendix I-D; Atlantic Shores 2024) with measures to avoid accidental releases and a protocol to respond to such a release. Furthermore, Atlantic Shores would implement appropriate measures during HDD activities at export cable landfalls to minimize potential release of HDD fluid. Therefore, the risks of accidental releases are expected to be low.

Operation and maintenance activities of the Proposed Action, including O&M vessels, may increase the risk of accidental releases of fuels, fluids, hazardous materials, trash and debris, and invasive species. Impacts on finfish, invertebrates, and EFH from accidental releases are expected to be similar to those described for the construction and installation and decommissioning phases of the Proposed Action. Vessels used during O&M would be relatively smaller than the large installation vessels used during construction and installation, limiting the volume of discharges of ballast water and bilge water. As described for construction and installation, the Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste, and Project measures to avoid or limit accidental release would be adopted. Impacts due to accidental releases on finfish, invertebrates, and EFH are anticipated to be negligible.

**Anchoring:** The Proposed Action would result in increased anchoring from construction and installation and decommissioning vessels. Anchored vessels associated with the Proposed Action would disturb approximately 714 acres (289 hectares) of seafloor (Appendix D, Table D.A2-2). As described under the No Action Alternative, anchoring would cause several impacts on finfish, invertebrates, and EFH, including increased turbidity levels, mortality of finfish and invertebrates from physical contact with anchors and chains, and damage to or degradation of sensitive habitat in areas where anchors and chains meet the seafloor. However, the extent of all anchoring impacts would be minimal and localized. Impacts from increased turbidity and mortality from physical contact are expected to be short term, whereas impacts from damage to or degradation of sensitive habitats could be long term. Atlantic Shores would minimize anchoring impacts by establishing a seasonal work window that avoids installation and construction activities during periods when sensitive species and life stages would be present in the Project area, as feasible and in consultation with agencies. Additionally, Atlantic Shores proposes to minimize construction anchoring impacts by use of dynamic positioning systems or anchoring to midline buoys, thereby limiting the use of anchors and jack-up features, where feasible (GEO-02, GEO-03, FIN-04; Appendix G, Table G-1). Impacts due to anchoring on finfish, invertebrates, and EFH are anticipated to be negligible.

**Cable emplacement and maintenance:** The Proposed Action would involve the emplacement of up to 988 miles (1,590 kilometers) of export, interlink, and interarray cables. The maximum interarray configuration would involve up to 547 miles (880 kilometers) (Appendix D, Table D.A2-1). The export cable configuration would include up to 441 miles (710 kilometers) of cables. The emplacement of the export and interarray cables would result in a 576-acre (233-hectare) area of disturbance of seabed habitat. As described under the No Action Alternative, cable emplacement and maintenance activities would disturb or alter seafloor habitats and may disturb, displace, and injure or kill finfish and invertebrates; release sediment into the water column. The emplacement of interarray and interlink cables could disturb complex bottom habitat, but soft-bottom habitat predominates the WTA where cables would be installed (COP Volume II, Appendix II-J3; Atlantic Shores 2024). The southern three quarters of the Monmouth ECC are dominated by gravels, gravel mixes, and sandy gravels complex habitats.

Displacement may occur in mobile benthic species (e.g., American lobster, monkfish, winter flounder), whereas mortality may occur in immobile or slow-moving species and life stages (e.g., Atlantic surfclam, demersal eggs, squid egg mops). Disturbed communities may include prey for Atlantic sturgeon as discussed in Section 3.5.5.3, *Impacts of Alternative A – No Action on Finfish, Invertebrates, and Essential Fish Habitat*. Array and offshore export cables would be installed by jet plow (GEO-02, FIN-04; Appendix G, Table G-1), where possible, with alternative methods to include plowing and trenching. The use of jet plow requires withdrawal water from the water column, which can entrain finfish and invertebrates, including the ESA-listed Atlantic sturgeon (Reine et al. 2014).

Sediment disturbances from cable emplacement would cause increases in turbidity and sediment deposition along the interarray and export cable corridors. As described under the No Action Alternative, sediment deposition could have negative impacts on slow-moving and sessile species and early life stages (i.e., eggs and larvae) of finfish and invertebrates. Slow-moving species (e.g., horseshoe crabs, Jonah crabs, scallops, whelks) may not be able to escape the area of sediment deposition but are expected to uncover themselves during and after sedimentation. Sessile species are the most vulnerable to sediment deposition because of their inability to avoid affected areas, but these species often possess adaptations to high turbidity levels and sedimentation events, which occur periodically in soft-bottom habitats (Wilber et al. 2005). Sediment deposition may bury demersal eggs (e.g., Atlantic wolffish eggs, longfin squid egg mops, winter flounder eggs) and newly settled bivalve spat (e.g., American oyster spat), thereby causing sub-lethal effects or mortality. As discussed in Section 3.5.5.3, Atlantic sturgeon are not expected to be affected by sediment plumes (Wilkens et al. 2015). The Proposed Action is expected to abide to seasonal work restrictions from January to April in the offshore Project area to address impacts on NARWs, which could also benefit migrating sturgeon and spawning winter flounder and eggs. Atlantic sturgeon migrate from marine habitats to freshwater systems from late winter to early summer, entering river systems such as the Hudson River as early as April (Breece et al. 2021; Kazyak et al. 2020; Stein et al. 2004). Winter flounder spawning occurs in inshore waters from late winter to early spring (Pereira et al. 1999). Atlantic Shores is also expected to abide by a cable installation activity work restriction within nearshore environments from June 1 to September 1 to avoid impacts on sandbar shark nursery and pupping habitat (FIN-10; Appendix G, Table G-1).

Sediment transport and deposition modeling was conducted in the WTA and offshore export cable corridor for construction and installation activities (COP Volume II, Appendix II-J3; Atlantic Shores 2024). The models demonstrated that TSS concentrations would be influenced by bottom currents. For the Atlantic and Monmouth ECC pit excavations, sediment depositions would exceed 0.04 inch (1 millimeter) at distances up to 1,572 and 656 feet (479 and 200 meters), respectively. Modeled TSS concentrations from interarray and export cable corridors remained relatively close to corridor centerlines, constrained to the bottom water column, and short-lived with water column concentrations substantially dissipating within 2 to 4 hours and fully dissipating in less than 6 hours. Modeled maximum distances to the 0.04- and 0.4-inch (1- and 10-millimeter) thickness contours were 2,805 and 538 feet (855 and 164 meters), respectively. Based on the relatively small area over which sediment would be deposited and the small amount of affected soft-bottom habitat relative to that available regionally, sediment deposition is expected to have a localized, short-term impact on finfish, invertebrates, and

EFH, including species associated with complex reef habitat such as the Axel Carlson and Manasquan Inlet reefs (see Figure 3.6.1-13 in Section 3.6.1). Affected populations are expected to completely recover following construction and installation activities.

The Proposed Action would require the removal of some sand bedforms via “pre-sweeping” or dredging in 20 percent of export cable corridors and 10 percent of interarray cable corridors. These activities would create narrow troughs or flats in fields of sand waves, altering the seabed profile and potentially causing localized, short-term impacts on finfish, invertebrates, and EFH. As described under the No Action Alternative, sand ripples provide vertically structured habitat for finfish and invertebrates in an otherwise flat seascape. Sediment plumes from dredging sand ripples are expected to be redeposited in areas of similar sediment composition, and tidal and wind-forced bottom currents are expected to reform most ripple areas within days to weeks following disturbance. Although some sand ripples may not recover to the same height and width as pre-disturbance, the habitat function is expected to fully recover post-disturbance. The Atlantic City Reef area is located just outside the western edge of the WTA (Figure 3.5.5-2). BOEM expects that the impacts of seabed profile alterations on finfish, invertebrates, and EFH are expected to be localized and short term, dissipating over time as mobile sand waves fill in the altered seabed profile.

All impacts from cable emplacement are expected to be localized to the emplacement corridor. Impacts on finfish and invertebrates from turbidity and from displacement and mortality are expected to be short term. Impacts from habitat alteration are expected to be long term only in areas where cables are armored. Atlantic Shores has sited offshore export cable routes that would minimize overlap with sensitive benthic habitats, and cables would be further micro-sited along those routes to avoid boulders and other hard-bottom habitat to the extent feasible. Cable emplacement impacts would be further minimized by seasonal work window restrictions that avoid construction during periods when sensitive species and life stages would be present in the Project area, as feasible and in consultation with agencies; by using cable installation tools that minimize the area and duration of sediment suspension, as feasible; and by using HDD at the export cable landfall sites to minimize physical disturbance of coastal habitats. Given these avoidance and conservation measures, the probability of adverse interactions of cables with sensitive finfish, invertebrate, and EFH resources is low.

A temporary offshore platform may be placed on benthic habitat at landfall sites to a support HDD rig for installation of export cables. Installation of export cables at landfall sites would also require up to four 98.4- by 26.2-foot (30- by 8-meter) temporary cofferdams. Installation of cofferdams would result in direct disturbance to sandy bottom sediments. After initial injury, mortality, and/or displacement of organisms within the cofferdam footprint, the seabed and communities are expected to recover.

Maintenance of the export, interlink, and interarray cables could potentially disturb seafloor habitat. Seafloor disturbance during maintenance would be relatively minimal compared to disturbances from cable emplacement during construction and installation. Furthermore, cable maintenance would also be infrequent. Therefore, seafloor disturbances during maintenance would be considerably minimal compared to those during construction and installation.

Atlantic horseshoe crabs are an important invertebrate resource that is utilized in the medical industry (Tanacredi et al. 2009). The Delaware horseshoe spawning population is located in waters off Ocean City, Maryland, from where they migrate into Delaware Bay and adjacent coastal waters to spawn (Swan 2005). The Project WTA and ECCs do not overlap the protected Carl N. Shuster Jr. Horseshoe Crab Reserve. The northern end of the reserve is west of the WTA. However, horseshoe crab eggs may be present at the Atlantic City landfall and adjacent beaches. The spawning season of horseshoe crabs in the Mid-Atlantic Bight occurs from April to July with peaks in May and June (Smith et al. 2017). Horseshoe crab larvae occur close to shoreline habitats (Botton and Loveland 2003) so would potentially overlap the nearshore segments of ECCs where they are susceptible to cable emplacement impacts. Adults have been documented to migrate to distances over 62 miles (100 kilometers), though approximately 75 percent of adults travel distances no farther than 12 miles (20 kilometers) (Swan 2005). Adult and larval horseshoe crab are expected to overlap nearshore ECCs where impacts are anticipated to be minimal given that they are a mobile epifaunal species capable of burying within sediments. Horseshoe crab populations in the Mid-Atlantic Bight are considered stable, and the greatest threat remains commercial exploitation (Smith et al. 2017).

BOEM expects the impacts due to cable emplacement on finfish, invertebrates, and EFH to be moderate, while cable maintenance activities would have minor impacts.

**Discharges/intakes:** Increases in Project vessel discharges would occur during construction and installation, O&M, and decommissioning. As described under the No Action Alternative, certain discharges are required to comply with permitting standards that are established to minimize potential impacts on the environment. Discharge volumes from Project-related vessel activities would be relatively minimal considering that the Project would contribute 211 of the 3,215 planned offshore wind structures (7 percent) and 988 of 27,131 miles (4 percent) of planned cables (Appendix D, Tables D.A2-1 and D.A2-2). Atlantic Shores anticipates using closed-cycle cooling technologies for offshore OSSs, which do not require intakes and discharges.

Entrainment and impingement of finfish and invertebrates would not occur under either transmission option considered in the PDE. HVAC would not use non-contact cooling water. Atlantic Shores has indicated that if HVDC is used, it is anticipated that a closed-loop cooling system would be utilized, pending technical suitability and commercial availability of the technology (COP Volume I, Section 4.5.1; Atlantic Shores 2024). Entrainment and impingement of organisms may also occur during operation of cable-laying equipment along cable corridors during installation. Impacts from entrainment and impingement of finfish and invertebrates are anticipated to be negligible, mostly confined to cable centerlines, and short term.

**Electric and magnetic fields and cable heat:** The interarray and export cables that would be installed as part of the Proposed Action would generate EMF in the surrounding waters for the duration of the operational period. The Proposed Action would install up to 441 miles (710 kilometers) of 230–275 kV HVAC or 320–525 kV HVDC offshore export cables. Additionally, 547 miles (880 kilometers) of 66–150 kV HVAC interarray cables would be installed. Up to eight export cables would be required under the HVAC cable option while only two cables would be required under the HVDC cable option; five cables would be required if a mixture of cable options are used between Projects 1 and 2. EMFs from HVAC cables are emitted more efficiently into the marine environment than from HVDC cables (Gill et al. 2012b). Atlantic Shores modeled magnetic fields from potential cables operating at 60 Hz assuming use of shielding and burial and predicted source strengths ranging from 60.1 to 244.4 milliGauss (6,000 to 24,440 nanoTesla). Those source levels were predicted to decrease to 50 milliGauss (5,000 nanoTesla) at distances of just 1.7 to 2.8 feet (0.52 to 0.85 meter) from the cable (COP Volume II; Atlantic Shores 2024). The strength of this modeled magnetic flux field range is just below those generated by the earth's magnetic field ranging from 300 to 600 milliGauss (30,000 to 60,000 nanoTesla) (Gill et al. 2014). The modeled magnetic flux field range, however, is within or greater than those that have been found to affect some invertebrates (e.g., sea urchin larvae at 10 to 10,000 milliGauss [1,000 to 100,000 nanoTesla]) and fish (e.g., American eel at 50 milliGauss [5,000 nanoTesla]) (Gill et al. 2014).

As described under the No Action Alternative, adverse impacts of EMF on finfish and invertebrates have been documented in scientific literature. Behavioral and physiological impacts of EMF have been documented in benthic epifaunal and infaunal invertebrates and finfishes (Scott et al. 2018, 2021; Hutchison et al. 2018, 2020a, 2021; Scanlan et al. 2018; Ernst and Lohmann 2018). However, finfish responses to EMF have been mixed and contradictory, even within species (Minkoff et al. 2020; Scanlan et al. 2018). Current research on magnetic fields suggests that sturgeon behavior and migrations are not affected (McIntyre 2017; Klimley et al. 2017). Further research is needed to understand the mechanisms of EMF impacts and the large-scale or population-scale consequences of EMF (Hutchison et al. 2020b).

Heat emission would occur along the planned 1,025 miles (1,650 kilometers) of Project cables. Heat emission from above-sediment cables would be minimized by cooling from bottom water (BOEM 2023c) and mitigated by cable sheathing or armoring, or both. However, heat from buried cables may radiate at considerable distances relative to burial depths, depending on cable source heat and sediment substrate (Emeana et al. 2016). Based on controlled experiments, simulated buried cables emitted heat less than 6.6 feet (2 meters) for cable heat 66°F (19°C) (Emeana et al. 2016). At source heat 109°F (43°C) and higher, radiation distances approach 6.6 feet (2 meters) (Emeana et al. 2016). Alternating current cables emit higher heat than direct current cables (Taormina et al. 2018). Impacts of cable heat would mostly affect infaunal communities as heat quickly dissipates in the water column. Infaunal communities may also be vulnerable to changes in sediment chemistry caused by cable heat, including decreases in dissolved oxygen (Meißner and Sordyl 2006). Project cables would be buried to a target depth of 5 to 6.6 feet (1.5 to 2.0 meters) (GEO-07, FIN-03; Appendix G, Table G-1) where possible, providing some measure of mitigation depending on actual cable temperatures. Unburied cable segments are not expected to exceed 10 percent of interarray and 20 percent of export cable lengths. Cable protection options include rock placement, concrete mattresses, rock bags, grout-filled bags, or half-shell pipes (described further in Section 2.1.2, *Alternative B – Proposed Action*). Cable protection is expected to reduce the amount of cable heat that reaches the water via advection. Heat that reaches the water is expected to quickly dissipate (BOEM 2023c; Taormina et al. 2018). Additionally, Atlantic Shores would institute a cable monitoring system that would monitor if buried cable depth is sufficient and include acoustic sensing and monitoring of distributed temperature and discharge (OCE-05, PUB-13; Appendix G, Table G-1). Impacts from cable heat on finfish and invertebrates are expected to be negligible.

However, some species are known to be sensitive to increased temperatures. For example, the Atlantic surf clam adults may experience thermal stress at temperatures above 20°C and ingestion slows or stops at temperatures above 24°C (Zhang et al. 2016; Cargnelli et al. 1999). However, maximum growth of early juvenile surf clams occurs within the 20 to 24°C temperature range (Acquafredda et al. 2019). Thermal mortality in juveniles occurs at temperatures of 27°C and greater (Acquafredda et al. 2019). Under thermal stress, respiration rates continue to increase as temperature increases, while ingestion decreases, compromising condition and potentially leading to death (Narváez et al. 2015; Munroe et al. 2013; Freitas et al. 2009; Powell and Stanton 1985). Atlantic surf clam distributions have shifted northward and to deeper waters in response to rising sea temperatures due to climate change (Weinberg 2005; Kim and Powell 2004). Impacts due to EMF and cable heat on finfish, invertebrates, and EMF are anticipated to be minor to moderate and experienced for the life of the Project.

**Gear utilization:** Atlantic Shores would implement benthic monitoring surveys in the Offshore Project area to establish pre-construction baselines, measure Project-related impacts, and monitor recovery of habitats and biological communities (COP Volume II, Appendix II-H; Atlantic Shores 2024). Atlantic Shores has also proposed to implement fisheries monitoring surveys (COP Volume II, Appendix II-K; Atlantic Shores 2024). Benthic survey gear types include benthic grab samplers, multibeam echosounders, and underwater video cameras. Proposed fisheries survey gear types include clam dredges, demersal fish trawls, and fish pots.

As discussed in Section 3.5.5.3*,* underwater video surveys are not expected to produce significant, if any, adverse impacts on finfish and invertebrates or their habitats (Beisiegel et al. 2017; Mallet and Pelletier 2014). Multibeam echosounders may produce sound in frequency ranges detectable by fish, but studies on their impacts are lacking (Mooney et al. 2020). As discussed in Section 3.5.5.3, noticeable impacts on benthic fish and invertebrates and their benthic habitats are expected from use of benthic grab and towed (otter trawls and clam dredges) gears surveys during Project biological monitoring. The Atlantic Shores benthic grab survey program plans to collect 378 samples per year in the WTA and ECC area using a 0.43-square-foot (0.04-square-meter) standard sampler (e.g., Van Veen, Day, or Ponar) (COP Volume II, Appendix II-H; Atlantic Shores 2024). The proposed fish monitoring program currently under development by Atlantic Shores in coordination with state and federal agencies, would include use of otter trawls, hydraulic clam dredges, and fish trap, or "pot," surveys in the WTA only (COP Volume II, Appendix II-K; Atlantic Shores 2024). As discussed in Section 3.5.5.3, towed gears, such as otter trawls and dredges, would produce adverse impacts by removing benthic fauna and disturbing benthic habitats (Jennings et al. 2001, 2002; Collie et al. 2000; Kaiser et al. 2000).

ESA-listed species including Atlantic and shortnose sturgeon are also vulnerable to monitoring gears that may result in injury or mortality. Atlantic Shores proposes to conduct demersal fish trawl tows with tow speeds of 3 knots and for 20-minute durations (COP Volume II, Appendix II-K; Atlantic Shores 2024). Trawl size does not affect capture success of sturgeon while sturgeon are caught regularly in trawls towed at durations of 5 minutes (Moser et al. 2000). Bottom trawl tow durations were kept at 15 minutes or less and speeds of 3.0 to 3.5 knots to limit stress to Atlantic sturgeon catch and comply with a NMFS-issued Endangered Species permit during studies along the New York state coastal waters (Ingram et al. 2019; Melnychuk et al. 2017; Dunton et al. 2015). Sturgeon are hardy species and are expected to survive capture and handling during trawl monitoring surveys with tow durations of up to 5 minutes (Moser et al. 2000); however, handling time is a factor affecting survival (Beardsall et al. 2013; Davis 2002). Initial survival of Atlantic sturgeon following trawl capture is high and has been measured at 94 percent in two separate studies (Beardsall et al. 2013; Dunton et al. 2015). However, Beardsall et al. (2013) found that lactic acid levels in Atlantic sturgeon increase with handling time following trawl capture, indicating increasing physical exhaustion. Fish mortality generally increases with increasing lactic acid levels (Davis 2002). Latent effects from stress from handling and injury may occur weeks following release that may result in mortality not measured during initial release (Broadhurst et al. 2006; Davis 2002). Injury from capture could result from gear contact or from spines or shells from other species in catches (Broadhurst et al. 2006; Davis 2002; Bottari et al. 2003; Pranovi et al. 2001). High catch volume may also cause injury due to crush pressure (Mandelman and Farrington 2007a, 2007b; Broadhurst et al. 2006). Injury from high catch volumes depends on morphology, however, with torpedo-shaped fishes being generally less vulnerable (Pranovi et al. 2001). Cumulative effects from all these sources of stress and injury also affect trawl capture survival (Broadhurst et al. 2006). Taken together, injury of a few individual sturgeon can be expected from gear use during monitoring surveys.

Adverse impacts are expected from use of fish traps due to removal of fauna. Fish traps also directly disturb benthic habitats and epifauna (Schweitzer et al. 2018). Indirect impacts would also occur from resuspension of sediments during gear deployment and retrieval (Breimann et al. 2022; Palanques et al. 2022; Paradis et al. 2021; Pilskaln et al. 1998; Jones 1992; Churchill 1989).

Impacts from gear utilization on finfish, invertebrates, and EFH during biological monitoring are anticipated to range from minor to moderate.

**Lighting:** Vessel activity associated with construction and installation and decommissioning of the Proposed Action would increase nighttime ambient light in the Project area. Project vessels operating at night would be equipped with deck and safety lighting. As described under the No Action Alternative, artificial lighting could elicit temporary attraction, avoidance, or other behavioral responses in some finfish and invertebrates, potentially affecting distributions near the light source. Artificial lighting may also cause short-term disruptions of biological functions that are triggered by changes in daily and seasonal daylight cycles (e.g., spawning).

Maintenance vessels and operation of offshore structures associated with the Proposed Action would increase artificial light at night during the O&M phase. The Proposed Action would involve lighting up to 200 WTGs, 10 OSSs, and 1 met tower during the operation period. Atlantic Shores would use lighting on the WTGs and OSSs that complies with FAA and USCG standards and would follow BOEM best practices to minimize illumination of the water surface. Furthermore, Atlantic Shores has proposed the use of an ADLS to minimize the time that FAA-required lighting is illuminated on the offshore structures (BIR-05, BAT-03, VIS-05, CUL-05; Appendix G, Table G-1). Therefore, light generated by O&M activities of the Proposed Action is expected to have a negligible impact on finfish, invertebrates, and EFH.

**Noise:** Underwater sources of anthropogenic noise associated with construction and installation and decommissioning of the Proposed Action would include aircraft, G&G surveys, pile driving during construction, cable emplacement, and vessel operations. As described under the No Action Alternative, these noise sources may affect finfish and invertebrates by causing behavioral changes, PTS or TTS, injury, and mortality. Extended exposure to mid-level noise or brief exposure to extremely loud sound can cause a PTS, which leads to long-term loss of hearing sensitivity. Less-intense noise may cause a TTS, resulting in short-term, reversible loss of hearing acuity (Buehler et al. 2015). The potential impacts associated with each noise source are discussed separately in the following paragraphs.

Helicopters may be used to transport workers during construction and installation of the Proposed Action. Noise from helicopters may cause behavioral changes in finfish and invertebrates in the immediate vicinity of the noise source. However, helicopters transiting to and from the Project area would fly at sufficient altitudes to avoid behavioral effects except during take-off and landing. Any behavioral responses that occur during low-altitude flight would be temporary, dissipating once the aircraft leave the area, and are not expected to be biologically significant.

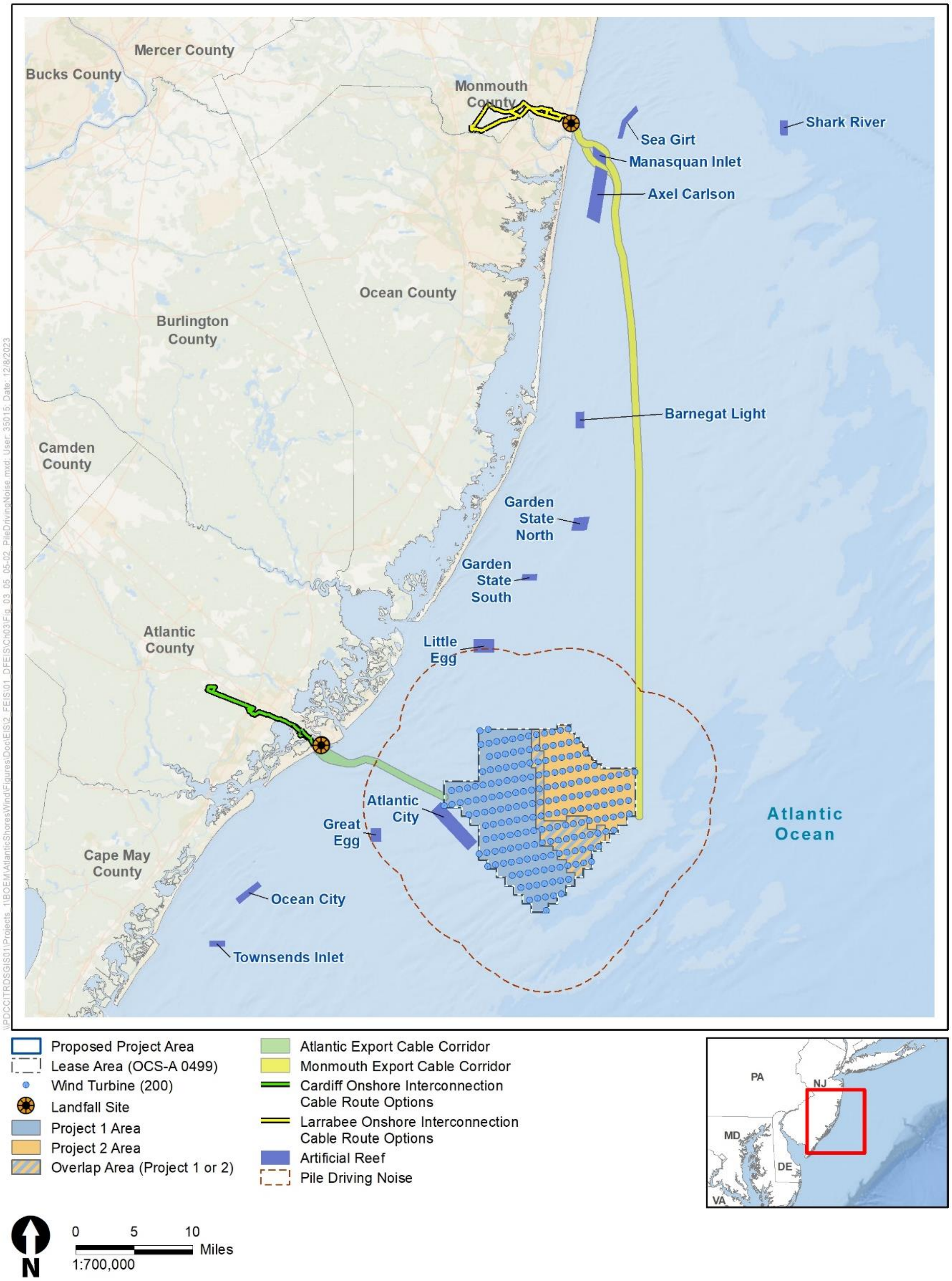
HRG surveys, a type of G&G survey, would be conducted prior to construction to support final engineering design and after cable emplacement to confirm burial of submarine export and interarray cables. The frequency range of the multibeam echosounder for these surveys has yet to be determined by Atlantic Shores (COP Volume II, Appendix II-H; Atlantic Shores 2024). As described under the No Action Alternative, G&G survey noise can disturb finfish and invertebrates in the immediate vicinity of the survey and can cause temporary behavioral changes. However, multibeam echosounders produce sound frequencies outside of the hearing range of ESA-listed fish (BOEM 2021c). Based on analyses in the Atlantic OCS, impacts from HRG survey multibeam echosounders are not expected to adversely affect fish species, including ESA-listed fish species such as Atlantic sturgeon (BOEM 2021c).

Another non-impulsive noise source that would be generated during construction activities of the Proposed Action is from dredging and cable emplacement activities. Dredging activities under the Proposed Action could include use of mechanical or hydraulic dredges, while cable laying would include trenching, jet plowing, and backfilling. Based on data from cable emplacement activities at European wind farms, noise levels would exceed 120 dB within an approximately 98,000-acre area (Nedwell and Howell 2004). These noise levels could cause temporary stress and behavioral responses in finfish and invertebrates but are not sufficient to cause injury or mortality.

The most substantial source of underwater noise associated with the Proposed Action would be impact pile driving during construction and installation. A total of 211 foundations are expected to be installed under the Proposed Action, each requiring a maximum of 7 to 9 hours of pile driving, which would occur over a maximum-case scenario of a total of 420 days (2 days per foundation assuming a single operating vessel and no daylight restrictions) over 3 years. As described under the No Action Alternative, the intense and impulsive noise generated by pile driving can cause injury or mortality to finfish and invertebrates over a small area around each pile and can cause temporary stress and behavioral changes over a larger area. The presence of potentially injurious noise would render EFH unavailable or unsuitable for the duration of the noise. Pile-driving noise could also result in reduced reproductive success while pile driving is occurring, particularly in species that spawn in aggregate. Fish with a swim bladder involved in hearing (e.g., herrings, gadids) are most susceptible to pile-driving noise while those without swim bladders (e.g., flatfish, rays, sharks) are least susceptible (Popper et al. 2014). An individual fish would be injured by pile-driving noise only if it remained near the pile during installation (NMFS 2015). Early life stages of finfish (i.e., eggs, larvae) and sessile invertebrates (i.e., longfin squid egg mops, ocean quahog, scallops, surfclam) are less sensitive to pile-driving noise but are more vulnerable because they are unable to move to avoid the noise. Surfclam, ocean quahog, and scallops may respond to the vibration and sound, including seismic noise, similarly to other bivalve species that have been observed to suddenly close their valves, "flinching," which inhibits feeding (Charifi et al. 2017; Day et al. 2017). Bivalve flinching response was induced at high energy sound (0.02 meters per second square at 122 $dB_{rms}$ re 1 micro-Pascal) in the 10 to less than 1,000 Hz frequency range (Charifi et al. 2017). The loss of foraging opportunity resulting from closed valves is expected to be a short-term, reversible, adverse impact on these species; once the disturbance ended, the bivalves would resume feeding. As mentioned in Section 3.5.5.3, sturgeon species have well developed ear structures and are able to hear in the 50 to 700 Hz sound range (Meyer et al. 2010) and possibly up to 1,000 Hz (Popper 2005).

As detailed in the Atlantic Shores Hydroacoustic Modeling Report (COP Volume II, Appendix II-L1; Atlantic Shores 2024), modeled unmitigated impact pile-driving noise during installation of 49-foot- (15-meter-) diameter steel monopile foundations were estimated to produce injurious and behavioral impacts over the greatest range; therefore, impacts in this section are reported under this scenario (COP Volume II, Appendix II-L1, Table 43; Atlantic Shores 2024). Acoustic radial distances ($R_{95\%}$) are the 95$^{th}$ percentile of ranges (based on modeling) at which the thresholds were expected to be exceeded. Based on unweighted sound pressure during modeled pile driving of 49-foot- (15-meter-) diameter steel monopiles with an unattenuated 4,400-kilojoule hammer, the maximum $R_{95\%}$ where behavioral impact thresholds were exceeded for all fish was 6.9 miles (11.2 kilometers) at the deep modeled location and 6.4 miles (10.2 kilometers) at the shallow modeled location. The maximum $R_{95\%}$ expected to cause injury to all fish from peak sound exposure was 0.27 mile (0.43 kilometer) at the deep modeled location and 0.31 mile (0.50 kilometer) at the shallow modeled location. Because of the relatively small footprint and short duration of injurious sound and the ability of most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause population-level impacts on fish. Affected fish species could include ESA-listed Atlantic sturgeon if present (see Section 3.5.5.1). Impacts of pile-driving noise on invertebrates, which are generally less sensitive to sound than fish, are expected to occur within a closer distance from the sound source.

The Great Egg and Atlantic City artificial reef areas fully overlap the 7-mile (11.3-kilometer) buffer zone around the WTA that is expected to experience behavioral effects for fishes based on modeled pile-driving sound associated with the proposed Project (see Figure 3.5.5-2). The Little Egg artificial reef area partially overlaps the pile driving noise impact zone. Fish and invertebrates within these artificial reef areas would experience behavioral effects discussed in Section 3.5.5.3. Behavioral responses to pile-driving noise include dispersal, diving, and habitat displacement. Consequences for these responses are not expected to be severe as normal behavior would resume following pile-driving activity.




Source: Atlantic Shores 2023, AKRF 2023.

**Figure 3.5.5-2. Artificial reefs adjacent to the Project area and the pile-driving noise impact zone**

Noise impacts from vibratory pile driving are expected at the Monmouth and Atlantic cable landing sites during cofferdam installation. Sound source levels from vibratory pile driving are expected to be comparatively lower than impact pile driving and therefore vibratory pile driving noise impacts are expected to be at a lower level.

Atlantic Shores would implement measures to avoid, minimize, and mitigate impacts of pile-driving noise on finfish and invertebrates, including using soft-start procedures and noise abatement systems, implementing time-of-day restrictions unless effective reduced-visibility monitoring equipment is available, and implementing seasonal work windows that avoid construction during periods when sensitive species and life stages would be present in the Project area. With these measures in place, injuries to fish and invertebrates are expected to be minimal. While some fish and invertebrates are expected to experience behavioral effects within the ensonified area, these effects are expected to be temporary, as behavior is expected to return to pre-construction levels following the completion of pile driving (Jones et al. 2020; Shelledy et al. 2018). Impacts from injurious sound are expected to be short term and localized. Overall, noise impacts due to impact pile driving on finfish, invertebrates, and EFH are expected to be minor.

Noise-producing activities associated with emplacement of 988 miles (1,590 kilometers) of export, interlink, and interarray cables as part of the Proposed Action may include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. Impact range distances to received noise levels that would induce 100 percent avoidance behavior in four species of fish (cod, dab, herring, and salmon) were modeled. These distances varied among the four species ranging up to 3 feet (≤1 meter) for trenching, from less than 3 to 26 feet (<1 to 8 meters) for cable laying, less than 3 to 20 feet (<1 to 6 meters) for cable protection installation, and from less than 3 to 7 feet (<1 to 2 meters) for cable-laying vessel noise (Nedwell et al. 2012). With regards to received noise levels that would generate a behavioral reaction in about 85 percent of fish, modeled ranges for the four species varied from 3 to 217 feet (1 to 66 meters) for cable laying, from less than 3 to 89 feet (<1 to 27 meters) for trenching, from 13 to 203 feet (4 to 62 meters) for cable protection installation, and from 3 to 118 feet (1 to 36 meters) for cable-laying vessel noise (Nedwell et al. 2012). These modeled noise level metrics do not indicate injurious consequences, but Nedwell et al. (2007) note that prolonged exposure to noise levels that would induce 100 percent avoidance may cause injury. Because the cable-laying vessel and equipment would be continually moving and the ensonified area would move with it, a given area would not be ensonified for more than a few hours. Therefore, any behavioral responses to cable-laying noise are expected to be short term and localized.

As many as 16 vessels would be in operation during construction and installation of the Proposed Action. Vessels generate low-frequency (mostly 10 to 500 Hz) (MMS 2007), non-impulsive noise that could cause temporary startle and stress responses in finfish and invertebrates. In an analysis conducted for the Cape Wind EIS (MMS 2009), the maximum perceived sound for finfish, based on information from earlier studies, was evaluated at 3 meters (10 feet) from source sound levels for tugboats and barges reported by Malme et al. (1989). This analysis calculated maximum received sound for finfish, including Atlantic salmon, “bass,” “cod,” and tautog, at 3 meters (10 feet) from the source to be well below harassment and injury thresholds used at the time and may be just above the avoidance thresholds. Therefore, potential Project vessel sound levels would not be expected to cause harassment or physical harm to finfish but would cause avoidance (MMS 2009). Vessel-related noise is expected to affect hearing in sensitive, pelagic species, such as Atlantic herring and Atlantic mackerel, but these highly mobile species are capable of swimming away from the noise source. Vessel noise may result in brief periods of exposure near the surface of the water column but is not expected to cause injury, hearing impairment, or long-term masking of biologically relevant cues in finfish and invertebrates. Consistent with this, BOEM determined that adverse impacts on finfish and invertebrates from noise generated by vessel transit and operations are not expected (BOEM 2018).

Noise during the O&M period of the Proposed Action would occur during maintenance activities and operation of WTGs. Behavioral and physical impacts of noise on finfish and invertebrates are expected to be similar to what was identified for construction and installation and decommissioning.

Helicopter and vessel transport of personnel to offshore structures from the Proposed Action would be necessary for inspections and maintenance. Impacts from helicopter- and vessel-related noise on finfish and invertebrates are expected to be similar to what was identified for construction and installation and decommissioning. Helicopter and vessel transportation would be greatly reduced and infrequent during the O&M period, however.

Operating WTGs generate non-impulsive, underwater noise that is audible to some finfish and invertebrates. Available measurements of operational noise from WTGs of sizes ranging from 0.2 to 6.15 MW were evaluated in a study by Tougaard et al. (2020). Normalizing these measurements to 328 feet (100 meters) from WTGs and to a wind speed of 33 feet (10 meters) per second, produced estimated root-mean-square SPL below 120 dB re 1 micropascal in the 25 to 1,000 Hz frequency band for a single operating turbine generating 6.15 MW or less (Tougaard et al. 2020). The proposed 10 MW WTG installations are larger than the largest included in the calculations by Tougaard et al. (2020). Noise levels associated with operating WTGs are expected to decrease to ambient levels within a relatively short distance from the turbine foundations (Thomsen et al. 2015). Based on the studies in this discussion, expected sound levels from the Proposed Action that are potentially harmful to finfish would be restricted to a very small area around each monopile. Affected species may include ESA-listed Atlantic sturgeon. Sensitivity thresholds have not been established for most species of invertebrates, but their lack of a gas-filled structure associated with hearing suggests that their sensitivity to noise may be similar to that of fish without swim bladders. As the best available data indicate noise levels produced by operating WTGs would be below fish behavior and injury thresholds, noise from operating WTGs is not expected to produce impacts on finfish and invertebrates. However, if the larger WTGs installed for the Proposed Action produce sound levels that exceed these thresholds, WTG noise may result in minor impacts on finfish and invertebrates.

Atlantic Shores would plan to avoid UXOs/MECs during construction if any are identified. If avoidance is not possible, Atlantic Shores would adhere to the U.S. Committee on the Marine Transportation System Proposed National Guidance for Industry on Responding to Munitions and Explosives of Concern in U.S. Federal Waters (2023) for removal of any UXOs/MECs. Removal of explosives may involve detonation which would cause harm to individual finfish and invertebrates near the detonation site as described in Section 3.5.5.3.

**Presence of structures:** The Proposed Action would include construction of up to 200 WTGs, 10 OSSs, and 1 met tower that would include installation of up to 268 acres (108 hectares) of hard scour protection around the foundations and up to 595 acres (241 hectares) of hard cable protection around the export and interarray cables (Appendix D, Table D.A2-2). WTGs would be positioned in a uniform grid aligned in rows oriented in an east-northeast to west-southwest direction spaced 1.0 nautical mile (1.9 kilometers) apart. WTGs within each row would be positioned 0.6 nautical mile (1.1 kilometers) apart (Figure 2.1-1). The OSSs and met tower would be positioned outside of the WTG grid but within the Lease Area. As described under the No Action Alternative, the presence of structures can affect finfish, invertebrates, and EFH through entanglement of fishing gear, resulting in lost gear, hydrodynamic disturbance, fish aggregation, habitat conversion, and increased migration disturbances. Each of these potential impacts is addressed separately in the following paragraphs. In addition to these impacts, seabed preparation may be needed at some WTG positions prior to pile-driving installation. The WTG positions would be positioned to avoid needing seabed preparation. Seabed preparation methods could involve use of trailing suction hopper dredging, jetting/controlled flow excavation, or backhoe/dipper removal. The seabed disturbance and turbidity plume impacts of seabed preparation would be similar to those discussed under *Cable emplacement and maintenance* IPF, but would be drastically less adverse.

The Proposed Action would install up to 289 acres (117 hectares) of hard scour protection around the WTG foundations, OSSs, and met tower. Additional hard structure may be installed for cable protection where cable burial is not feasible (see Section 2.1.2.1 for cable protection options). For example, cable burial target depth may not be achievable where Project cables intersect existing cable near the Atlantic City, New Jersey, landfall site. Project cables at these intersections may not be buried and would require above-seafloor cable protection (Section 2.1.2.1 in Chapter 2). Commercial and recreational fishing vessels that deploy gear over these structures, particularly trawls and dredges, would be at risk of entanglement and loss of fishing gear. As described under the No Action Alternative, lost fishing gear, carried by ocean currents, can result in the ensnarement, injury, or mortality of finfish and invertebrates and can result in the short-term alteration of benthic habitat. Impacts of lost gear on finfish, invertebrates, and EFH are expected be short term and localized, but the increased risk of gear loss is expected to occur in the long term, persisting as long as the structures remain.

The tall, vertical foundations that would be installed for each of the 200 WTGs as part of the Proposed Action would cause continuous, fine-scale hydrodynamic disturbances. As described under the No Action Alternative, the placement of offshore WTG foundations can alter downstream flows and resulting larval dispersal patterns (Chen et al. 2016), but flows are expected to return to background levels 8 to 10 pile diameters downstream of the foundation (Miles et al. 2017). This indicates that background conditions would exist 394 to 492 feet (120 to 150 meters) downstream of the largest monopile foundations that are being considered as part of the Proposed Action. Given the small scale at which hydrological changes from the Proposed Action would occur, impacts on finfish and invertebrates are expected to be negligible. As described under the No Action Alternative, hydrodynamic disturbances from offshore wind structures may also affect the Mid-Atlantic Cold Pool, a region of seasonally stratified water that is important to the dispersal and survival of early life stages of many fish and invertebrates (BOEM 2021a). Offshore wind structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). Changes in Cold Pool dynamics resulting from the Proposed Action could potentially cause changes in habitat suitability and fish community structure, but the extent of these potential impacts is uncertain. Any impacts from hydrodynamic disturbances are expected to be long term, persisting as long as the WTG foundations are in place. Modeling studies in the North Sea suggest that wind wake impacts could extend horizontally at a scale of up to 43.5 miles (70 kilometers). However, further research is needed to evaluate the consequences of these wind impacts on hydrodynamics and regional-scale ecological processes.

As described in Section 3.5.5.3, local hydrodynamic disturbances could also be induced by wind wakes from turbines (Christiansen et al. 2022; Akhtar et al. 2021; Platis et al. 2020). Hydrodynamic disturbances of wind wakes reduce intensity of surface waves, advective transport, and stratification, which would lead to changes in primary and secondary production that would transfer up to higher trophic levels (Christiansen et al. 2022; Daewel et al. 2022; Barfuss et al. 2021; Paskyabi 2015). Changes to current flow and advective transport could also have consequences on larval transport and survival (Daewel et al. 2011, 2022).

The installation of WTG foundations, OSSs, met tower, scour protection, and cable protection as part of the Proposed Action would create 504.3 acres (204.1 hectares) of structurally complex, hard-bottom habitat in an otherwise flat and sandy seascape, including sand wave and ridge and swale sensitive habitats. Because hard-bottom and three-dimensional structures in the Project area are currently limited to shipwrecks and artificial reefs, some structure-oriented finfish and invertebrates are expected to aggregate around this new hard-bottom habitat (Guida et al. 2017). Artificial reefs in New Jersey and New York coastal waters have been observed to attract numerous species of finfish and invertebrates, including American lobster, Atlantic cod, black sea bass, scup, summer flounder, tautog, and several species of crab (Wilber et al. 2022b; Hutchison et al. 2020; NJDEP 2019); these same species are expected to be attracted to the hard-bottom habitat created as part of the Proposed Action. A recent meta-analysis of the effect of wind farms on fish abundance concluded that effects are positive, indicating that more fish occur within wind farms than at nearby reference locations (Methratta and Dardick 2019). However, based on the discussion for the No Action Alternative, higher abundance or biomass at wind farms does not indicate increases in overall system or population-level abundance or biomass. The redistribution of fish to wind farms may have an overall negative effect on a system or fish population under some hypothesized scenarios discussed in Section 3.5.5.3 (Reubens et al. 2014). As discussed for the No Action Alternative, there is some evidence to support that the addition of complex habitat to mid-Atlantic shelf waters would potentially increase the carrying capacity of an area for some species such as black sea bass (Stevens et al. 2019). Further studies are needed to evaluate if offshore wind structures could be beneficial at the regional or population level (Mavraki et al. 2021; Hutchison et al. 2020). The effects of fish aggregation near structures are expected to be localized and long term and may be adverse or neutral on finfish and invertebrate populations, as the dynamics of predation and fishing would vary by location.

The Proposed Action would result in the conversion of approximately 504.3 acres (204.1 hectares) of primarily soft-bottom habitat to hard-bottom habitat. Although conversion of soft-bottom habitat would result in the displacement of soft-bottom species (e.g., Atlantic surfclam, squid, winter flounder), soft-bottom habitat is the dominant habitat type in the geographic analysis area, and species that rely on this habitat are not expected to experience population-level impacts from habitat conversion (Guida et al. 2017; Greene et al. 2010). Underwater portions of foundations would be colonized by encrusting and attaching organisms, creating an array of biogenic artificial reefs (Mavraki et al. 2021; Degraer et al. 2020; Degraer et al. 2018; Hooper et al. 2017a, 2017b; Griffin et al. 2016; Fayram and de Risi 2007). The assemblage of species that colonizes each WTG, OSS, or met tower foundation would be influenced not only by the amount of surface area but also by the seasonal availability of larval recruits immediately following installation. Therefore, the pattern of colonization and succession would vary throughout the Project area, especially during the early years (Krone et al. 2013, 2017). The area surrounding each WTG foundation would accumulate remains of attached organisms, which may provide essential habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Krone et al. 2017; Coates et al. 2013; Goddard and Love 2008). The colonization of these structures may cause a localized increase in biomass and diversity (Causon and Gill 2018; Reubens et al. 2014; Krone et al. 2013), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by fewer species (Kerckhof et al. 2019). As mentioned for the No Action Alternative, some invertebrate species may benefit from the presence of structures (Todd et al. 2021; Page et al. 1999). Colonizing organisms, including fishes, may include non-indigenous species (Kerckhof et al. 2011). Impacts of habitat conversion on finfish and invertebrates are expected to be localized and long term, continuing as long as the structures remain. Colonization by non-indigenous species may be permanent.

The 504.3 acres (204.1 hectares) of hard-bottom habitat created by the WTG foundations, OSSs, met tower, scour protection around foundations, and cable protection as part of the Proposed Action may provide forage and refuge for some migratory finfish and shellfish, such as black sea bass, longfin squid, monkfish, and summer flounder. The WTG foundations may also attract highly migratory fishes (NOAA Fisheries 2017); mahi-mahi and some tuna (e.g., yellowfin, bigeye) and sharks (e.g., dusky, whitetip, shortfin mako, common thresher) may be attracted by the abundant prey (Itano and Holland 2000; Wilhelmsson and Langhamer 2014) or use the structures as navigational landmarks (Taormina et al. 2018). These behavioral effects may affect the migrations of individual fish, but the consequences are not yet known. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migrations (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018).

Impacts due to noise on finfish, invertebrates, and EFH are anticipated to be minor**.**

**Traffic:** Both sturgeon species and giant manta ray would be at risk to vessel strikes from Project-related vessel activity. The maximum number of vessels expected to operate at any given time during construction would range from 2 to 16. Up to 20 round trips each to the Portsmouth Marine Terminal in

Norfolk, Virginia, near the mouth of the James River, and the Repauno port in New Jersey within the Delaware Estuary are planned during the construction phase, and one trip per year is planned during operation. Atlantic sturgeon are known to occur or transit this vessel route (Balazik et al. 2020). Both sturgeon species occur in the Delaware Estuary where up to 1,390 round trips are planned during construction and up to 35 are planned during operation (see Section 3.6.6). Sturgeon species are particularly vulnerable in the estuarine environment where collisions are more likely due to less separation space compared to the offshore environment. During the O&M phase of the Project, an estimated 1,861 vessel round trips are expected to occur annually between the Lease Area and the ports in Virginia and New Jersey. This amount of vessel traffic represents a 91 percent increase compared to existing vessel traffic. Vessel-related injuries and mortalities of sturgeon have been documented in the Delaware and Chesapeake Estuaries especially during spring-summer spawning migrations (Balazik et al. 2012a; Brown and Murphy 2010); therefore, Project-related vessel traffic would result in increased risks for vessel collisions compared to existing vessel traffic.

Giant manta ray occur offshore in shelf waters and may occur in the vicinity of the Offshore Project area during warmer months (Farmer et al. 2022) where they could be at risk to vessel strikes including from Project vessels. Vessel strike injuries have been documented to occur on manta rays (Pate and Marshall 2020; McGregor et al. 2019).

Impacts due to traffic on finfish are expected to be minor.

### *Impacts of the Connected Action*

As described in Chapter 2, improvements to the existing marine infrastructure within an approximate 20.6-acre (8.3-hectare) site at the Atlantic City, New Jersey, Inlet Marina are planned in connection with construction of the O&M facility and potentially an associated parking structure of the Proposed Action. The connected action includes construction of a new 541-foot (165-meter) bulkhead composed of corrugated steel sheet pile to replace the existing and deteriorating 250-foot (76-meter) bulkhead. The proposed design for new shoreline structures consists of three floating docks, 9.0 feet (2.7 meters) wide and extending 92.7 feet (28.3 meters) from the shoreline. Each floating dock will be equipped with a 37.0-foot (11.3-meter) gangway and stabilized by two 4.0-foot (1.2-meter) diameter steel piles. This dock area will also include 16 dolphin structures each with seven 1.0-foot (0.3-meter) timber clusters.[2]

The connected action would include maintenance dredging at Farley's Marina Fuel and Clam Creek and would co-occur with maintenance dredging for Atlantic City in portions of the Federal Channel leading into the Inlet Marina and most of the inlet area to reestablish a channel depth of 15 feet (4.6 meters) below the plane of Mean Low Water plus 1.0 foot (0.3 meter) of allowable overdredge. The estimated dredge volumes would be up to 20,113 cubic yards (15,378 cubic meters) at Farley's Marina Fuel and up to 122,710 cubic yards (93,818 cubic meters) from Clam Creek. Dredging would be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. The volume of dredge material from

[2] The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the approved USACE Nationwide Permit 13.

the connected action would be combined with dredge material from Atlantic City's complete maintenance dredging project. The combined volume of dredge material is estimated at 597,761 cubic yards (457,021 cubic meters) and would be disposed at three proposed locations: (1) DH #86 site, a 14.4-acre (5.8-hectare) subaqueous borrow pit restoration site within Beach Thorofare and owned by the New Jersey Department of Transportation Office of Maritime Resources; (2) Tuckahoe Turf Farm upland site in Estell Manor, New Jersey; and 3) Kinsley's Landfill upland site in Sewell, New Jersey. Placement of the dredged material at the proposed DH #86 site is contingent on a use agreement between the City of Atlantic City and the Office of Maritime Resources. Atlantic Shores is proposing to implement the construction of the new bulkhead and the City of Atlantic City would complete the maintenance dredging at the site.

Finfish and invertebrate communities in the nearshore environment of the connected action are expected to be similar to the communities described in Section 3.5.5.1. Some offshore species are less likely to be found near shore (e.g., tunas). The affected area of the connected action is EFH for 21 species (Atlantic Shores 2024). Additionally, HAPC for sandbar shark and summer flounder (SAV) overlaps the connected action footprint. BOEM expects the connected action to affect finfish, invertebrates, and EFH through the following primary IPFs.

**Accidental releases:** Risks of accidental release of fuels/fluids/hazardous materials, and trash and debris are possible during construction and installation and O&M activities associated with the connected action. BOEM assumes that construction vessels would comply with laws and regulations to properly dispose of marine debris and minimize accidental releases of fuels/fluids/hazardous materials. The relative contribution of the risks of accidental releases associated with the connected action is minimal compared to risks under the No Action and Proposed Action alternatives and therefore is anticipated to be negligible.

**Anchoring:** Activities associated with the connected action may require vessels to anchor near the Inlet Marina or within Beach Thorofare. Anchor/chain disturbances to bottom sediments could injure or kill invertebrates and early life stages or fish, damage habitats, and resuspend sediments. Damage to bottom habitats is expected to be temporary if they occur to soft-bottom habitats and long term if complex hard habitat is damaged. Losses of organisms due to mortality would be limited to the area that is contacted by anchors/chains. Such loss would be relatively minimal compared to the amount of available habitat to organisms. Resuspended sediments would be dispersed via tidal currents and could bury benthic organisms or eggs. Impacts of anchoring from the connected action are expected to be negligible.

**Discharges/intakes:** At least three vessels (dredge vessel, tug, and scow) would be required to conduct dredging activities associated with the connected action. Vessel traffic associated with construction activities for the connected action would not be permanent. Furthermore, use of Inlet Marina following construction would not result in a net increase in commercial vessel traffic and is not expected to exceed an increase of two non-commercial vessels. All vessels associated with the connected action are expected to comply with environmental permitting standards for discharged materials and impacts are expected to be negligible.

**Noise:** Activities associated with the connected action would generate noise from the operation of construction vessels and pile driving. Construction vessels would include at least three vessel types (dredge vessel, tug, and scow) during a temporary construction window.

The connected action would include the Installation of sheet piles for construction of the new bulkhead via impact and/or vibratory pile driving. Impact pile driving may be required for installing each of the six 4.0-foot (1.2-meter) steel piles and 112 1.0-foot (0.3-meter) timber piles. The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the approved permit. These activities would generate noise that potentially affects finfish and invertebrates by causing behavioral changes, PTS or TTS, injury, and mortality. Some organisms that are likely to be found in the nearshore environment (e.g., longfin inshore squid) have been shown to be resilient to pile-driving noise. For example, the spawning behavior of longfin inshore squid was shown to be unaffected by pile-driving noise (Jones et al. 2023).

Construction vessel activity would also generate noise during connected action activities. Vessels associated with the connected action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in finfish and invertebrates. For example, foraging and predator avoidance was reduced in shore crabs under playback sounds mimicking vessel noise (Wale et al. 2013). Blue crabs were shown to experience reductions in olfactory sensitivity and masking in hearing (Solé et al. 2023). The presence of winter flounder larvae is possible near the connected action area. Negative impacts in the feeding of larval winter flounder were demonstrated in response to simulated boat noise playback (Gendron et al. 2020). Impacts of vessel noise on individual finfish and invertebrates are expected to be minor, temporary, and localized. The volume of construction vessel traffic is expected to be small and occur during a limited number of days.

**Presence of structures:** Minimal impacts on finfish and invertebrates are expected due to presence of structures from construction of the connected action. The connected action includes construction of a new bulkhead, 16 seven-timber pile dolphins, and 6 steel piles to support an overwater floating dock.[3]

The existing bulkhead already provides hard substrate that provides habitat for associated finfish and invertebrate communities (e.g., oysters and crabs). Some species with demersal life stages (e.g., winter flounder and longfin inshore squid eggs) could lose habitat area. Winter flounder eggs are deposited on soft or heterogeneous habitats from November through April (Ziegler et al. 2018; Pereira et al. 1999). Longfin inshore squid also deposit eggs on the bottom, except that they require hard bottom substrate from late spring through early summer (Jacobson 2005). The installation of piles could also experience reef effects that are discussed in Sections 3.5.5.3 and 3.5.5.5. These impacts are expected to be negligible due to the relatively minimal loss of existing habitat.

[3] The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the approved permit.

The presence of the floating dock may have similar shading effects on finfish and invertebrates to those experienced by shading from piers. Fish communities under piers in estuarine systems tend to be different than natural or communities outside of the pier shadow (Able and Duffy-Anderson 2010). Common fish species under piers are usually those that do not rely on visual feeding (e.g., American eel, naked goby [*Gobiosoma bosc*]). Further, feeding and growth are adversely affected under piers for fish species that rely on vision for feeding despite adequate abundances of prey (Able and Duffy-Anderson 2010). However, these results are from the lower Hudson River where overwater structures are considerably larger than the proposed floating docks of the connected action. The impacts due to the overwater shading effects from floating docks are therefore expected to be negligible.

**Port utilization:** Dredging and dredge material management from the connected action may affect finfish, invertebrates, and EFH through mortality, direct disturbance and modification of bottom habitat, and sediment suspension and deposition. Demersal and pelagic fish and invertebrates are expected to avoid the dredge, but benthic invertebrates and fish with benthic life stages (e.g., eggs, larvae) may be captured by the dredge, possibly resulting in mortality. The potential loss of individual fish and invertebrates due to mortality from dredging is not expected to cause population-level effects on any species. BOEM expects that permit requirements for dredging activities would adhere to restrictions and regulations intended to minimize disturbances or protect species of concern; however, critical habitats for spawning, overwintering, or areas of dense aggregations are not present within the connected action area.

Dredging activity associated with the connected action would disturb sediments releasing them into the water column. Resuspended sediments would drift or disperse to other locations before resettling, including areas of complex-bottom structure and EFH habitats. Resuspended sediments may contain chemical contaminants. Mechanical dredging could resuspend sediments at concentrations up to 445 mg/L above ambient concentrations (NMFS 2022). Elevated suspended sediment conditions are expected to be temporary, and most fish and invertebrates are capable of mediating temporary increases in suspended sediment by expelling filtered sediments or reducing filtration rates (Bergstrom et al. 2013; Clarke and Wilber 2000). Further, the use of cofferdams or turbidity curtains to minimize the dispersal of sediments is proposed. Redeposition of disturbed sediments may temporarily or permanently alter nearby complex hard-bottom habitats and may bury organisms. In response to moderate sediment deposition, mobile fishes and crustaceans may actively avoid areas of deposition. However, some demersal eggs and larvae, including winter flounder and inshore longfin squid eggs, could be buried by suspended sediment that settles following dredging.

Habitat disturbance and modification associated with dredging could result in short-term habitat disturbance and modification within the dredge footprint. Benthic communities typically recover from dredging disturbances within 1 year (Wilber and Clarke 2007). Dredging is not expected to alter the existing sediment composition. Given this, subsequent changes in benthic community composition are not expected. However, dredging may expose underlying chemical contaminants, which may affect recolonization by benthic invertebrates. Impacts from habitat disturbance and modification on finfish, invertebrates, and EFH are anticipated to be minor, short term, and localized.

Resuspension of sediments would also occur from pile-driving activity associated with the connected action. Pile driving could resuspend sediments at concentrations of 5 to 10 mg/L above ambient concentrations within 300 feet (91 meters) of a pile (FHWA 2012). Impacts due to resuspension of sediments from pile driving are expected to be relatively lower than from dredging.

Approximately 334,069 cubic yards (255,414 cubic meters) of combined dredge material associated with dredging Atlantic City's maintenance dredging and for the connected action is proposed to be disposed in-water at DH #86, a 14.0-acre (5.7-hectare) human-made subaqueous borrow pit. The dredge material would be mechanically and hydraulically placed and would temporarily release suspended sediments. The vast majority of the placed dredge material is expected to settle within the borrow pit. Organisms within the immediate 14.0-acre (5.7-hectare) area would potentially be killed from burial; however, only seven invertebrate taxa were identified at depths greater than 15 feet (4.6 meters) and numbers of fish decreased at depths greater than 25 feet (7.6 meters) based on a study that sampled within and around DH #86 (McKenna et al. 2018). The benthic invertebrate community within the borrow pit, and in the vicinity, is mostly composed of crustaceans (67 percent) and polychaetes (25 percent), while bivalves account for 5 percent of the benthic invertebrate community and the overall total number of taxa was 46 (McKenna et al. 2018). Only seven taxa represent the benthic invertebrate community at depths greater than 15 feet (4.6 meters), including three polychaete, three crustacean, and one bivalve taxa/taxon (McKenna et al. 2018). Fish surveys conducted within and in the vicinity of the borrow pit found that fish abundance decreases at depths greater than 25 feet (7.6 meters) while identifying the presence of summer flounder and blue crab within the boundaries of the borrow pit (McKenna et al. 2018). In the study done to characterize the biological community at the site, dissolved oxygen concentrations were found to be unsuitable for most organisms (< 2 mg/L) at depths greater than 29.5 feet (9 meters) in May and at depths greater than 23.0 feet (7 meters) in August (McKenna et al. 2018).

Geotechnical boring samples were taken within the dredge footprint area of the connected action during four sampling events in June and August 2020 and April and May 2021 (ACT Engineers, Inc. 2021). Out of 28 boring samples, 12 were found to exceed NJDEP Residential Direct Contact Criteria for Benzo(a)pyrene, arsenic, and lead. Dredging at these locations could potentially release contaminants in resuspended sediments and/or result in contaminated dredge materials.

Proposed dredging activities falling under the *Port utilization* IPF are expected to have minor impacts on finfish, invertebrates, and EFH.

### *Cumulative Impacts of Alternative B – Proposed Action*

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned activities include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications, tidal energy projects, marine minerals use and ocean-dredge material disposal, military use, marine transportation, fisheries use and management, oil and gas activities, regulated fishing effort, global climate change, and planned offshore wind development.

**Accidental releases:** The incremental contributions of the Proposed Action to the cumulative impacts of accidental releases from ongoing and planned activities on finfish, invertebrates, and EFH are anticipated to be negligible considering that the volume of vessel activities from construction and installation, O&M, and decommissioning of the Proposed Action would contribute a relatively small amount of increased vessel traffic from overseas ports.

**Anchoring:** The incremental contributions of the Proposed Action to the cumulative impacts of anchoring from ongoing and planned activities on finfish, invertebrates, and EFH are expected to be undetectable. The negligible to minor cumulative impacts from ongoing and planned activities determined for the No Action Alternative would therefore remain unchanged considering contributions from the Proposed Action. Overall, anchoring impacts are expected to be localized and short term.

**Cable emplacement and maintenance:** The incremental contributions of the Proposed Action to the cumulative impacts of cable emplacement and maintenance from ongoing and planned activities on finfish, invertebrates, and EFH are expected to be negligible. The short-term and localized direct habitat disturbance and indirect impacts from resuspension and redeposition of sediments due to cable emplacement activities of wind development projects, including the Proposed Action, would occur on staggered construction schedules and may not be cumulative.

**Discharges/intakes:** The Proposed Action would contribute negligible impacts from discharges/intakes to the cumulative impacts from ongoing and planned activities on finfish, invertebrates, and EFH. The negligible impact determination of discharges/intakes from ongoing and planned activities would therefore remain unchanged with incremental contributions from the Proposed Action.

**Electric and magnetic fields and cable heat:** The incremental contributions of the Proposed Action to the cumulative impacts of EMF and cable heat from ongoing and planned activities on finfish, invertebrates, and EFH are anticipated to range from minor to moderate. EMF and cable heat from ongoing and planned activities and the Proposed Action are expected to be fully cumulative across projects because the cables that generate them would be operational in the long term. However, the impact determinations of EMF and cable heat from ongoing and planned activities are not expected to be elevated with incremental contributions from the Proposed Action.

**Gear utilization:** The incremental contributions of the Proposed Action to the cumulative impacts of gear utilization from ongoing and planned activities on finfish, invertebrates, and EFH are anticipated to range from minor to moderate. Gear utilization from monitoring surveys of the Proposed Action would have localized impacts. Although survey programs would be planned to occur in the long term, monitoring surveys would occur intermittently, allowing some level of recovery in between disturbances. Some existing scientific monitoring surveys are expected to be affected by offshore wind development, thereby lessening cumulative impacts. Gear utilization during biological monitoring may be temporarily synergistic with short-term impacts from cable emplacement. However, the cumulative and synergistic effects are not expected to have population-level impacts.

**Lighting:** The incremental contributions of the Proposed Action to the cumulative impacts of lighting from ongoing and planned activities on finfish, invertebrates, and EFH are anticipated to be negligible. Lighting from the Proposed Action would occur temporarily (e.g., construction vessel lighting) and over the long term (e.g., offshore wind structure lighting). The staggered construction schedules of planned offshore wind projects including the Proposed Action may reduce cumulative impacts from vessel lighting. The relative contribution of lighting impacts from vessel activity by the Proposed Action is negligible to the lighting from ongoing and planned vessel activity. Impacts from offshore wind structure lighting of ongoing and planned activities including the Proposed Action are expected to be long term but localized.

**Noise:** The incremental contributions of the Proposed Action to the cumulative impacts of noise from ongoing and planned activities on finfish, invertebrates, and EFH are anticipated to range from minor to moderate. Noise impacts from construction of the Proposed Action may not be fully cumulative considering that construction of other planned activities are anticipated to occur on a staggered schedule. Operational noise impacts, however, are anticipated to be cumulative.

**Presence of structures:** The incremental contributions of the Proposed Action to the cumulative impacts of presence of structures from ongoing and planned activities on finfish, invertebrates, and EFH are anticipated to range from minor to moderate. Impacts of presence of structures are expected to be long term and cumulative within the geographic analysis area. Potential cumulative impacts include all those that are discussed under the No Action Alternative.

### *Conclusions*

**Impacts of Alternative B – Proposed Action.** Individual IPFs associated with construction and installation, O&M, and decommissioning of the Proposed Action would result in adverse impacts on finfish, invertebrates, and EFH ranging from **negligible to moderate** and some **minor beneficial** impacts. Although some impacts need to be further evaluated by science (e.g., EMF, wind wakes), especially within the Atlantic OCS, no IPF is expected to have regional-scale impacts, while impact periods are expected to range from short term to potentially permanent. Impact determinations for each IPF are provided in the following paragraphs.

Negligible adverse impacts are expected from IPFs including accidental releases, anchoring, discharges/intakes, and artificial lighting. Each of these impacts are expected to be localized to within or near the Offshore Project area periphery. Impacts from accidental releases of fuel, fluids, and hazardous materials are expected to occur on the short term as they are expected to dilute and disperse to negligible concentrations. However, potential accidental releases of nonnative species could be long term. Anchoring impacts are expected to be short term while artificial lighting impacts are expected to be long term, occurring over the life of the Project.

Minor impacts on finfish, invertebrates, and EFH are expected from cable maintenance, noise, and traffic. Impacts of pile-driving noise are anticipated to be minor and short term, occurring during construction. Operational WTG noise may also have minor impacts if the larger WTGs associated with the Proposed Action produce sound levels that exceed regulatory thresholds for finfish.

IPFs that would have minor to moderate adverse impacts on finfish, invertebrates, and EFH include presence of EMFs and gear utilization during offshore wind-related biological monitoring surveys. Impacts from EMF are expected to be localized along cable corridors and occur long term over the life of the Project.

The highest adverse impact level expected from any IPF associated with the Proposed Action is moderate. Impacts due to presence of structures are expected to be moderate adverse with minor beneficial impacts. The presence of structures is not expected to have regional or population-level impacts, and impacts would occur over the life of the Project. Moderate adverse impacts are expected from cable emplacement during the construction phase of the project. Adverse impacts from cable emplacement are expected to be spatially localized, but impact periods would range from short term to potentially permanent. Cable emplacement in soft-bottom habitats and some complex habitats (e.g., gravel and sand mixes) are expected to be short term because these habitats and the communities that utilize them typically recover following disturbances while sediment plumes generated by bottom disturbances of these habitats settle in the short term. If cable emplacement occurs over hard-bottom complex habitats such as reefs, adverse impacts could be permanent.

Adverse impacts on ESA-listed species are also expected from IPFs including cable emplacement, EMFs, presence of structures, and vessel traffic. Negligible adverse impacts on ESA-listed species are expected from the presence of EMFs. EMF impacts are expected to be long term, occurring over the life of the Project. Gear utilization during Project biological monitoring surveys could have negligible to minor impacts that would occur over the short term. Impacts on ESA-listed species from presence of structures could range from minor to moderate. Minor impacts from presence of structures would result from loss of soft-bottom habitats, and moderate impacts are possible if local hydrology and pelagic food webs are altered. Impacts from presence of structures are expected to be localized and long term, occurring during the life of the Project. Moderate adverse impacts on ESA-listed species are expected from cable emplacement and vessel traffic. Both of these impacts are expected to be short term and localized. However, the risk of vessel collisions with Atlantic sturgeon is highest along migratory pathways.

BOEM expects that the connected action alone would have negligible to minor impacts on finfish, invertebrates, and EFH resulting from accidental releases, noise, presence of structures, and port utilization. These impacts are expected to be localized and temporary or short term.

**Cumulative Impacts of Alternative B – Proposed Action.** Cumulative impacts resulting from individual IPFs from ongoing and planned activities, including the Proposed Action, would range from **negligible to moderate adverse** and **minor beneficial**. The moderate adverse impacts would result from cable emplacement activities during construction phases and permanent impacts due to the presence of structure because losses of individual finfish and invertebrates as well as disturbances and conversion of habitats are expected. Considering all IPFs together, BOEM anticipates that the impacts from ongoing and planned activities, including the Proposed Action, would result in moderate impacts on finfish, invertebrates, and EFH in the geographic analysis area. This impact rating is mostly driven by the presence of structures associated with the Project and planned offshore wind projects. The Proposed Action would contribute to the overall impact rating primarily through long-term impacts associated with the presence of structures and short-term impacts from seafloor disturbances during cable emplacement.

BOEM anticipates that cumulative impacts on finfish, invertebrates, and EFH as the result of ongoing and planned activities, including the Proposed Action, are anticipated to be **moderate** because of short-term impacts due to cable emplacement activities and long-term impacts due to presence of structures that would not result in population-level effects.

#### 3.5.5.6 Impacts of Alternative C on Finfish, Invertebrates, and Essential Fish Habitat

Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) intends to minimize impacts on sensitive habitat areas that are important to fish communities by adjusting the layout or the maximum number of WTGs and OSSs. Under Alternative C1, up to 16 WTGs, 1 OSS, and associated cables within the "Lobster Hole" designated area would be removed (Figure 2.1-8). The "Lobster Hole" broad swale depression is a known productive fishing area with potentially broader regional value. Alternative C2 would remove up to 13 WTGs and associated interarray cables within the NMFS-identified sand ridge complex (Figure 2.1-9). A combination of Alternatives C1 and C2 would be considered. The combined alternatives would allow for the removal of up to 29 WTGs, 1 OSS, and associated interarray cables from both the AOC 1 and AOC 2 areas. The combined Alternatives C1 and C2 would minimize impacts on sensitive bedform habitats. Alternative C3 would remove up to 6 WTGs and associated interarray cables within 1,000 feet (305 meters) of the sand ridge complex area identified by NMFS and demarcated using of NOAA's Benthic Terrain Modeler and bathymetry data provided by Atlantic Shores. Sand ridge habitat is important to demersal fishes that utilize it as shelter and where important predator-prey relationships occur (Figure 2.1-10; Auster et al. 2003; Gerstner 1998). Alternative C4 would microsite 29 WTGs, 1 OSS and associated interarray cables outside of 1,000-foot (305-meter) buffers of ridges and swales within AOC 1 and AOC 2 (Figure 2.1-11).

Alternative C1 would result in a reduction in the number of foundations and a reduction in the length of interarray cables, such that the impacts associated with the installation and operations of these Project components would be reduced. Depending on the types of foundations that are installed, Alternative C1 would result in temporary impacts on 2,904 to 3,078 acres (1,175 to 1,246 hectares) of benthic habitat and permanent impacts on 545 to 643 acres (221 to 260 hectares) of benthic habitat (Table 10-2 in BOEM's EFH Assessment). Alternative C1 would result in 2.9 percent and 4.4 percent reductions in the maximum temporary and permanent impacts on benthic habitat compared to the Proposed Action, including 8.8 and 17.1 percent reductions in temporary and permanent impacts on heterogeneous complex habitat.

Alternative C2 would result in temporary impacts on 2,918 to 3,095 acres (1,181 to 1,253 hectares) of benthic habitat and permanent impacts on 549 to 648 acres (222 to 262 hectares) of benthic habitat, depending on the types of foundations that are installed (Table 10-3 in BOEM's EFH Assessment). Alternative C2 would result in 2.4 percent and 3.7 percent reductions in the maximum temporary and permanent impacts on benthic habitat compared to the Proposed Action. Further, Alternative C2 would result in reduced impacts on non-complex soft-bottom habitat, including ripples, which provides EFH for some species in the area (e.g., hakes, flounders).

Alternative C3 would result in temporary impacts on 2,953 to 3,136 acres (1,195 to 1,269 hectares) of benthic habitat and permanent impacts on 561 to 661 acres (227 to 268 hectares) of benthic habitat, depending on the types of foundations that are installed (Table 10-4 in BOEM's EFH Assessment). Alternative C3 would result in 1.1 percent and 1.7 percent reductions in the maximum temporary and permanent impacts on benthic habitat compared to the Proposed Action. Further, Alternative C3 would result in reduced impacts on non-complex soft-bottom habitat, including ripples, which provides EFH for some species in the area.

### *Onshore Activities and Facilities*

Impacts associated with onshore activities and facilities for Alternative C are anticipated to be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.5.5).

### *Offshore Activities and Facilities*

The potential reduction of facilities from options under Alternative C would reduce impacts of EMFs, noise, and the presence of structures. Presence of structures under the Proposed Action include moderate adverse and minor beneficial impacts on finfish and invertebrates, which would be reduced under Alternative C. These minor differences in interarray and export cable locations would avoid or create a 1,000-foot (305-meter) buffer around sensitive sand wave and ridge and swale habitat areas. Alternative C would result in a reduction of impacts on sensitive habitats due to habitat conversion from presence of structures, noise, and sediment resuspension and redeposition. This reduction of impacts on sensitive habitats is valuable to finfish and invertebrate resources. Protecting these areas of high fish and invertebrate abundance may have added benefits to the overall regional health of these resources (e.g., due to high production that can spill into nearby habitats).

Impacts of Alternative C on ESA-listed species are anticipated to be similar to those described under the Proposed Action. Although the reduction of impacts under Alternative C is expected to benefit the overall finfish and invertebrate communities in the WTA, ESA-listed species may also benefit. ESA-listed species potentially occurring in the WTA include giant manta ray and Atlantic sturgeon.

### *Cumulative Impacts of Alternative C*

Although Alternative C would slightly reduce adverse impacts on finfish, invertebrates, and EFH compared to the Proposed Action, the relative reduction of impacts are expected to be minimal in the context of cumulative impacts with ongoing activities and planned offshore wind development; therefore, the cumulative impacts would range from negligible to moderate with minor beneficial impacts and an overall impact of moderate driven by presence of structures from projects other than the Proposed Action.

*Conclusions*

**Impacts of Alternative C.** Under Alternative C impacts due to presence of structures and cable emplacement would be slightly reduced compared to those impacts under the Proposed Action. Those differences, however, are not sufficient to justify a change in the impact determination for these IPFs under Alternative C as compared to under the Proposed Action. While impacts on some sensitive complex and soft-bottom habitat areas would be avoided under Alternative C, impacts on these habitats in other areas would be unavoidable. Unavoidable impacts, including on sensitive habitats, fall under the moderate impact level defined in Table 3.5.5-1. The construction and installation, O&M, and decommissioning of Alternative C would likely result in overall **negligible to moderate adverse** and **minor beneficial** impacts on finfish, invertebrates, and EFH.

**Cumulative Impacts of Alternative C.** Cumulative impacts on finfish, invertebrates and EFH from ongoing and planned activities, including Alternative C, would range from **negligible to moderate adverse** with **minor beneficial** impacts. Moderate impacts would result from cable emplacement activities during construction phases and permanent impacts due to the presence of structures because losses of individual fish and invertebrates and disturbances to and conversion of existing habitats are expected.

BOEM anticipates that cumulative impacts on finfish, invertebrates, and EFH as the result of ongoing and planned activities, including the impacts from Alternative C, are anticipated to be **moderate** because of short-term impacts due to cable emplacement activities and long-term impacts due to presence of structures that would not result in population-level effects.

### 3.5.5.7 Impacts of Alternatives D and E on Finfish, Invertebrates, and Essential Fish Habitat

Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) is intended to minimize visual impacts by altering the WTG layout and possibly reducing the number of WTGs. Alternative D1 would remove turbines up to 12 miles (19.3 kilometers) from shore. This would result in the removal of up to 21 WTGs from Project 1. The height of the remaining turbines in Project 1 would be restricted to a maximum blade tip height of 932 feet (284 meters) ASML. Alternative D2 would remove up to 31 turbines up to 12.75 miles (20.5 kilometers) from shore. The height of the remaining turbines under Alternative D2 would be restricted to a maximum blade tip height of 932 feet (284 meters) ASML. Although not the primary intent of Alternative D, the removal of WTGs under Alternatives D1, D2, or D3 would also avoid sensitive ridge and swale habitats.

Alternative D1 would result in a reduction in the number of foundations and a reduction in the length of interarray cables, such that the impacts associated with the installation and operations of these Project components are expected to be reduced. Depending on the types of foundations that are installed, Alternative D1 would result in temporary impacts on 2,877 to 3,047 acres (1,164 to 1,233 hectares) of benthic habitat and permanent impacts on 534 to 632 acres (216 to 256 hectares) of benthic habitat (Table 10-5 in BOEM's EFH Assessment). Alternative D1 would result in 3.9 percent and 6.1 percent reductions in the maximum temporary and permanent impacts on benthic habitat compared to the

Proposed Action, including a 7.9 percent reduction in permanent impacts on soft-bottom habitat. Alternative D1 would remove WTG positions from an area that contains non-complex soft-bottom habitat, including ripples, which provides EFH for some species in the area.

Alternative D2 would result in temporary impacts on 2,826 to 2,988 acres (1,144 to 1,209 hectares) of benthic habitat and permanent impacts on 516 to 613 acres (209 to 248 hectares) of benthic habitat, depending on the types of foundations that are installed (Table 10-6 in BOEM’s EFH Assessment). Alternative D2 would result in 5.8 percent and 8.9 percent reductions in the maximum temporary and permanent impacts on benthic habitat compared to the Proposed Action, including a 10.7 percent reduction in permanent impacts on soft-bottom habitat. Alternative D2 would remove WTG positions from an area that contains non-complex soft-bottom habitat, including ripples, which provides EFH for some species in the area.

Alternative D3 would result in temporary impacts on 2,953 to 3,136 acres (1,195 to 1,269 hectares) of benthic habitat and permanent impacts on 561 to 661 acres (227 to 268 hectares) of benthic habitat, depending on the types of foundations that are installed (Table 10-7 in BOEM’s EFH Assessment). Alternative D3 would result in 1.1 percent and 1.7 percent reductions in the maximum temporary and permanent impacts on benthic habitat compared to the Proposed Action. Alternative D3 would remove WTG positions from an area that contains non-complex soft-bottom habitat, including ripples, which provides EFH for some species in the area.

Under Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), impacts on existing ocean uses would be minimized by modifying the WTG layout. Proposed modifications under Alternative E include creating a setback between Atlantic Shores South and Ocean Wind 1 (OCS-A 0498). The setback range under Alternatives E would range from 0.81 nautical mile (1,500 meters) to 1.08 nautical miles (2,000 meters).

Alternative E would result in a reduction in the number of foundations and a reduction in the length of interarray cables, such that the impacts associated with the installation and operations of these Project components are expected to be reduced. Depending on the types of foundations that are installed and if the foundations are excluded from the setback area, Alternative E would potentially result in temporary impacts on 2,960 to 3,143 acres (1,198 to 1,272 hectares) of benthic habitat and permanent impacts on 564 to 663 acres (228 to 268 hectares) of benthic habitat (Table 10-8 in BOEM’s EFH Assessment). Alternative E would result in 0.9 percent and 1.4 percent reductions in the maximum temporary and permanent impacts on benthic habitat compared to the Proposed Action.

#### *Onshore Activities and Facilities*

Impacts associated with onshore activities and facilities for Alternatives D and E are expected to be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.5.5).

### *Offshore Activities and Facilities*

Alternatives D and E would slightly reduce offshore impacts on finfish, invertebrates, and EFH from those under the Proposed Action. The reduction of the number of WTGs in under Alternative D would reduce impacts due to presence of structures and cable emplacement, and, to a lesser extent, would reduce impacts due to pile-driving noise. Under Alternative D, up to 31 WTGs may be removed. Removal of WTG positions under Alternative D would avoid impacts on sensitive ridge and swale habitats, though this was not the purpose of the alternative. Under Alternative E, up to 4 to 5 WTGs may be removed or microsited. Any reduction in the number of WTGs may also reduce the length of the interarray cable. Alternatives D and E would consider a 2 to 16 percent reduction in the number of WTGs, and a reduction in the length of interarray cable, would reduce cable emplacement and noise, benefiting some finfish and invertebrate species.

Alternatives D and E may lead to slightly reduced impacts due to presence of structures on Atlantic sturgeon that may migrate through the Offshore Project area. Specifically, less soft bottom would be converted to hard bottom, and, more importantly, disturbances to complex habitats would be reduced, possibly also benefitting Atlantic sturgeon. The potential impacts from presences of structures on local hydrology and food webs would also be reduced, possibly benefitting giant manta ray.

### *Cumulative Impacts of Alternatives D and E*

The slight reduction of adverse impacts under Alternatives D and E on finfish, invertebrates, and EFH is not expected to be noticeable in the context of cumulative impacts with ongoing activities and planned offshore wind development.

### *Conclusions*

**Impacts of Alternatives D and E.** Alternatives D and E would slightly reduce impacts due to presence of structures and cable emplacement compared to impacts under the Proposed Action. Construction and installation, O&M, and decommissioning of Alternatives D and E would not result in changes to impact determinations under the Proposed Action. Despite some reductions in impacts on sensitive habitats due to presence of structures and cable emplacement, other sensitive habitats would still experience impacts, which is within the moderate impact level defined in Table 3.5.5-1. Impacts of Alternatives D and E would range from **negligible to moderate adverse**, and **minor beneficial** impacts on finfish, invertebrates, and EFH similar to the Proposed Action.

**Cumulative Impacts of Alternatives D and E.** Cumulative impacts on finfish, invertebrates, and EFH from ongoing and planned activities, including Alternative D or E, would range from **negligible to moderate adverse** with **minor beneficial** impacts. Moderate impacts would result from cable emplacement activities during construction phases and permanent impacts due to the presence of structures because losses of individual fish and invertebrates and disturbances to and conversion of existing habitats are expected.

BOEM anticipates that cumulative impacts on finfish, invertebrates, and EFH as the result of ongoing and planned activities, including impacts from Alternatives D and E, are anticipated to be **moderate** because of short-term impacts due to cable emplacement activities and long-term impacts due to presence of structures that would not result in population-level effects.

### 3.5.5.8 Impacts of Alternative F on Finfish, Invertebrates, and Essential Fish Habitat

Under Alternative F (Foundation Structures), construction and installation, O&M, and decommissioning would occur within a range of design parameters, including a range of foundation types, all of which are evaluated under the Proposed Action (Section 3.5.5.5). Departing from the Proposed Action, Alternatives F1 to F3 would evaluate impacts associated with specific foundation types. Under Alternative F1, monopiles and piled jacked foundations would be used for up to 200 WTG foundations, 1 permanent met tower (Project 1), and up to 10 small OSSs (monopile or piled jacket), up to 5 medium OSSs (piled jacket), or 4 large OSSs (piled jacket) for Project 1 and Project 2. Under Alternative F2, mono-bucket, suction bucket jacket, and suction bucket tetrahedron base foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and either up to 10 small OSSs (mono-bucket or suction bucket jacket), up to 5 medium OSSs (suction bucket jacket), or 4 large OSSs (suction bucket jacket), for Project 1 and Project 2. Under Alternative F3, gravity-pad tetrahedron and GBS foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and either up to 10 small OSSs, up to 5 medium OSSs, or 4 large OSSs, with GBS for Project 1 and Project 2.

#### *Onshore Activities and Facilities*

Impacts associated with onshore activities and facilities for Alternative F are expected to be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.5.5).

#### *Offshore Activities and Facilities*

Though all potential offshore activities under Alternative F were evaluated under the Proposed Action, sub-alternatives of Alternative F may exclude some activities evaluated under the Proposed Action. Activities would not differ between the Proposed Action and Alternative F1. Under Alternatives F2 and F3, no impact pile driving would be conducted, eliminating impacts due to underwater noise. Absent the potential impacts on finfish and invertebrates from pile-driving noise, the overall construction and installation impacts on finfish and invertebrates are expected to be reduced under Alternatives F2 and F3 compared to the Proposed Action. Impacts due to pile-driving noise on finfish, invertebrates, and EFH would be eliminated under Alternatives F2 and F3 compared to those described under the Proposed Action.

Alternatives F1 and F3 would result in a reduction in the installation of scour protection compared to the Proposed Action and Alternative F2. Reductions in scour protection would reduce O&M impacts due to the presence of structures. Specifically, the loss of soft-bottom habitat would be reduced. This would benefit the existing benthic, surficial, and infaunal fish and invertebrate communities. Alternatives F1 and F3 would also result in a decreased artificial reef effect. As discussed under the No Action Alternative and the Proposed Action, the artificial reef effect from scour protection may increase overall abundance and diversity of finfish and invertebrates. The reduction in scour protection under Alternative F3 would also reduce the risk of lost recreational fishing gear. Impacts on finfish, invertebrates, and EFH due to presence of structures in Alternatives F1 and F3 are expected to be slightly reduced compared to in the Proposed Action.

The suction bucket installation process under Alternative F2 would involve removal of a maximum volume of 11.4 million gallons of water per mono-bucket foundations or 1.4 million gallons per suction bucket in the suction bucket jacket or suction bucket tetrahedron base foundations. This process involves pumping out water using a pump and filter. Fish and invertebrate larvae would be susceptible to impingement and entrainment during the installation of these foundations.

As with other finfish species, impacts due to pile-driving noise would be eliminated and impacts due to presence of structures would be slightly reduced for ESA-listed species under Alternative F compared to the Proposed Action.

### *Cumulative Impacts of Alternative F*

Alternative F is expected to result in slight reductions in adverse impacts due to noise and presence of structures. However, the slight reduction of adverse impacts may not be noticeable in the context of cumulative impacts with ongoing activities and planned offshore wind development.

### *Conclusions*

**Impacts of Alternative F.** Alternative F could result in reduction or elimination of impacts due to pile-driving noise with possible reductions in impacts due to structures. However, the overall range of impacts under Alternative F would still range from **negligible to moderate adverse** with **minor beneficial,** similar to the Proposed Action taking all IPFs into consideration. Under Alternatives F2 and F3, impacts due to pile-driving noise would be eliminated. Therefore, impacts due to noise under Alternatives F2 and F3 would be reduced to negligible adverse compared to the negligible to moderate determination under the Proposed Action.

**Cumulative Impacts of Alternative F.** Cumulative impacts on finfish, invertebrates, and EFH from ongoing and planned activities, including Alternative F1, F2, or F3, would range from **negligible** to **moderate adverse** with **minor beneficial** impacts. Moderate impacts would result from cable emplacement activities during construction phases and permanent impacts due to the presence of structures because losses of individual fish and invertebrates and disturbances to and conversion of existing habitats are expected.

BOEM anticipates that cumulative impacts on finfish, invertebrates, and EFH as the result of ongoing and planned activities, including impacts from Alternative F, are anticipated to be **moderate** because of short-term impacts due to cable emplacement activities and long-term impacts due to presence of structures that would not result in population-level effects.

### 3.5.5.9 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Tables G-2 and G-3 and summarized and assessed in Table 3.5.5-2. After publication of the Draft EIS, BOEM conducted consultation with NMFS pursuant to Section 305(b) of the MSA (i.e., EFH consultation), which resulted in NMFS issuing EFH Conservation Recommendations. EFH Conservation Recommendations are analyzed collectively in Table 3.5.5-2. If one or more of the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts on finfish, invertebrates, and EFH could be further reduced.

**Table 3.5.5-2. Proposed mitigation measures – finfish, invertebrates, and EFH**

| Measure | Description | Effect |
|---|---|---|
| Marine debris awareness training | Vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP must complete marine trash and debris awareness training annually. Atlantic Shores must submit an annual report describing its marine trash and debris awareness training process and certify that the training process was followed for the previous calendar year. | Marine debris and trash awareness training would minimize the risk of finfish ingestion of or entanglement in marine debris. While adoption of this measure would decrease risk to finfish under the Proposed Action, it would not alter the impact determination of negligible for accidental spills and releases. |
| Passive Acoustic Monitoring (PAM) Plan | BOEM and USACE would ensure that the Lessee prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. This plan would be submitted to NMFS and BOEM for review and concurrence at least 120 days prior to the planned start of activities requiring PAM. | A PAM Plan could help identify the presence of ESA-listed Atlantic sturgeon, timing of presence, and monitor their movements. |
| Sampling gear | All sampling gear must be hauled at least once every 30 days, and all gear must be removed from the water and stored on land between survey seasons to minimize risk of entanglement. | The regular hauling of sampling gear would reduce risk of entanglement or effects of entanglement in fisheries survey gear. While adoption of this measure would reduce risk under the Proposed Action, it would not alter the impact determination of negligible for gear utilization. |
| Gear identification | To facilitate identification of gear on any entangled animals, all trap/pot gear used in Project surveys must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long (0.9-meter-long) strip of black and | Gear identification would improve accountability in the case of gear loss. While adoption of this measure would improve accountability |

| Measure | Description | Effect |
|---|---|---|
| | white duct tape within 2 fathoms of a buoy attachment. In addition, three additional marks must be placed on the top, middle, and bottom of the line using black and white paint or duct tape. | under the Proposed Action, it would not alter the impact determination of negligible for gear utilization. |
| Lost survey gear | All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost survey gear must be reported to NMFS and BSEE. | Lost survey gear would improve accountability in the case of gear loss. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization. |
| Survey training | For any vessel trips where gear is set or hauled for trawl or ventless trap surveys, at least one of the survey staff onboard must have completed Northeast Fisheries Observer Program observer training within the last 5 years or completed other equivalent training in protected species identification and safe handling. Appropriate reference materials must be on board each survey vessel. Atlantic Shores must prepare a training plan that addresses how these survey requirements will be met. | Survey staff training would reduce risk of entanglement or effects of entanglement in fisheries survey gear. While adoption of this measure would reduce risk under the Proposed Action, it would not alter the impact determination of negligible for gear utilization. |
| Atlantic sturgeon identification and data collection | Any Atlantic sturgeon caught or retrieved in any fisheries survey gear must first be identified to species or species group. Each ESA-listed species caught or retrieved must then be documented using appropriate equipment and data collection forms. Live, uninjured animals must be returned to the water as quickly as possible after completing the required handling and documentation. | Atlantic sturgeon identification and data collection would improve accountability for documenting take associated with fisheries surveys. While adoption of this measure would improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization. |
| Atlantic sturgeon handling and resuscitation guidelines | Any Atlantic sturgeon caught and retrieved in gear used in fisheries surveys must be handled and resuscitated (if unresponsive) according to established protocols provided at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. | Atlantic sturgeon handling and resuscitation guidelines would reduce effects of entanglement in fisheries survey gear. While adoption of this measure would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization. |
| Take notification | The Greater Atlantic Regional Fisheries Office Protected Resources Division must be notified as soon as possible of all observed takes of Atlantic sturgeon occurring as a result of any fisheries survey. | Atlantic sturgeon take notification would improve accountability for documenting take associated |

| Measure | Description | Effect |
|---|---|---|
| | | with fisheries surveys. While adoption of this measure would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization. |
| Reporting | The Lessee must report to BOEM and BSEE within 24 hours of confirmation of any incidental take of an endangered or threatened species. | Multi-agency reporting of incidental takes of ESA-listed species, including Atlantic sturgeon, would add further accountability and documentation of impacts. |
| Monthly/annual reporting requirements | To document the amount or extent of take that occurs during all phases of the Proposed Action, Atlantic Shores must submit monthly reports during the construction phase and during the first year of operation and must submit annual reports beginning in year 2 of operation. | Reporting requirements to document take would improve accountability for documenting Atlantic sturgeon take associated with the Proposed Action. While adoption of this measure would improve accountability, it would not alter the overall impact determination of minor for the Proposed Action. |
| Data collection BA BMPs | All Project Design Criteria and Best Management Practices incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) will be applied to activities associated with the construction, maintenance, and operations of the Atlantic Shores Wind project as applicable. | Compliance with Project Design Criteria and Best Management Practices for Protected Species would minimize risk to finfish during HRG surveys. While adoption of this measure would decrease risk to Atlantic sturgeon under the Proposed Action, it would not alter the impact determination of negligible for HRG activities. |
| Project Design Criteria (PDC) minimize vessel interactions with protected species (from HRG Programmatic) | All vessels associated with survey activities (transiting [i.e., traveling between a port and the survey site] or actively surveying) must comply with the vessel strike avoidance measures (PDC-5) in the Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection, last revised in November 2021, including the measures below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. | Complying with strike avoidance measures would minimize or avoid vessel strikes with ESA-listed finfish, including Atlantic sturgeon. |
| Periodic underwater surveys, reporting | The Lessee must monitor indirect impacts associated with charter and recreational fishing gear lost from expected increases in fishing around WTG foundations | Periodic underwater surveys and reporting of monofilament and other |

| Measure | Description | Effect |
|---|---|---|
| of monofilament and other fishing gear around WTG foundations | by surveying at least 10 of the WTGs located closest to shore in each Project 1 and Project 2 area of the Atlantic Shores South Lease Area (OCS-A 0499) annually. If Atlantic Shores utilizes piled jacket foundations for WTGs in Project 2, BOEM may increase the number of foundations that must be surveyed in Project 2. Survey design and effort (i.e., the number of WTGs and frequency of reporting) may be modified only upon concurrence by BOEM and BSEE. Atlantic Shores must monitor potential loss of fishing gear in the vicinity of WTG foundations by surveying at least 10 different WTGs in each Project 1 and Project 2 area annually. Survey design and effort may be modified based upon previous survey results after review and concurrence by BOEM. Atlantic Shores must conduct surveys by remotely operated vehicles, divers, or other means to determine the locations and amounts of marine debris. | fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. While adoption of this measure would reduce risk to finfish under the Proposed Action, it would not alter the impact determination of minor associated with the presence of structures. |
| Artificial reef buffer for turbines | Atlantic Shores must remove a single turbine approximately 150–200 feet (31 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site). | This measure would reduce impacts on EFH by removing the footprint of one foundation. While adoption of this measure would reduce risk to EFH under the Proposed Action, it would not alter the impact determination of minor associated with the presence of structures. |
| Cable maintenance | In conjunction with cable monitoring, Atlantic Shores will develop and implement a Cable Maintenance Plan that requires prompt remedial burial of exposed and shallow-buried cable segments, will review to address repeat exposures, and will develop a process for identifying when cable burial depths reach unacceptable risk levels. | This measure would reduce the risk of EMF exposure to organisms by ensuring proper burial depth. While adoption of this measure would reduce risk to finfish and invertebrates under the Proposed Action, it would not alter the impact determination of minor associated with EMF. |
| Light impact reduction | The Lessee must use lighting technology that minimizes impacts on avian species to the extent practicable including lighting designed to minimize upward illumination. The Lessee must provide USFWS with a courtesy copy of the final Lighting, Marking, and Signaling plan, and the Lessee's approved application to USCG to establish Private Aids to Navigation. | This measure is expected to reduce the impacts of artificial light at night on finfish and invertebrate resources during the construction and operational periods. |
| Sound field verification (SFV) plan and sound field verification of | The purpose of the SFV process is to document sound propagation from foundation installation for estimating distances to isopleths of potential injury and harassment to verify that the modeled acoustic fields were conservative enough to not underestimate the number | SFV monitoring would ensure that modeled acoustic fields do not underestimate actual acoustic fields and exposures of marine life including ESA- |

| Measure | Description | Effect |
|---|---|---|
| foundation installation | of exposures of protected marine life to sounds over regulatory thresholds.<br>The Lessee will submit an SFV plan consistent with requirements of the NMFS Biological Opinion for review and written approval by USACE, BOEM, and NMFS 120 days before the planned commencement of field activities for pile driving. The plan will include measurement procedures and results reporting that meet ISO standard 18406:2017 (Underwater acoustics – Measurement of radiated underwater sound from percussive pile driving). The results of sound field verification must be compared to modeled injury and disturbance isopleths for marine mammals, sea turtles, and Atlantic sturgeon. The results of sound field verification must be compared to modeled injury and disturbance isopleths for marine mammals, sea turtles, and Atlantic sturgeon. The plan would be reviewed and approved by BOEM and NMFS. | listed fish species to injurious or harassment sounds. |
| Reporting requirements: Delaware River vessel trip documentation | Effects on ESA-listed sturgeon resulting from project vessel operations in the Delaware Bay and Delaware River must be monitored and reported.<br>• BOEM, BSEE, and/or USACE must require that the Lessee document and report project vessel trips to/from ports in the Delaware River, including the number of vessel calls to the Paulsboro Marine Terminal, New Jersey Wind Port, and Repauno.<br>• BOEM, BSEE, and/or USACE must ensure that the Lessee is aware of and complies with the following reporting requirements for all project vessels transitioning to/from ports in the Delaware River:<br>○ Report any sturgeon observed with injuries or mortalities along the transit route in the Delaware Bay, Delaware River, or in the vicinity of the port that the vessel is calling on the NMFS within 24 hours by submitting the form available at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null to nmfs.gar.incidental-take@noaa.gov.<br>○ Collect any dead sturgeon observed in the vicinity of the port that the vessel is calling on and hold in cold storage until proper disposal procedures are discussed with NMFS GARFO.<br>○ Complete procedures for genetic sampling of any collected dead Atlantic sturgeon that are over 29.5 inches (75 centimeters). | Reporting requirements of sturgeon would provide additional accountability and documentation of Project-related impacts as well as increased monitoring and documentation of non-Project-related sturgeon mortalities within the Delaware Bay and Delaware River. |
| EFH Consultation Recommendations | EFH Conservation Recommendations from NMFS were transmitted by letter dated October 16, 2023. EFH Conservation Recommendations for activities under BOEM's jurisdiction were provided for WTG, OSS, and cable removal and/or relocation (micrositing), cable emplacement, anchoring and jack-up footing, avoidance | EFH Conservation Recommendations including micrositing, avoidance of sensitive and productive habitats including the western portion of Lobster |

| Measure | Description | Effect |
| --- | --- | --- |
| | of sensitive and productive habitats, spill prevention measures, anti-corrosive measures, scour protection, marine debris removal, habitat alteration minimization, boulder relocation, noise and noise mitigation, development of Project *in situ m*onitoring programs, and reinitiation of EFH consultation. EFH Conservation recommendations for activities under USACE's jurisdiction were provided for in-water work time of year restrictions, inshore/estuarine habitat impact minimization or restoration, mitigation of impacts on NMFS scientific surveys, artificial reef avoidance and impact monitoring, and provision of relocated or placed structural impediments to marine users. | Hole (AOC 1), spatially complex sand ridge/trough habitats in the southern tip of the Lease Area, restoration of seafloor contours, bathymetry, and sediment types, and the Atlantic City, Manasquan Inlet, and Axel Carson artificial reefs to the extent practicable, anchoring and jack-up footing, minimization of habitat alterations including boulder relocation distance, conservation of large-scale bedform topography, and cable crossings of sensitive habitats, ant-corrosion, spill prevention measures, and development of habitat alteration action plans are expected to minimize disturbances and alteration of habitats including EFH. Conservation Recommendations for avoiding use of plastics or polymers in scour materials, considering sediment mobility for target cable burial depth, marine debris disposal, simultaneous cable lay and burial methods, and provision of relocated or placed structures are expected to avoid or minimize disturbance or losses of individuals.<br>In-water work restrictions would avoid impacts on specific finfish species with EFH. In-water work restrictions from January 1 to May 31 in estuarine and inshore habitats would avoid suspended sediment and redeposition impacts on benthic spawning winter flounder and eggs and larvae. In-water work restrictions from June 1 to September 15 |

| Measure | Description | Effect |
| --- | --- | --- |
| | | within sandbar shark EFH-HAPC would protect sandbar shark pups and juveniles when they are present. Conservation Recommendations for noise during construction including noise dampening/mitigation measures during pile driving within 5.9 nautical miles (11 kilometers) of any artificial reef sites/shipwrecks/fish havens, mandatory 4-hour quiet periods during a 24-hour pile driving event, and noise mitigation protocols in consultation with resource agencies prior to construction activities would minimize disturbances or losses of individuals and disturbance to available habitats. The Conservation Recommendations to identify and provide information on impacts to NMFS scientific surveys, pre-, during, and post-construction monitoring of impacts on reef sites, and develop a Project-specific *in situ* monitoring program would provide information on specific impacts on finfish, invertebrates, and EFH and identify stressors created by Project activities during construction and operational phases would ensure continuation of biological monitoring in the OCS and provide information on impacts on or recovery of finfish and invertebrate communities. Conservation Recommendations would provide incremental reductions in impacts on habitats and individuals but reductions in the overall impact determination ratings |

| Measure | Description | Effect |
|---|---|---|
| | | are not anticipated for any of the IPFs. |

### *Measures Incorporated in the Preferred Alternative*

The Preferred Alternative includes the mitigation measure to remove a single turbine approximately 150 to 200 feet (46 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site). The adoption of this mitigation measure would be ensured if the Preferred Alternative is selected. Although the impact determination made for finfish, invertebrates, and EFH under the Proposed Action described in Section 3.5.5.5 would not change, the removal of the turbine at this location would reduce the sound intensity experienced within the Fish Haven during the pile-driving construction period. The measure would also ensure that injurious sound levels, 1,411 to 1,640 feet (430 to 500 meters) from pile driving source, are not experienced within the Fish Haven. Additional benefits of this measure to finfish, invertebrates, and EFH include reduced potential sediment plume and reef effect impacts.

## 3.5.5.10 Comparison of Alternatives

Construction and installation, O&M, and decommissioning of Alternatives C and D would result in minor reductions of impacts due to presence of structures and cable emplacement, but the moderate adverse impact determination would remain as determined under the Proposed Action. This determination is maintained due to impacts not being avoided sufficiently for a change in determination as defined in Table 3.5.5-1. Alternative E would also result in slightly reduced structure-related impacts on finfish, invertebrates, and EFH. Alternative E would reduce a relatively lower number of WTG positions compared to Alternative D and would avoid less habitat area compared to Alternatives C and D. Therefore, determinations of impacts due to presence of structures under Alternative E remain identical to those expected under the Proposed Action. Under Alternatives F2 and F3, the absence of pile-driving noise would reduce noise impacts on finfish and invertebrates to negligible adverse compared to negligible to minor under the Proposed Action.

## 3.5.5.11 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical mile (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. Accordingly, the Preferred Alternative would include up to 195 WTGs,[4] up to 10 OSSs, up to 1 permanent met tower for Project 1, up to 4 temporary metocean anchor midline buoys, 2 onshore substations and/or converter stations, 1 O&M facility and potentially an associated parking structure, and up to 8 transmission cables making landfall at two New Jersey locations (Sea Girt and Atlantic City). All permanent structures must be located in the uniform grid spacing and the total number of permanent structures constructed (WTGs, OSSs, and met tower) would not exceed 197.

Finfish, invertebrate, and EFH resources would benefit from avoidance and reductions in impacts to bottom habitats from the Project. The total number of WTGs (195) in the Preferred Alternative would reduce the number of WTGs (200) evaluated under the Proposed Action. This reduction in the number of WTGs would reduce the total area of bottom habitat temporarily disturbed during construction of the Project and the total area of bottom habitat that is converted to hard bottom. The total area of bottom habitat converted to hard bottom under the Preferred Alternative would be reduced by 10.4 acres (4.2 hectares) compared to under the Proposed Action. The avoidance and reduction of impacts within the two NMFS-identified AOCs is particularly beneficial to finfish and invertebrates that are known to be productive there. Other impacts would also be reduced if the Preferred Alternative is implemented, including pile driving and vessel noise, turbine operational noise, turbidity, and sediment deposition.

The overall impacts of the Preferred Alternative on finfish, invertebrates, and EFH are expected to be similar to those under the Proposed Action. Despite the reductions in impacts to these resources described in the previous paragraph, the impact determinations made under the Proposed Action would remain unchanged if the Preferred Alternative is implemented. However, it is BOEM’s opinion that, given the importance of the Lobster Hole and the ridge and swale AOCs to finfish and invertebrates, avoidance or reductions in disturbances within these areas is valuable. Impact determinations of the Preferred Alternative would therefore range from **negligible to moderate adverse** with some **minor beneficial** impacts on finfish, invertebrates, and EFH. The cumulative impacts of the Preferred Alternative combined with ongoing and planned activities in the geographic analysis area, including the connected action, would range from **negligible to moderate adverse** with some **minor beneficial** impacts.

[4] 195 WTGs assumes that 197 total positions are available and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

### 3.5.7 Sea Turtles

This section discusses potential impacts on sea turtles from the proposed Project, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area. The geographic analysis area, as shown on Figure 3.5.7-1, includes the Northeast Shelf, Southeast Shelf, and Gulf of Mexico LMEs. These LMEs capture the general movement range for sea turtles that could be affected by the Project. Due to the size of the geographic analysis area, for analysis purposes in this EIS, the focus is on sea turtles that would likely occur in the proposed Project area and be affected by Project activities. The geographic analysis area does not include all areas that could be transited by Project vessels (e.g., it does not consider vessel transits from Europe).

#### 3.5.7.1 Description of the Affected Environment and Future Baseline Conditions

Five species of sea turtles have been documented in U.S. waters of the northwest Atlantic Ocean, where the Offshore Project area occurs: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and loggerhead (*Caretta caretta*). All five species are listed under the ESA; hawksbill, Kemp's ridley, and leatherback sea turtles are listed as endangered, and green and loggerhead sea turtles are listed as threatened. Critical habitat has been designated for green, hawksbill, leatherback, and loggerhead sea turtles; however, critical habitat for these species is not within or in the vicinity of the Offshore Project area. The BA for Atlantic Shores South provides a detailed discussion of ESA-listed species and potential impacts on these species as a result of the Project. The BA submitted to NMFS found that the Proposed Action *may affect, is likely to adversely affect* ESA-listed sea turtle species (i.e., green, Kemp's ridley, leatherback, and loggerhead sea turtles) but is expected to have no effect on critical habitat designated for loggerhead sea turtles (BOEM 2023). Consultation with NMFS pursuant to Section 7 of the ESA was completed December 18, 2023. NMFS concluded that the Proposed Action is likely to adversely affect but is not likely to jeopardize the continued existence of the North Atlantic DPS of green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and the Northwest Atlantic DPS of loggerhead sea turtles. The Proposed Action is expected to have no effect on critical habitat designated for the Northwest Atlantic DPS of loggerhead sea turtles (NMFS 2023).

Although hawksbill sea turtles have been documented in OCS waters of the northwest Atlantic Ocean, they are rare in this region and have not been documented within New Jersey waters (Conserve Wildlife Foundation of New Jersey 2022). Therefore, this species is considered unlikely to occur. Hawksbill sea turtles occur regularly in the Gulf of Mexico; however, vessel traffic is the only Project activity that could affect sea turtles in this region, and only 20 vessel round trips to the Gulf of Mexico are expected for the Project. Given the low number of vessel trips and the vessel strike avoidance measures that would be in place (Section 3.5.7.5, *Impacts of Alternative B*), impacts in the Gulf of Mexico are considered unlikely. Therefore, hawksbill sea turtle will not be evaluated further in this EIS.

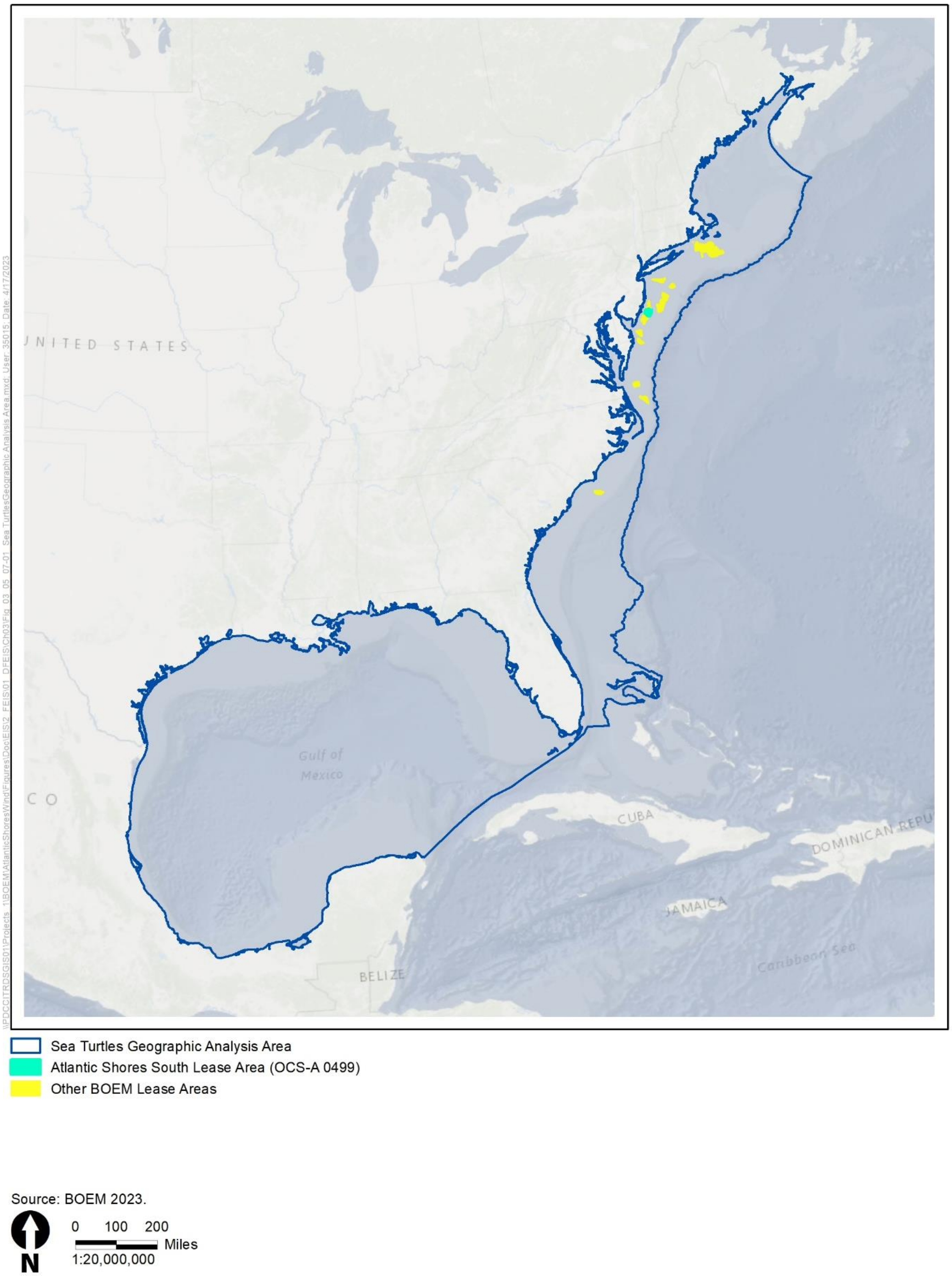



**Figure 3.5.7-1. Sea turtles geographic analysis area**

Sea turtles generally migrate into or through the Offshore Project area as they travel between their northern-latitude feeding grounds and their nesting grounds in the southern U.S., the Gulf of Mexico, and the Caribbean. As ocean waters warm in the spring, sea turtles migrate northward to their feeding grounds in the mid-Atlantic, typically arriving in the spring or summer and remaining through the fall. As water temperatures cool, most sea turtles begin their return migration to the south. Historically, this southward migration begins in October, and most turtles have left by the first week in November. Based on this seasonal migration pattern, sea turtles are generally expected to occur in the Offshore Project area between May and November (NMFS 2021e). Some individuals may remain in the mid-Atlantic into the winter when they could experience cold stunning as temperatures drop below 50°F (10°C) (NMFS 2021a), but occurrence is less likely when water temperatures are low (i.e., winter and spring) (BOEM 2012; Greene et al. 2010).

The best available information on the occurrence and distribution of sea turtles in the Project area is provided by a combination of sighting data, technical reports, and academic publications, including:

- Aerial and shipboard survey data collected by the Northwest Atlantic Marine Ecoregional Assessment (Greene et al. 2010), the Northeast Fisheries Science Center, the New York State Energy Research and Development Authority (NYSERDA) (Normandeau Associates Inc. and APEM Inc. 2018, 2019a, 2019b, 2019c, 2020), the New Jersey Department of Environmental Protection (Geo-Marine 2010); and
- Data retrieved from the North Atlantic Right Whale Consortium database (NARWC 2021).

Species occurrence is summarized in Table 3.5.7-1 and described in the following paragraphs. Seasonal density estimates derived from NYSERDA annual reports are provided in Table 3.5.7-2.

**Table 3.5.7-1. Sea turtles likely to occur in the Project area**

| Common Name | Scientific Name | Distinct Population Segment (DPS)/ Population | ESA Status | Relative Occurrence in the Project Area[1] |
|---|---|---|---|---|
| Green sea turtle | *Chelonia mydas* | North Atlantic DPS | Threatened | Uncommon |
| Kemp's ridley sea turtle | *Lepidochelys kempii* | -- | Endangered | Uncommon |
| Leatherback sea turtle | *Dermochelys coriacea* | Northwest Atlantic[2] | Endangered | Common |
| Loggerhead sea turtle | *Caretta caretta* | Northwest Atlantic DPS | Threatened | Common |

Source: COP Volume II, Section 4.8, Table 4.8-1; Atlantic Shores 2024.

[1] Uncommon = occurring in low numbers or on an irregular basis; Common = occurring consistently in moderate to large numbers.

[2] DPSs have not been designated for leatherback sea turtle as the species is listed as endangered throughout its global range.

**Table 3.5.7-2. Seasonal sea turtle density estimates derived from NYSERDA annual reports**

| Species | Density (animals/100 square kilometers)[1] | | | |
|---|---|---|---|---|
| | Spring | Summer | Fall | Winter |
| Green sea turtle | 0.000 | 0.038 | 0.000 | 0.000 |
| Kemp's ridley sea turtle | 0.050 | 0.991 | 0.190 | 0.000 |
| Leatherback sea turtle | 0.000 | 0.331 | 0.789 | 0.000 |
| Loggerhead sea turtle | 0.254 | 26.799 | 0.190 | 0.025 |

Source: COP Volume II, Section 4.8, Table 4.8-2; Atlantic Shores 2024.
[1] Density estimates are derived from seasonal abundance surveys conducted offshore New York (Normandeau Associates Inc., and APEM Inc. 2018, 2019a, 2019b, 2019c, 2020).

**Green sea turtle**: Green sea turtles found in the Project area belong to the North Atlantic DPS. This species inhabits tropical and subtropical waters around the globe. In the U.S., green sea turtles occur from Texas to Maine, as well as the Caribbean. Late juveniles and adults are typically found in nearshore waters of shallow coastal habitats (NMFS 2021b). In the pelagic environment, juvenile green sea turtles are often found in convergence zones (NMFS and USFWS 1991).

No green sea turtle nesting has been documented on the New Jersey coast. Their diet is largely herbivorous, composed primarily of algae and seagrasses with occasional sponges and invertebrates (NMFS 2021b). Although they have the potential to occur year-round, green sea turtles generally occur seasonally offshore of New Jersey in summer and fall. Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 3.5.7-2. Green sea turtles have a seasonal density of 0.038 animals per 39 square miles (100 square kilometers) during the summer and seasonal densities of 0.000 animals per 39 square miles (100 square kilometers) in the other three seasons. There is no population estimate for the North Atlantic DPS of green sea turtles. However, nester abundance for this DPS is estimated at 167,424 (Seminoff et al. 2015). All major nesting populations in this DPS have shown long-term increases in abundance (Seminoff et al. 2015).

**Kemp's ridley sea turtle**: All Kemp's ridley sea turtles, including those found in the Project area, belong to a single population. This species primarily inhabits the Gulf of Mexico, although large juveniles and adults travel along the U.S. Atlantic coast. At these life stages, Kemp's ridley sea turtles occupy nearshore habitats in subtropical to warm temperate waters, including sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters.

A single Kemp's ridley nest was documented on Queens County's West Beach, New York, in 2018. However, this nest was outside the known nesting range for the species, which is essentially limited to the beaches of the western Gulf of Mexico (NMFS and USFWS 2015). The diet of Kemp's ridley sea turtles is composed primarily of crabs (NMFS 2022). Kemp's ridley sea turtles could occur in the Project area year-round, but they are mainly in the region during the summer and fall. Seasonal densities of this species were derived from NYSERDA annual reports[1] and are provided in Table 3.5.7-2. Kemp's ridley sea turtles have seasonal densities of 0.050 animals per 39 square miles (100 square kilometers) for spring, 0.991 animals per 39 square miles (100 square kilometers) for summer, 0.190 animals per 39 square

[1] Though this species was observed during the surveys conducted for NYSERDA, it is the smallest sea turtle species, making it difficult to observe during aerial surveys.

miles (100 square kilometers) for fall, and 0.000 animals per 39 square miles (100 square kilometers) for winter. In 2012, the population of individuals aged 2 and up was estimated at 248,307 turtles (NMFS and USFWS 2015 citing Gallaway et al. 2013). Since 2009, there has been a decline in nest abundance for this population (NMFS and USFWS 2015).

**Leatherback sea turtle**: Leatherback sea turtles that occur in the Project area belong to the Northwest Atlantic population identified in the 2020 status review for the species (NMFS and USFWS 2020). However, this population has not been identified as a DPS or listed separately under the ESA at this time. This species is found in the Atlantic, Pacific, and Indian Oceans (NMFS 2021c). Leatherback sea turtles can be found throughout the western North Atlantic Ocean as far north as Nova Scotia, Newfoundland, and Labrador. While early life stages prefer oceanic waters, adult leatherback sea turtles are generally found in mid-ocean, continental shelf, and nearshore waters (NMFS and USFWS 1992). This species is often attracted to oceanographic features associated with jellyfish aggregations (e.g., mesoscale eddies, convergence zones, upwelling areas) (Bailey et al. 2012).

This species does not nest along the New Jersey coast. Leatherback sea turtle diets are composed primarily of jellyfish and other gelatinous prey, but they may also incidentally consume sea urchins, squid, crustaceans, fish, and vegetation (Eckert et al. 2012). Leatherback sea turtles could occur in the Project area throughout the year but are more common in the summer and fall (BOEM 2012; Geo-Marine 2010). During aerial and shipboard surveys for marine mammals and sea turtles off the coast of New Jersey in 2008 and 2009 (Geo-Marine 2010), 12 leatherback sea turtles were sighted. All sightings occurred in the summer. This species was observed in waters ranging from 59 to 98 feet (18 to 30 meters) deep, located 6.2 to 22.3 miles (10 to 36 kilometers) from shore. The mean sea surface temperature associated with leatherback sea turtle sightings was 66.2°F (19°C). Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 3.5.7-2. Leatherback sea turtles have a seasonal density of 0.000 animals per 39 square miles (100 square kilometers) for spring, 0.331 animals per 39 square miles (100 square kilometers) for summer, 0.789 animals per 39 square miles (100 square kilometers) for fall, and 0.000 animals per 39 square miles (100 square kilometers) for winter. The best available estimate of nesting female abundance for the Northwest Atlantic population is 20,659 females. This population is currently exhibiting an overall decreasing trend in annual nesting activity (NMFS and USFWS 2020).

**Loggerhead sea turtle**: Loggerhead sea turtles found in the Project area belong to the Northwest Atlantic DPS. This species inhabits nearshore and offshore habitats throughout the globe. Loggerhead sea turtles occur throughout the northwest Atlantic as far north as Newfoundland (NMFS 2021d). Coastal waters of the western Atlantic have been identified as foraging habitat for juveniles (USFWS 2020), and the Mid-Atlantic Bight serves as a seasonal foraging ground for approximately 40,000 to 60,000 juveniles and adults during the summer (NEFSC and SEFSC 2011). Satellite telemetry data indicate that up to 30 to 50 percent of the loggerhead sea turtles that inhabit the U.S. eastern seaboard utilize this seasonal foraging habitat (Patel et al. 2021; Winton et al. 2018).

A single loggerhead nest was documented at Island Beach State Park, New Jersey, in 1979 (Brandner 1983). However, this nest was outside the known nesting range for the species, which stretches from

Texas to Virginia (NMFS and USFWS 2008). Juvenile loggerhead sea turtles have omnivorous diets, consuming crabs, mollusks, jellyfish, and vegetation. Adults are carnivores, consuming primarily benthic invertebrates (NMFS 2021d). Loggerhead sea turtles could occur in the Project area throughout the year but are more common in the summer and fall (BOEM 2012; Geo-Marine 2010). During aerial and shipboard surveys for marine mammals and sea turtles off the coast of New Jersey in 2008 and 2009 (Geo-Marine 2010), 69 loggerhead sea turtles were sighted. Sightings occurred between June and October. This species was observed in waters ranging from 30 to 112 feet (9 to 34 meters) deep, located 0.9 to 23.6 miles (1.5 to 38 kilometers) from shore. The mean sea surface temperature associated with loggerhead sea turtle sightings was 65.3°F (18.5°C). Seasonal densities of this species were derived from NYSERDA annual reports and are provided in Table 3.5.7-2. Loggerhead sea turtles have a seasonal density of 0.254 animals per 39 square miles (100 square kilometers) for spring, 26.779 animals per 39 square miles (100 square kilometers) for summer, 0.190 animals per 39 square miles (100 square kilometers) for fall, and 0.025 animals per 39 square miles (100 square kilometers) for winter. The most recent population estimate for the northwest Atlantic continental shelf, calculated in 2010, is 588,000 juvenile and adult loggerhead sea turtles (NEFSC and SEFSC 2011). The recovery units for the Northwest Atlantic DPS have shown no trend or an increasing trend in nest abundance; however, these recovery units have not met their recovery criteria for annual increases in nest abundance (Bolten et al. 2019).

All four sea turtle species likely to occur in the geographic analysis area are subject to regional, pre-existing threats. These threats include fisheries bycatch, loss or degradation of nesting and foraging habitat, entanglement in fishing gear, vessel strikes, predation and harvest, disease, and climate change. Green, Kemp's ridley, and loggerhead sea turtles are also susceptible to cold stunning.

The hearing range of sea turtles is limited to low frequencies, typically below 1,600 Hz. The documented hearing range for each of the four sea turtle species is provided in Table 3.5.7-3.

**Table 3.5.7-3. Sea turtle hearing ranges**

| Species | Hearing Range (Hz) | | Source |
|---|---|---|---|
| | Minimum | Maximum | |
| Green | 50 | 1,600 | Dow Piniak et al. 2012a |
| Kemp's ridley | 100 | 500 | Bartol and Ketten 2006 |
| Leatherback | 50 | 1,200 | Dow Piniak et al. 2012b |
| Loggerhead | 50–100 | 800–1,130 | Martin et al. 2012 |

### 3.5.7.2 Impact Level Definitions for Sea Turtles

This Final EIS uses a four-level classification scheme to characterize potential impacts of the alternatives, including the Proposed Action, as shown in Table 3.5.7-4. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

**Table 3.5.7-4. Definitions of potential adverse and beneficial impact levels for sea turtles**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations. |
| | Beneficial | Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations. |
| Minor | Adverse | Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts may include injury or loss of individuals, but these impacts would not result in population-level effects. |
| | Beneficial | Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts could increase survival and fitness, but would not result in population-level effects. |
| Moderate | Adverse | Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Adverse effects would likely be recoverable and would not affect population or DPS viability. |
| | Beneficial | Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Impacts would be measurable at the population level. |
| Major | Adverse | Impacts on sea turtles would be significant and extensive and long term in duration, and could have population-level effects that are not recoverable, even with mitigation. |
| | Beneficial | Impacts would be significant and extensive and contribute to population or DPS recovery. |

### 3.5.7.3 Impacts of Alternative A – No Action on Sea Turtles

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

#### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for sea turtles, described in Section 3.5.7.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends, and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles are generally associated with coastal and offshore development, marine transport, and fisheries use. Coastal and offshore development, marine transport, and fisheries use and associated impacts are expected to continue at current trends and have the potential to affect sea turtles through accidental releases, which can have physiological effects on sea turtles; electric and magnetic fields and cable heat and lighting, which can result in behavioral changes in sea turtles (e.g., Luschi et al. 2007; Wang et al. 2019); cable emplacement and maintenance and port utilization, which can disturb benthic habitats and affect water quality; noise, which can have physiological and behavioral effects on sea turtles; the presence of structures, which can result in behavioral changes in sea turtles, effects on prey species, and increased risk of interactions with fishing gear; and vessel traffic, which increases risk of vessel collision. See Appendix D, Table D.A1-21 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for sea turtles.

Global climate change is an ongoing risk for sea turtle species in the geographic analysis area. Warming and sea level rise could affect sea turtles through increased storm frequency and severity, altered habitat/ecology, altered migration patterns, increased disease incidence, increased erosion and sediment deposition, and development of protective measures (e.g., seawalls and barriers). Ocean acidification may also affect sea turtles (Hawkes et al. 2009). Warming and sea level rise, with their associated consequences, and ocean acidification could lead to long-term, high-consequence impacts on sea turtles, including changes to sea turtle distribution, habitat use, migratory patterns, nesting periods, nestling sex ratios, nesting habitat quality or availability, prey distribution or abundance, and foraging habitat availability (Fuentes and Abbs 2010; Janzen 1994; Newson et al. 2009; Witt et al. 2010).

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles (based on the scenario shown in Appendix D) include:

- Continued O&M of the BIWF Project (5 WTGs) installed in state waters;
- Continued O&M of the CVOW pilot Project (2 WTGs) installed in OCS-A 0497; and
- Ongoing construction of six offshore wind projects: the Vineyard Wind 1 Project (62 WTGs and 1 OSS) in OCS-A 0501, the SFWF Project (12 WTGs and 1 OSS) in OCS-A 0517, the Ocean Wind 1 Project (98 WTGs and 3 OSSs) in OCS-A 0498, the Revolution Wind Project (65 WTGs and 2 OSSs) in OCS-A 0486, the Empire Wind Project (147 WTGs and 2 OSSs), and the CVOW-C Project (202 WTGs and 3 OSSs).

Ongoing offshore wind activities would affect sea turtles through the primary IPFs of noise, presence of structures, and vessel traffic. These activities would have the same types of impacts that are described in detail below, under *Cumulative Impacts of Alternative A – No Action*, for planned offshore wind activities, but the impacts would be of lower intensity.

### *Cumulative Impacts of Alternative A – No Action*

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

Planned non-offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles, in the absence of the Proposed Action, include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities, including development of the oil and gas leases sold in the two lease sales in 2023 and up to three new lease sales between 2024 and 2029 in the Gulf of Mexico; and onshore development activities (see Section D.2 in Appendix D for a description of planned activities). BOEM expects planned activities other than offshore wind to affect sea turtles through several primary IPFs, including accidental releases, electric and magnetic fields and cable heat, lighting, cable emplacement and maintenance, port utilization, noise, and the presence of structures.

The sections below summarize the potential impacts of ongoing and planned offshore wind activities in U.S. waters of the Atlantic Ocean and Gulf of Mexico, excluding the Proposed Action, on sea turtles during construction and installation, O&M, and decommissioning of the projects. Other planned offshore wind activities in the geographic analysis area for sea turtles include the construction and installation, O&M, and decommissioning of 27 offshore wind projects, which would result in an additional 2,345 WTGs in the geographic analysis area (Appendix D, Table D.A2-1).

BOEM expects planned offshore wind development activities to affect sea turtles through the following primary IPFs.

**Accidental releases**: Offshore wind activities may increase accidental releases of fuels, fluids, hazardous materials, including petroleum products, and trash and debris due to increased vessel traffic and installation of WTGs and other offshore structures. The risk of accidental releases is expected to be highest during construction and installation, but accidental releases could also occur during O&M and decommissioning.

Ongoing and planned offshore wind activities are expected to gradually increase vessel traffic over the next 35 years, increasing the risk of accidental releases of fuels, fluids, and hazardous materials. There would be a low risk of fuel, fluid, and hazardous materials leaks from any of the 2,940 WTGs (Appendix D, Table D.A2-1) anticipated in the geographic analysis area. The total volume of WTG fuels, fluids, and hazardous materials in the geographic analysis area is estimated at 21.3 million gallons (80.6 million liters) (Appendix D, Table D.A2-3). OSSs and ESPs are expected to hold an additional 10.1 million gallons (38.1 million liters) of fuels, fluids, and hazardous materials (Appendix D, Table D.A2-3).

BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons (484,533 liters) is likely to occur no more frequently than once every 1,000 years, and a release of 2,000 gallons (7,570 liters) or less is likely to occur every 5 to 20 years (Bejarano et al. 2013). Sea turtle exposure to oil spills through aquatic contact or inhalation of fumes can result in death (Shigenaka et al. 2010) or sublethal effects, including but not limited to adrenal effects, dehydration, hematological effects, increased disease incidence, hepatological effects, poor body condition, dermal effects, and skeletomuscular effects (Bembenek-Bailey et al. 2019; Camacho et al. 2013; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Such sublethal effects would affect individual fitness but are not expected to affect sea turtle populations. In addition to direct effects on sea turtles, accidental releases can indirectly affect sea turtles through impacts on prey species (see Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*). Given the volumes of fuels, fluids, and hazardous materials potentially involved and the likelihood of release occurrence, the long-term increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

Increased vessel traffic would also increase the risk of accidental releases of trash and debris during construction and installation, O&M, and decommissioning of offshore wind facilities. All sea turtle species are known to ingest trash and debris, including plastic fragments, tar, paper, polystyrene foam, hooks, lines, and net fragments (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014; Thomás et al. 2002). Such ingestion can occur accidentally or intentionally when individuals mistake the debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Ingestion of trash and debris can result in death or sublethal effects, including but not limited to dietary dilution, chemical contamination, depressed immune system, poor body condition, reduced growth rates, reduced fecundity, and reduced reproductive success (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). These sublethal effects would affect individual fitness, but mortality and sublethal effects associated with ingestion of trash and debris are not expected to have population-level effects. BOEM assumes that all vessels will comply with laws and regulations to minimize trash releases and expects that such releases would be small and infrequent. The amount of trash and debris accidentally released during planned offshore wind activities would likely be minimal compared to trash releases associated with ongoing activities, including land-based activities and commercial and recreational fishing.

Accidental releases from planned offshore wind activities would likely result in minor impacts for sea turtles and are unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable. Impacts from accidental releases from planned non-offshore wind activities would likely be minor because fuel spills have lesser potential impacts on sea turtles due to their low probability of occurrence and relatively limited spatial extent and debris release would be accidental and localized.

**Cable emplacement and maintenance**: Ongoing and planned offshore wind activities will involve the placement and maintenance of export and interarray cables. Cable emplacement and maintenance activities disturb bottom sediment, resulting in temporary increases in suspended sediment concentrations. Cable emplacement associated with ongoing and planned offshore wind activities, including export cable emplacement, interarray cable emplacement, and anchoring, is expected to disturb more than 63,933 acres (25,873 hectares) of seabed between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2). This acreage could be reduced if open-access offshore transmission systems are built, as have been proposed. However, such projects are not considered reasonably foreseeable at this time. During cable installation, sediment plumes would be present for up to 6 hours at a time until the activity is completed, and suspended sediment settles back to the seabed. Areas subject to cumulative increases in suspended sediment from simultaneous activities would be limited because the occurrence of concurrent cable installation operations is expected to be limited. The increases in suspended sediment associated with cable emplacement and maintenance would be short term and localized to the cable corridor.

Elevated levels of suspended sediment may cause small changes in sea turtle movement and behavior (NMFS 2020). Such changes are expected to be too small to be reasonably measured as sea turtles are capable of swimming through turbidity plumes (NMFS 2020). Elevated suspended sediment may affect sea turtles indirectly if prey species, including benthic mollusks, crustaceans, sponges, and sea pens are affected by redeposition of sediment. Elevated suspended sediment concentrations have adverse effects on benthic communities when they exceed 390 milligrams per liter (USEPA 1986). See Section 3.5.5 for a discussion of impacts on prey species. There are no data to suggest that suspended sediment has physiological effects on sea turtles.

Any dredging required prior to cable emplacement could have additional impacts on sea turtles due to impingement, entrainment, or capture in certain types of dredges. Mechanical dredging is not expected to capture, injure, or kill sea turtles (USACE 2020). Hopper dredges may strike, impinge, or entrain sea turtles, which may result in injury or mortality (Ramirez et al. 2017; Ramirez et al. 2017 citing Dickerson et al. 1990, 1991; Ramirez et al. 2017 citing Reine et al. 1998; Ramirez et al. 2017 citing Richardson 1990). The sea turtle species most often affected by dredge interactions is loggerhead sea turtles, followed by green sea turtles, then Kemp's ridley sea turtles (Ramirez et al. 2017). However, the risk of interactions between hopper dredges and sea turtles is expected to be lower in the offshore environment where dredging for offshore wind cables would most likely occur (Michel et al. 2013; USACE 2020). The risk of injury or mortality of individual sea turtles due to dredging associated with planned offshore wind activities is considered low, and any impacts are expected to be minor given population-level effects are unlikely to occur.

**Electric and magnetic fields and cable heat**: Offshore wind activities would install up to 12,881 miles (20,730 kilometers) of export and interarray cables (Appendix D, Table D.A2-1), increasing the production of EMF and heat in the geographic analysis area. EMF and heat effects would be reduced by cable burial to an appropriate depth and shielding, if necessary. Cables are also expected to be separated by a minimum distance of 330 feet (100 meters), avoiding additive effects from adjacent cables.

Sea turtles are capable of detecting magnetic fields (e.g., Lohmann and Lohmann 1996; Normandeau et al. 2011; Putman et al. 2015), and behavioral responses to such fields have been documented (e.g., Luschi et al. 2007). The threshold for behavioral responses varies somewhat among species. Loggerhead sea turtles have exhibited responses to field intensities ranging from 0.0047 to 4,000 microteslas, and green sea turtles have responded to field intensities ranging from 29.3 to 200 microteslas (Normandeau et al. 2011); other species are expected to have similar thresholds due to similar anatomical features, behaviors, and life history characteristics. Juvenile and adult sea turtles may detect EMFs associated with ongoing and planned activities when foraging on benthic prey or resting on the bottom in relatively close proximity to cables. There are no data on EMF impacts on sea turtles associated with underwater cables. Migratory disruptions have been documented in sea turtles with magnets attached to their heads (Luschi et al. 2007), but evidence that EMF associated with planned offshore wind activities would likely result in some deviations from direct migration routes is lacking (Snoek et al. 2016). Any deviations are expected to be minor (Normandeau et al. 2011), and any increased energy expenditure due to these deviations would not be biologically significant.

Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters (Taormina et al. 2018). There are no data on cable heat effects on sea turtles (Taormina et al. 2018). However, increased heat in the sediment could affect benthic organisms that serve as prey for sea turtles that forage in the benthos. Based on the narrowness of cable corridors and expected weakness of thermal radiation, impacts on benthic organisms are not expected to be significant (Taormina et al. 2018) and would be limited to a small area around the cable. Given the expected cable burial depths, thermal effects would not occur at the surface of the seabed where sea turtles would forage. Therefore, any effects on sea turtle prey availability are anticipated to be negligible.

**Gear utilization:** Ongoing and planned offshore wind activities are expected to include monitoring surveys in the project areas. Sea turtles could be affected by these surveys through survey vessel traffic and interactions with survey gear. Survey vessels would produce underwater noise and increase the risk of vessel strikes. The effects of vessel noise and increased strike risk would be similar to those discussed under the *Noise* and *Traffic* IPFs.

Additional impacts on sea turtles could result from interactions with mobile (e.g., trawl, dredge) or fixed (e.g., trap, hydrophone) survey gear. Offshore wind projects are expected to use trawl surveys, among other methods, for project monitoring. The capture and mortality of sea turtles in fisheries utilizing bottom-trawls are well documented (Henwood and Stuntz 1987; NMFS and USFWS 1991, 1992; NRC 1990). Though sea turtles are capable of extended dive durations, entanglement and forcible submersion in fishing gear leads to rapid oxygen consumption (Lutcavage and Lutz 1997). Based on available research, restricting tow times to 30 minutes or less is expected to prevent sea turtle morality in trawl nets (Epperly et al. 2002; Sasso and Epperly 2006). BOEM anticipates trawl surveys for offshore wind project monitoring would be limited to tow times of 20 minutes, indicating that this activity poses a negligible risk of mortality. Additional mitigation measures would be expected to eliminate the risk of serious injury and mortality from forced submergence for sea turtles caught in bottom-trawl survey gear. Tows for clam dredge surveys would have a very short duration of 120 seconds, and the survey vessels would be subject to mitigation measures similar to those for the trawl survey. Therefore, effects of dredge surveys on sea turtles are anticipated to be negligible.

The vertical buoy and anchor lines associated with monitoring surveys using fixed gear, such as fish traps or baited remote underwater video, could pose a risk of entanglement for sea turtles. While there is a theoretical risk of sea turtle entanglement in trap and pot gear, particularly for leatherback sea turtles (NMFS 2016), the likelihood of entanglement would be negligible given the patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the relatively limited duration of each sampling event. BOEM also anticipates mitigation measures would be in place to reduce sea turtle interactions during fisheries surveys. Sea turtle prey species (e.g., crabs, whelks, and fish) may be collected as bycatch in trap gear. However, all bycatch is expected to be returned to the water and would still be available as prey for sea turtles regardless of their condition, particularly for loggerhead sea turtles, which are known to forage for live prey and scavenge dead organisms. Given the non-extractive nature of fixed gear surveys, any effects on sea turtles from the collection of potential sea turtle prey would be so small that they cannot be meaningfully measured, detected, or evaluated. Therefore, indirect effects on sea turtles due to collection of potential prey items would be negligible.

Hydrophone mooring lines for passive acoustic monitoring studies pose a theoretical entanglement risk to sea turtles, similar to trap and pot surveys. However, BOEM anticipates that monitoring studies utilizing moored systems would be required to use the best available technology to reduce any potential risks of entanglement. Therefore, passive acoustic studies are expected to pose a negligible risk of entanglement to sea turtles.

Monitoring surveys are expected to occur at short-term, regular intervals over the lifetime of a project. Though the potential extent and number of animals potentially exposed cannot be determined without project-specific information, impacts of gear utilization on sea turtles are expected to be negligible given the negligible risk of mortality, the negligible risk of entanglement, and the negligible effect on sea turtle prey availability.

**Lighting**: Vessels and offshore structures associated with ongoing and planned offshore wind activities will produce light at night. Lighting on vessels and offshore structures could elicit attraction, avoidance, or other behavioral responses in sea turtles. In laboratory experiments, juvenile loggerhead sea turtles consistently oriented toward light sticks of various colors and types used by pelagic longline fisheries (Wang et al. 2019), indicating that non-early life stage hard-shelled sea turtle species expected to occur in the vicinity of the Project (i.e., green, Kemp's ridley, and loggerhead) could be attracted to offshore light sources. In contrast, juvenile leatherback sea turtles failed to orient toward or oriented away from lights in laboratory experiments (Gless et al. 2008), indicating that life stages of this species expected to occur in the vicinity of the Project may not be attracted to offshore lighting. Any behavioral responses to offshore lighting are expected to be localized and temporary.

In ongoing and planned offshore wind activities described in Appendix D, 2,940 WTGs and 41 OSSs/ESPs and met towers would be constructed between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2). These offshore structures would have yellow flashing navigational lighting and red flashing FAA hazard lights, in accordance with BOEM's (2021a) lighting and marking guidelines. Following these guidelines, direct lighting would be avoided, and indirect lighting of the water surface would be minimized to the greatest extent practicable. As described in the previous paragraph, offshore lighting may attract juvenile green, Kemp's ridley, and loggerhead sea turtles, based on laboratory experiments. The flashing lights on offshore structures associated with ongoing and planned offshore wind activities are unlikely to disorient juvenile or adult sea turtles, as they do not present a continuous light source (Orr et al. 2013). There is no evidence that lighting on oil and gas platforms in the Gulf of Mexico, which may have considerably more lighting than offshore WTGs, has had any effect on sea turtles over decades of operation (BOEM 2019). Given that lighting of the water surface would be minimized and any behavioral responses in sea turtles would be localized and short term, lighting on offshore structures associated with planned offshore wind activities would have minor effects on sea turtles.

**Noise**: Ongoing and planned offshore wind activities would generate anthropogenic noise from aircraft, G&G surveys, offshore wind turbines, pile driving, cable laying, and vessels. See Section B.5 of Appendix B for information on the physical qualities of these noise sources. These noise sources have the potential to affect sea turtles through behavioral or physiological effects. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

**Noise: Aircraft.** Helicopters may be used to transport crew during construction and installation or O&M of offshore wind facilities. When aircraft travel at relatively low altitude, non-impulsive aircraft noise has the potential to elicit stress or behavioral responses (e.g., diving or swimming away or altered dive patterns) (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). Helicopters transiting to offshore wind facilities are expected to fly at sufficient altitudes to avoid behavioral effects on sea turtles, with the exception of WTG inspections, take-off, and landing. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area; these responses are not expected to be biologically significant.

**Noise: G&G surveys.** G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities. Site assessment and characterization activities are expected to occur intermittently over a 2- to 10-year period at locations spread throughout much of the geographic analysis area. Although schedules for many planned offshore wind activities are still being developed, it would be possible to avoid overlapping noise impacts on sea turtles by scheduling site assessment and characterization activities to avoid conducting simultaneous G&G surveys in proximity to each other. Such surveys can generate high-intensity, impulsive noise that has the potential to affect sea turtles through auditory injuries, stress, disturbance, and behavioral responses. TTS or PTS could occur if sea turtles are close to survey activities. However, TTS and PTS are considered unlikely, as sea turtles are expected to avoid survey activities, and survey vessels would be mobile (NSF and USGS 2011). BOEM has concluded that underwater noise associated with G&G surveys for offshore wind activities would likely result in temporary displacement and behavioral effects or biologically insignificant physiological effects (BOEM 2019) and has developed Project Design Criteria and Best Management Practices for offshore wind data collection activities (e.g., G&G surveys) to minimize impacts on protected species (BOEM 2021b) that lessees will be required to follow. Any resulting impacts on individual sea turtles are not expected to result in stock- or population-level effects.

**Noise: Impact and vibratory pile driving.** Ongoing and planned construction of offshore wind farms will generate impulsive and vibratory pile-driving noise during foundation installation. Pile driving is expected to occur for up to 7 to 9 hours at a time for monopiles, and 3 to 4 hours at a time for pin piles as 2,940 WTGs and 41 OSSs/ESPs and met towers are constructed between 2023 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2). The intense, impulsive noise associated with impact pile driving can cause behavioral or physiological effects. Potential behavioral effects of pile-driving noise include altered dive patterns, short-term disturbance, startle responses, and short-term displacement (NSF and USGS 2011; Samuel et al. 2005). Potential physiological effects include temporary stress response and, close to the pile-driving activity, TTS or PTS. Behavioral effects and most physiological effects are expected to be of short duration and localized to the ensonified area. BOEM expects that sea turtles would be displaced for up to 18 hours per day during foundation installation, depending on the type of WTG, OSS, ESP or met tower foundation. Therefore, any disruptions to foraging or other normal behaviors would be temporary, and increased energy expenditures associated with this displacement are expected to be small. It is possible that pile driving could displace animals into areas with lower habitat quality or higher risk (e.g., vessel collision or fisheries interaction).

Multiple construction activities within the same calendar year could potentially affect migration, foraging, breeding, and individual fitness. The magnitude of impacts would depend upon the locations, duration, and timing of concurrent construction; such impacts could be long term and of high intensity and high exposure level. For example, individuals repeatedly exposed to pile driving over a significant period of time (e.g., a season, a year, or a life stage) may incur energetic costs associated with avoidance movements that would be sufficient to cause long-term effects on individual fitness (Navy 2018). However, habituation may occur in sea turtles (Hazel et al. 2007), potentially reducing avoidance and reducing the impacts of repeated exposures.

**Noise: Operating WTGs.** Operating WTGs generate non-impulsive underwater noise that is audible to sea turtles. Available measurements of operational noise from WTGs of sizes ranging from 0.2 to 6.15 MW were evaluated in a study by Tougaard et al. (2020). Normalizing these various measurements to 328 feet (100 meters) from WTGs and to a wind speed of 33 feet (10 meters) per second, and calculating a best-fit regression led to predictions of root-mean-square sound pressure levels associated with operating WTGs ranging from approximately 105 to 120 dB re 1 µPa for 500 kW to 6 MW WTGs (Tougaard et al. 2020). WTGs selected or under consideration for ongoing and planned offshore wind activities (12 MW or greater) are considerably larger than those currently in operation. Operational sound levels produced by larger WTGs are expected to be greater than those discussed in Tougaard et al. (2020), but in all cases are expected to decrease to ambient levels within a relatively short distance from the turbine foundations (Kraus et al. 2016; Thomsen et al. 2015). At Block Island Wind Farm, turbine noise reaches ambient noise levels (i.e., 110 dB re 1 µPa) within 0.6 mile (1 kilometer) of the turbine foundations (Elliott et al. 2019). Maximum noise levels anticipated from operating WTGs are below recommended thresholds for sea turtle injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. Additionally, studies suggest that sea turtles acclimate to repetitive underwater noise in the absence of an accompanying threat (Bartol and Bartol 2011; Hazel et al. 2007; Navy 2018). As the best available data indicates that sound levels produced by operating WTGs would be below sea turtle behavior and injury thresholds, noise impacts on sea turtles from operating WTGs are expected to be negligible. If larger WTGs installed for planned offshore wind activities produce sound levels that exceed recommended thresholds, WTG noise may result in minor impacts on sea turtles.

**Noise: Cable laying.** Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. Modeling based on noise data collected during cable-laying operations in Europe estimates that underwater root-mean-square sound pressure levels would exceed 120 dB re 1 µPa in a 99,000-acre (40,000-hectare) area surrounding the source (Nedwell and Howell 2004; Taormina et al. 2018). As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the dynamic nature of the ensonified area, a given location would not be ensonified for more than a few hours. Therefore, it is unlikely that cable-laying noise would result in adverse effects on sea turtles.

**Noise: UXO detonations.** Planned offshore wind activities may encounter UXO on the seabed in their lease areas or along export cable routes. While non-explosive methods may be employed to lift and move these objects, some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could cause disturbance and injury to sea turtles, but the number of affected individuals would be small relative to the population sizes. The number and location of detonations that may be required for planned projects are relatively unknown.

**Noise: Vessels.** Vessels generate low-frequency (mostly 10 to 500 Hz) (MMS 2007), non-impulsive noise that could affect sea turtles. Vessel noise overlaps with the hearing range of sea turtles and may elicit behavioral responses, including startle responses and changes in diving patterns, or a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). It is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for sea turtles at any given time from 2023 to 2030. This increase in vessel activity could cause repeated, intermittent impacts on sea turtles due to short-term, localized behavioral responses, which would dissipate once the vessel leaves the area. Behavioral effects on individual sea turtles may occur; however, minimal stock- or population-level effects are expected given the localized and short-term nature of anticipated effects.

**Noise: Summary of impacts.** Based on the above discussion, BOEM anticipates that the impacts of noise on sea turtles from planned offshore wind activities would be minor. Impacts from noise from planned non-offshore wind activities would likely be minor because noise associated with these activities is anticipated to be localized, infrequent, and temporary.

**Port utilization**: The increased size of vessels and increased volume of vessel traffic associated with planned offshore wind activities will likely result in port expansion within the geographic analysis area. At least two proposed offshore wind projects are considering port expansion, and other ports along the East Coast may be upgraded to accommodate the development of offshore wind projects. Increased port utilization and expansion results in increased noise associated with vessels or pile driving for port expansion and increased suspended sediment concentrations during port expansion activities, including dredging and pile driving. The impacts of vessel noise on sea turtles are expected to be short term and localized, as previously described for the *noise* IPF in this section. Impacts on water quality associated with increased suspended sediment would also be short term and localized, as previously described for the *cable emplacement and maintenance* IPF in this section. Additionally, the area affected by benthic disturbance would be small compared to available foraging habitat.

Increased port utilization may require dredging at ports or within navigation channels to accommodate the large ships required to carry WTG components. In addition to benthic disturbance and increased suspended sediment concentrations, dredging can affect sea turtles through impingement, entrainment, or capture in the dredges, as described for the *cable emplacement and maintenance* IPF in this section. These impacts would be localized to nearshore habitats, and typical mitigation measures (e.g., timing restrictions) are expected to minimize risk to sea turtles. Therefore, risks of injury or mortality are considered low and population-level effects are unlikely to occur. For these reasons, the impacts of port utilization on sea turtles from planned offshore wind activities would likely be minor because the potentially affected habitats would be small relative to the habitat used by sea turtles in the geographic analysis area and any physical interactions with dredging equipment, were they to occur, would not result in population-level effects.

**Presence of structures**: An estimated 2,938 WTGs and 43 OSSs/ESPs and met towers could be built in the geographic analysis area due to ongoing and planned offshore wind activities. These structures would occupy open-water, pelagic habitat and would provide presently unavailable hard structure within the water column. Approximately 4,727 acres (1,913 hectares) of hard scour protection would be installed around the foundations, and an additional 8,158 acres (3,301 hectares) of hard protection would be installed around the export and interarray cables (Appendix D, Table D.A2-2). The rock and concrete material used for scour protection and cable protection represents presently unavailable benthic hard structure on the seabed. The installation of WTGs and OSSs/ESPs and hard protection could result in hydrodynamic changes; obstructions that cause loss of fish gear resulting in entanglement or ingestion by sea turtles; habitat conversion from open-water pelagic and benthic soft substrates to structurally complex, mid-water and benthic hard bottom; new areas of prey aggregation; avoidance or displacement; and behavioral disruption.

The presence of foundations for WTGs, OSSs/ESPs, and met towers could alter local hydrodynamic patterns at a fine scale. Water flows are reduced immediately downstream of foundations but return to ambient levels within a relatively short distance (Miles et al. 2017). The downstream area affected by reduced flows is dependent on pile diameter. For monopiles (i.e., the structures with the largest diameter), effects are expected to dissipate within 300 to 400 feet (91 to 122 meters). Individual foundations may increase vertical mixing and deepen the thermocline, potentially increasing pelagic productivity locally (English et al. 2017; Kellison and Sedberry 1998). A recent modeling study found that offshore wind structures could deepen the thermocline in the WTA by 3.3 to 6.6 feet (1 to 2 meters) and also lead to a greater retention of cooler water in the WTA during the summer (Johnson et al. 2021). Although effects from individual structures are highly localized, the presence of an estimated 2,939 WTGs could result in regional impacts on wind wave energy, mixing regimes, and upwelling (van Berkel et al. 2020).

Modeling in the North Sea demonstrated that offshore wind farms have the potential to reduce wind speed at the water surface and in turn influence temperature and salinity distribution in the wind farm area (Christiansen et al. 2022). In comparison to long-term variation in temperature and salinity, wind farm effects were relatively small. However, impacts on stratification strength at a large scale and atypical mesoscale variations in current may occur (Christiansen et al. 2022). Wind wakes induced by large offshore wind farm clusters in the North Sea have been shown to result in large-scale changes in annual primary production with local changes (increase/decrease) of up to 10 percent, while region-wide averages in estimated annual primary production remain almost unchanged (Daewel et al. 2022). Golbazi et al. (2022) modeled the effects of 10 MW turbines in WEAs off the eastern coast of the United States and found that wind speed, among other meteorological metrics, would be reduced at the surface. However, these reductions would be negligible (Golbazi et al. 2022). Conversely, infrastructure associated with offshore wind farms may increase mixing, particularly in stratified shelf seas (Carpenter et al. 2016; Dorrell et al. 2022; Schultze et al. 2020). Stratification may influence the mixed layer depth, which in turn affects primary productivity. Increased mixing during summer, when the water column is typically stratified, could increase primary productivity around offshore wind facilities (English et al. 2017; Kellison and Sedberry 1998). Alterations in primary productivity may alter typical distributions of fish and invertebrates on the OCS, which are normally driven by primary productivity associated with cold pool upwelling (Chen et al. 2018; Lentz 2017; Matte and Waldhauer 1984). These localized and regional alterations to hydrodynamics could have impacts on sea turtle prey species. Fine-scale effects on water flow could have localized impacts on prey distribution and abundance. Regional hydrodynamic effects could affect prey species at a broader scale. Effects on surface currents could influence patterns of larval distribution (Johnson et al. 2021) and seasonal mixing regimes could influence primary productivity, both of which could in turn affect the distribution of fish and invertebrates on the OCS (Chen et al. 2018; Lentz 2017; Matte and Waldhauer 1984). Hydrodynamic alterations due to the presence of offshore wind foundation structures could increase primary productivity in the vicinity of the structures (Carpenter et al. 2016; Schultze et al. 2020). However, such an increase would be highly localized, and the increased productivity may be consumed by filter feeders colonizing the structures (Slavik et al. 2019) rather than leading to increased prey abundance for sea turtles. A recent National Academy of Sciences panel convened to assess potential impacts from offshore wind farms in the Nantucket Shoals region on marine hydrodynamics and the availability of zooplankton prey confirmed that although these effects may occur, they would not likely be distinguishable from the other physical and biological factors affecting the occurrence of prey in the region. The panel noted that “the paucity of observations and uncertainty of the modeled hydrodynamic effects make it difficult to assess the ecological impacts of offshore wind farms, particularly considering the scale of both natural and human-caused variability in the Nantucket Shoals region....” (NASEM 2023).

In-water structures associated with ongoing activities may serve as artificial reefs, resulting in increased recreational fishing activity in the vicinity of the structures. An increase in recreational fishing activity increases the risk of sea turtles becoming entangled in or ingesting lost fishing gear, which could injure or kill sea turtles. Specifically, entanglement and hooking can cause abrasions, loss of limbs, or increased drag resulting in reduced swimming efficiency and decreased ability to forage or avoid predators (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Between 2016 and 2018, 186 sea turtles were observed to have been hooked or entangled by recreational fishing gear. Although recreational fishermen would be expected to disperse effort across many WTG foundations to avoid overcrowding, risk of entanglement and ingestion of fishing gear could increase as fishermen and sea turtles are attracted to the structures.

Although the artificial reef effect could increase risk of interactions with recreational fishing gear, this effect could also benefit sea turtles due to prey aggregation. In-water structures result in the conversion of open-water and soft-bottom habitat to hard-bottom habitat. This habitat conversion attracts and aggregates prey species (Causon and Gill 2018; Taormina et al. 2018), essentially creating artificial reefs. The aggregation of prey at artificial reefs can result in increased foraging opportunities for sea turtles. In the Gulf of Mexico, green, Kemp’s ridley, leatherback, and loggerhead sea turtles have been documented in the presence of offshore oil and gas platforms (Gitschlag and Herczeg 1994; Gitschlag and Renauld 1989; Hastings et al. 1976; Rosman et al. 1987), indicating that sea turtles are likely to use habitat created by in-water structures in the geographic analysis area. However, increased foraging opportunities are not expected to be biologically significant given the broad geographic range used by sea turtles on their annual foraging migrations compared to the localized scale of artificial reef effects.

Though sea turtle prey may be aggregated through the reef effect, it may also aggregate sea turtle predators. In field surveys of artificial and natural reefs off North Carolina conducted by Paxton et al. (2020), higher densities of large, reef-associated predators, specifically transient predators, were observed on artificial reefs than natural reefs. The aggregation of transient predators (e.g., sharks, barracuda, jacks, and mackerel) at artificial reefs was associated with greater vertical relief (Paxton et al. 2020), indicating that the vertical structure provided WTG foundations may attract relatively high densities of sharks. The attraction of both sea turtles and their predators to offshore wind structures may increase predation risk for sea turtles. Though the potential for increased predation risk associated with the presence of structures may affect individual sea turtles, it is not expected to result in population-level effects given the localized scale of artificial reef effects compared to the geographic range of sea turtles.

The presence of offshore wind facility structures could result in sea turtle avoidance and displacement, which could potentially move sea turtles into areas with lower habitat value or with a higher risk of vessel collision or fisheries interactions. Any avoidance or displacement is expected to be short term. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of offshore wind farms. Assuming fishing vessels are displaced to adjacent areas, risk of interaction with fishing vessels would not be greater than current risk given the patchy distribution of sea turtles. Presence of structures could potentially lead to a shift in gear types due to displacement. If displacement leads to an overall shift from mobile to fixed gear types, there could be an increased number of vertical lines in the water, increasing the risk of sea turtle interactions with fishing gear.

Disruption of normal behaviors, such as foraging and migration, could occur due to the presence of offshore structures. Although 2,938 WTGs and 43 and OSS/ESP and met tower structures are anticipated, spacing would be sufficient to allow sea turtles to utilize habitat between and around structures for foraging, resting, and migrating. Although individual migrations could be temporarily interrupted as sea turtles stop to forage or rest around structures, the presence of structures is not expected to result in measurable changes in general sea turtle migratory patterns.

Given the available information, the risk of injury to or mortality of individual sea turtles due to the presence of structures from planned offshore wind activities, and the interactions with fishing gear that they may cause, would be minor and population-level effects are unlikely to occur. Likewise, any beneficial impacts from the reef effect would be minor, as individuals may benefit but there would be no population-level effects.

**Traffic**: Offshore wind activities would result in increased vessel traffic due to vessels transiting to and from individual lease areas during construction and installation, O&M, and decommissioning.

Vessel strikes are an increasing concern for sea turtles. The percentage of stranded loggerhead sea turtles with injuries that were apparently caused by vessel strikes increased from approximately 10 percent in the 1980s to over 20 percent in 2004, although some stranded turtles may have been struck post-mortem (NMFS and USFWS 2007). Sea turtles are expected to be most vulnerable to vessel strikes in coastal foraging areas and may not be able to avoid collisions when vessel speeds exceed

2 knots (4 kilometers per hour) (Hazel et al. 2007). Average vessel speeds in the geographic analysis area may exceed 10 knots (19 kilometers per hour). Therefore, increased vessel traffic may result in sea turtle injury or mortality. It is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for sea turtles at any given time from 2023 to 2030. This increase in traffic would only be a small, incremental increase in overall traffic in the geographic analysis area (see Section 3.6.6, *Navigation and Vessel Traffic*).

The risk of vessel strike from offshore wind vessels would be dependent on the density of sea turtles in each project area, as well as the stage of the project, the time of year, the number of vessels utilized for each project, and the speed of each vessel. Collision risk is expected to be greatest when offshore wind vessels transit between the lease areas and ports utilized by each project as vessel speeds would be highest and turtles are expected to be most susceptible to strike in coastal foraging areas. The increased collision risk associated with this incremental increase in vessel traffic may result in injury or mortality of individual sea turtles. The risk would be greatest for species with the highest densities in a given project area. The increased risk of vessel strike would not be expected to have stock- or population-level impacts on sea turtles given their low densities in the geographic analysis area and patchy distribution. Additionally, minimization measures for vessel impacts would be required for planned offshore wind activities, further reducing the risk of injury or mortality for sea turtles. Therefore, BOEM anticipates that the impact of vessel strikes on sea turtles from planned offshore wind activities would be minor. Impacts from traffic from planned non-offshore wind activities would likely be minor because although marine traffic is increasing, population-level impacts from vessel strikes alone have not been demonstrated.

#### *Conclusions*

**Impacts of Alternative A – No Action.** Under the No Action Alternative, sea turtles would continue to be affected by existing environmental trends and ongoing activities.

The No Action Alternative, including ongoing non-offshore wind and offshore wind activities, impacts would range from negligible to minor adverse across individual IPFs. BOEM anticipates that adverse impacts of ongoing activities associated with the traffic and noise IPFs would be minor. Other adverse impacts associated with ongoing activities are expected to be negligible, particularly those impacts associated with the electric and magnetic fields and cable heat, accidental releases, and lighting IPFs. Overall, BOEM anticipates that adverse impacts associated with ongoing activities would be **minor** because impacts would be detectable and measurable but would not result in population-level effects.

**Cumulative Impacts of Alternative A – No Action.** For the No Action Alternative, BOEM expects that ongoing and planned activities would result in continuing temporary to permanent impacts on sea turtles. Impacts of ongoing activities, planned activities other than offshore wind, and planned offshore wind activities would range from **negligible to minor adverse** across individual IPFs and could include **minor beneficial** impacts. Adverse impacts would result mainly from pile-driving noise, presence of structures, and vessel traffic. Habitat conversion and prey aggregation associated with the presence of structures could result in minor beneficial impacts due to increased foraging opportunities for sea turtles. These effects would be localized and are not expected to affect individual fitness. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures as well as a potential increase in predator presence. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in **minor** impacts because impacts on sea turtles would be detectable and measurable but no population-level effects would occur.

### 3.5.7.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Foundation types used for WTGs, OSSs, and the met tower;
- The number of WTG, OSS, and met tower foundations installed; and
- The size of foundations installed.

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

- WTG, OSS, and met tower foundation types: the type(s) of foundation installed affects the impacts associated with installation.
- WTG, OSS, and met tower foundation number: the number of foundations installed affects the duration of potential pile driving. The more foundations, the longer the duration of pile driving would be.
- WTG, OSS, and met tower foundation size: the size of the pile affects the amount of noise produced during potential pile driving and thus the size of the ensonified area. Generally, a larger pile would result in a larger ensonified area.

Although variation is expected in the design parameters, the impact assessments in Sections 3.5.7.5 through 3.5.7.7 evaluate impacts associated with the maximum-case scenario for sea turtles identified in Appendix C.

### 3.5.7.5 Impacts of Alternative B – Proposed Action on Sea Turtles

As described in Section 2.1.2, the Proposed Action includes the construction of up to 200 WTGs, up to 10 OSSs, and up to 1 met tower, and the installation of up to 547 miles (880 kilometers) of interarray cables, 37 miles (60 kilometers) of interlink cables, and 441 miles (710 kilometers) of export cables between 2025 and 2028. The Proposed Action also includes 30 years of O&M over a 30-year commercial lifespan and decommissioning activities at the end of commercial life.

*Onshore Activities and Facilities*

Onshore construction and installation, O&M, and decommissioning activities for the Proposed Action are not expected to contribute to IPFs for sea turtles.

*Offshore Activities and Facilities*

**Accidental releases**: The Proposed Action may increase accidental releases of fuels, fluids, hazardous materials, and trash and debris during the construction and installation, O&M, and decommissioning phases of the Project. However, accidental releases are considered unlikely to occur. All Project vessels would comply with USCG regulations for the prevention and control of oil spills (33 CFR Part 155) (WAT-05; Appendix G, Table G-1), further reducing the likelihood of an accidental release. Atlantic Shores has also developed an OSRP (COP Volume I, Appendix I-D; Atlantic Shores 2024) with measures to prevent accidental releases and a protocol to respond to such a release (WAT-03; Appendix G, Table G-1). As accidental releases are not expected to occur, there would be no consequences to individual sea turtles or sea turtle populations. Therefore, the impacts are anticipated to be negligible.

**Cable emplacement and maintenance**: The Proposed Action would involve the placement of 1,025 miles (1,650 kilometers) of export, interlink, and interarray cables and the disturbance of approximately 4.1 square miles (10.6 square kilometers) of seabed for the emplacement of export cables (including anchoring disturbance), 0.3 square mile (0.7 square kilometer) of seabed for the emplacement of interlink cables, and 3.4 square miles (8.7 square kilometers) of seabed for the emplacement of interarray cables. The presence of algae or plant-like animals was visually documented at a small number of benthic sampling stations (4 out of 121) (COP Volume II, Appendix II-G2; Atlantic Shores 2024). The algae was characterized as seaweed and was observed at depths in excess of 66 feet (20 meters). Based on a review of SAV maps published by NJDEP in the vicinity of the Project, there are no documented occurrences of SAV in the Offshore Project area. See Section 3.5.2 for a detailed analysis of impacts on benthic resources (e.g., SAV).

As described in Section 3.5.7.3, *Impacts of Alternative A – No Action on Sea Turtles,* cable emplacement and maintenance activities disturb bottom sediment, temporarily increasing suspended sediment concentrations, which could result in behavioral effects on sea turtles or effects on sea turtle prey species for Kemp's ridley sea turtle, which forages in soft bottom habitats. As cable emplacement and maintenance activities are not expected to affect hard bottom or pelagic habitats or SAV beds, no effects on green, leatherback, or loggerhead prey species or foraging habitat are anticipated. Cable emplacement is expected to affect only a small percentage of foraging habitat available to Kemp's ridley sea turtles, and any effects on Kemp's ridley sea turtles or their prey species would be localized and short term. Recolonization and recovery of prey species is expected to occur within 2 to 4 years (Van Dalfsen and Essink 2001) but could occur in as little time as 100 days (Dernie et al. 2003). Given the short-term and localized nature of impacts and the available sea turtle habitat in the geographic analysis area, impacts of new cable emplacement on sea turtles are expected to be minimal.

Cable emplacement and maintenance for the Proposed Action may require sand bedform removal. Potential methods for removal include trailing suction hopper dredge, as well as cutterhead or backhoe dredging in limited areas. Dredging would result in increased suspended sediment concentrations and may result in physical interactions with the dredge (i.e., entrainment, impingement, or capture). As described in Section 3.5.7.3, increased suspended sediment concentrations could result in behavioral effects on sea turtles or effects on sea turtle prey species. Increased suspended sediment concentrations associated with hopper dredges may reach 475.0 mg/L (NMFS 2020 citing Anchor Environmental 2003) and could occur within a radius of up to 3,937 feet (1,200 meters) (NMFS 2020 citing Wilber and Clarke 2001). Increased suspended sediment concentrations associated with cutterhead dredging could reach 550.0 mg/L (NMFS 2020 citing Nightengale and Simenstad 2001) and would occur within a radius of up to 1,640 feet (500 meters) (NMFS 2020 citing Hayes et al. 2000; NMFS 2020 citing LaSalle 1990; NMFS 2020 citing USACE 1983). Elevated suspended sediment concentrations associated with mechanical dredging (e.g., backhoe dredging) could reach 445.0 mg/L (NMFS 2020 citing USACE 2001) and would occur within a radius of up to 2,400 feet (732 meters) (NMFS 2020 citing Burton 1993; NMFS 2020 citing USACE 2015). Elevated suspended sediment concentrations have adverse effects on benthic communities when they exceed 390 milligrams per liter (USEPA 1986). See Section 3.5.5 for a discussion of impacts on prey species. There are no data to suggest that suspended sediment has physiological effects on sea turtles.

Dredging associated with cable emplacement may also result in physical interactions with the dredge (i.e., entrainment, impingement, or capture). As described in Section 3.5.7.3, hopper dredges may result in injury or mortality of sea turtles (Ramirez et al. 2017; Ramirez et al. 2017 citing Dickerson et al. 1990, 1991; Ramirez et al. 2017 citing Reine et al. 1998; Ramirez et al. 2017 citing Richardson 1990), but mechanical dredging is not expected to capture, injure, or kill sea turtles (USACE 2020). Sea turtles are generally not known to be vulnerable to entrainment in cutterhead dredges. Based on the small size of their intake and relatively low intake velocity, cutterhead dredges are not expected to entrain sea turtles (NMFS 2018). Though hopper dredging would be the primary dredging method for sand bedform removal, the risk of injury or mortality of individual sea turtles due to dredging associated with offshore wind activities, which generally occurs in offshore waters, is considered low.

Given the available information, the risk of injury or mortality of individual sea turtles resulting from dredging necessary to support offshore wind project construction would be low and any impacts are anticipated to be minor as population-level effects are unlikely to occur.

**Electric and magnetic fields and cable heat**: During operation, the Proposed Action would result in the production of EMFs and heat. Though there are no data on EMF impacts on sea turtles associated with underwater cables, magnets can cause migratory disruptions (Luschi et al. 2007), indicating that EMFs could cause migratory deviations. Results of Atlantic Shores' EMF study (COP Volume II, Appendix II-I; Atlantic Shores 2024) indicate that EMFs from the Project would pose minimal risk to sea turtles. Given these results and the minor deviations, if any, that would be expected from EMFs associated with offshore wind activities, any increased energy expenditure due to migratory deviations would not be biologically significant for sea turtles. Heat has the potential to impact benthic species, which serve as prey for some sea turtle species, as described in Section 3.5.7.3. Atlantic Shores would bury cables to a target depth of 5 to 6.6 feet (1.5 to 2 meters) wherever possible (GEO-07; Appendix G, Table G-1). In areas where sufficient cable burial is not feasible, surface cable protection would be utilized. Cable burial and surface protection, where necessary, would minimize EMF and heat exposure. Any potential impacts on sea turtles from EMFs and heat associated with the Proposed Action are expected to be non-measurable, negligible impacts, if any, on sea turtle behavior.

**Gear utilization:** Monitoring surveys for the Proposed Action include otter trawl surveys, trap surveys, hydraulic clam dredge surveys, grab sampling, and underwater imagery. As described in Section 3.5.7.3, mobile gear surveys (e.g., trawl and dredge surveys) have the potential to capture sea turtles, and fixed gear surveys with vertical lines (e.g., trap surveys) have the potential to entangle sea turtles. Trawl surveys for the Proposed Action would be limited to 20 minutes and would not be expected to result in mortality of sea turtles if incidentally captured (Epperly et al. 2002; Sasso and Epperly 2006). BOEM anticipates capture probability in otter trawls to be low and expects incidentally caught turtles to resume normal behavior upon release. Therefore, the risk to sea turtles from otter trawl surveys would be negligible. The short tow times of clam dredge surveys are expected to minimize risk of sea turtle interaction. Therefore, effects of clam dredge surveys are expected to be negligible. For trap surveys, ropeless gear is preferred, which would eliminate vertical lines. Should the use of roped gear be necessary due to logistical or permitting constraints, an estimated 12 vertical lines would be utilized. The likelihood of entanglement in trap surveys for the Proposed Action would be negligible given the patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the relatively limited duration of each sampling event. Additionally, ventless trap surveys for the Proposed Action would utilize groundlines, ropeless gear, and biodegradable components to further reduce entanglement risk. Monitoring survey sampling events are expected to be short term, occurring at fixed intervals over the lifetime of the Proposed Action.

Sea turtles could also be affected by these surveys through survey vessel traffic. Survey vessels would produce underwater noise and increase the risk of vessel strikes. The effects of vessel noise and increased strike risk would be similar to those discussed under the *Noise* and *Traffic* IPFs in this section.

In addition to direct effects on sea turtles, monitoring surveys may indirectly affect these species through capture of prey items. However, biological monitoring proposed for the Project is expected to be non-extractive, returning captured organisms at the end of each sampling event. Therefore, indirect effects on sea turtles due to collection of potential prey items would be negligible, as described in Section 3.5.7.3.

Because trawl surveys for Project monitoring could lead to potential capture or minor injury of small numbers of sea turtles, gear utilization impacts on sea turtles would likely be minor.

**Lighting**: The construction and installation, O&M, and decommissioning of the Project would produce artificial light on the OCS. Vessels and lighting of heavy equipment in work areas would produce short-term, continuous light. Offshore structures would be sources of long-term, intermittent light.

Project vessels would have deck and safety lighting. Vessel operation would be greatest during the construction and installation phase of the Project. The Proposed Action includes lighting of up to 51 vessels,[2] though a maximum of 16 vessels are expected to operate at one time for a given construction and installation activity. These vessel numbers represent a small fraction of the light sources anticipated under Alternative A. Lighting of heavy equipment in work areas during the construction and installation and decommissioning phases of the Project would also introduce continuous artificial light to the OCS. Such lighting would be short term and would represent a small fraction of light sources anticipated under the No Action Alternative.

Under the Proposed Action, up to 200 WTGs, 1 met tower, 4 metocean buoys, and 10 OSSs would be lit with USCG navigational and FAA hazard lighting. In accordance with BOEM lighting guidelines (BOEM 2021a), all WTGs in excess of 699 feet (213 meters) above ground level would be lit with two synchronized red flashing obstruction lights (with medium-intensity FAA model L-864 and light-emitting diode color between 800 and 900 nanometers) placed on the back of the nacelle on opposite sides, and up to three FAA model L-810 red flashing lights at mid-mast level, adding up to 1,000 new red flashing lights to the offshore environment where none currently exist. Additionally, marine navigation lighting would consist of multiple types of flashing yellow lights on the corners of each OSS, corner-located WTGs, and significant peripheral structures such as a met tower, outer boundary WTGs, and interior WTGs. Atlantic Shores is considering use of an FAA-approved ADLS (COP Volume II, Section 4.3.2.2; Atlantic Shores 2024) (VIS-05; Appendix G, Table G-1), subject to FAA and BOEM approval, which is a lighting system that would only activate WTG and met tower lighting when aircraft enter a predefined airspace. For the Proposed Action, based on historical air traffic data, obstruction light activation under ADLS was estimated to occur less than 9 hours over the course of 1 year for flights passing through the Project light activation volume, which equals less than 1 percent of the time that full-time obstruction lights would be active (COP Volume II, Appendix II-M4; Atlantic Shores 2024).

As discussed in Section 3.5.7.3, light may elicit short-term, localized behavioral impacts in sea turtles, including attraction or avoidance. Light may also affect prey for some sea turtle species (Section 3.5.5). Vessel mast lighting and FAA lighting are expected to be too high to penetrate the water surface. However, deck lighting, equipment lighting, and navigation lighting on structures at the perimeters of the wind farm would be close to sea level and could penetrate the water surface. Artificial Project lighting that would penetrate the surface is expected to be localized and minimal. Additionally, there is no evidence that lighting on oil and gas platforms in the Gulf of Mexico has had any effect on sea turtles over decades of operation (BOEM 2019). Therefore, light associated with the Proposed Action is expected to have a minor effect on sea turtles.

**Noise:** Underwater anthropogenic noise sources associated with construction and installation and O&M of the Proposed Action would include G&G surveys, pile driving, cable laying, WTGs, vessels, and potentially aircraft. As described in Section 3.5.7.3, these noise sources have the potential to affect sea turtles through behavioral or physiological effects. Underwater sound propagation modeling for impact pile driving was conducted in support of the COP (see COP Volume II, Appendix II-L1; Atlantic Shores

[2] This is the maximum number of vessels that could be present at a given time in the unlikely event that all construction and installation activities for the Project were to occur simultaneously.

2024). The potential impacts associated with each noise source are discussed separately in the following paragraphs.

**Noise: Aircraft.** Aircraft may be used to support construction and installation of the Proposed Action. Helicopters may be used for crew transfer operations or visual inspection of equipment during installation. Atlantic Shores may utilize fixed-wing aircraft to support environmental monitoring and mitigation during construction and installation activities. As described in Section 3.5.7.3, aircraft traveling at relatively low altitude have the potential to elicit stress or behavioral responses in sea turtles (BOEM 2017; NSF and USGS 2011; Samuel et al. 2005). BOEM assumes aircraft transiting to and from the Project area would fly at sufficient altitudes to avoid behavioral effects on sea turtles, with the exception of inspections, take-off, and landing. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area, and are not expected to be biologically significant.

**Noise: Dredging.** Dredging may be required for seabed preparation prior to foundation installation, sand bedform clearing prior to cable installation, and excavation of the offshore HDD entrance/exit near the cable landing sites. Project dredging may utilize a trailing suction hopper dredge, a cutterhead dredge, and/or a backhoe dredge. Hydraulic suction dredging (e.g., trailing suction hopper dredging or cutterhead dredging) produces sounds ranging in frequency from approximately 1 to 2 kHz, with reported source levels of 172 to 190 dB re 1 µPa-m (McQueen et al. 2019; Robinson et al. 2011; Todd et al. 2015). Reported sound levels of mechanical dredges range from 107 to 124 dB re 1 µPa at 505 feet (154 meters) from the source with peak frequencies of 162.8 Hz (Dickerson et al. 2001; McQueen et al. 2019). Given the source levels produced by dredging, Project dredging is unlikely to exceed PTS thresholds for sea turtles. Behavioral effects could occur but would be temporary, with effects dissipating once the activity has ceased or the individual has left the area and are not expected to be biologically significant.

**Noise: G&G surveys.** HRG surveys may be conducted during construction and installation to support site clearance activities. As described in Section 3.5.7.3, G&G survey noise could affect sea turtles through auditory injuries, stress, disturbance, and behavioral responses. However, HRG survey equipment produces less-intense noise and operates in smaller areas than other G&G survey equipment (e.g., seismic air guns). Sound levels produced by HRG survey equipment are not expected to cause hearing damage in sea turtles, though behavioral effects could occur (BOEM 2014). Atlantic Shores has proposed the establishment and monitoring of protection zones (e.g., clearance zone, shutdown zone) to create sufficient opportunity to modify or halt Project activities, such as HRG surveys, potentially harmful to protected species (SEA-03; Appendix G, Table G-1). These zones would be visually monitored by NMFS-approved PSOs, which would alert Project personnel to the presence of protected species within these zones and would be equipped with night vision devices for monitoring during low-visibility conditions (SEA-04, Appendix G, Table G-1). Additionally, Atlantic Shores has proposed the implementation of equipment operating procedures to control the noise generated by survey equipment to prevent exposure of harmful sound levels to protected marine life, including ramp-up and ramp-down procedures (SEA-06; Appendix G, Table G-1). BOEM expects any noise impacts associated with HRG surveys would be minor.

**Noise: Impact and vibratory pile driving**. The loudest source of underwater noise associated with the Proposed Action would be impact pile driving during construction and installation. As noted above, underwater sound propagation modeling for impact pile driving was conducted in support of the COP (see COP Volume II, Appendix II-L1; Atlantic Shores 2024).

PTS thresholds developed by Finneran et al. (2017) were used to estimate acoustic ranges ($R_{95\%}$), radial distances that encompass 95 percent of the areas exposed to SELs above recommended sea turtle injury thresholds for impact pile driving (Table 3.5.7-6). For 49-foot (15-meter) monopiles (i.e., the maximum foundation pile diameter modeled), impact pile-driving sound levels could exceed recommended sea turtle injury thresholds up to 2.2 miles (3.5 kilometers) away, without sound mitigation (Table 3.5.7-5). Assuming 10 dB of noise attenuation due to noise-mitigating technology, the level of attenuation generally expected to be achievable by a single noise attenuation system (Bellman et al. 2020) and required for mitigation for the Proposed Action's LOA, recommended sea turtle injury thresholds could be exceeded within 0.8 mile (1.3 kilometers) of pile driving (Table 3.5.7-5). Exposure ranges ($ER_{95\%}$) were estimated from modeled sea turtle movements in the Offshore Project area. These ranges represent the radial distance from a pile-driving noise source which encompassed the closest point of approach for 95 percent of simulated animals (animats) exposed above relevant cumulate SEL injury thresholds. Taking expected sea turtle movements in the Offshore Project area into account, the injury exposure ranges are modeled to be up to 0.9 mile (1.5 kilometers) without mitigation and up to 0.14 miles (0.22 kilometers) with 10 dB of noise attenuation (see COP Volume II, Appendix II-L1, Tables 38 and 39; Atlantic Shores 2024).

**Table 3.5.7-5. Acoustic Ranges ($R_{95\%}$), in kilometers to cumulative SEL injury thresholds for one 15-meter monopile using a Menck MHU4400S hammer at two selected modeling locations**

| | Threshold (dB) | Attenuation Level (dB) | |
|---|---|---|---|
| | | 0 | 10 |
| Sea turtles | 204 | 3.50 | 1.30 |

Source: Summarized from COP Volume II, Appendix II-L1, Table F-90; Atlantic Shores 2024.

To estimate exposure ranges for behavioral reactions to impact pile driving, the behavioral threshold developed by McCauley et al. (2000) was used (Table 3.5.7-6). Without mitigation, exposure ranges for sea turtle behavioral thresholds were modeled to be up to 1.8 miles (3.0 kilometers). Assuming 10 dB of noise attenuation due to noise-mitigating technology, exposure ranges for behavioral thresholds were modeled to be up to 0.9 mile (1.4 kilometers).

**Table 3.5.7-6. Recommended sea turtle acoustic thresholds for impulsive noise sources**

| PTS Onset | | Behavior |
|---|---|---|
| Lpk[1] | SEL[2] | Lrms[3] |
| 232 | 204 | 175 |

Sources: Finneran et al. 2017; McCauley et al. 2000.
[1] Lpk = peak sound pressure level in decibels referenced to 1 microPascal.
[2] SEL = sound exposure level in decibels referenced to 1 microPascal squared second.
[3] Lrms = root-mean-square sound pressure level in decibels referenced to 1 microPascal.

Sea turtle noise exposure was modeled with and without noise mitigation for three construction schedules. The construction schedules included a seasonal pile driving restriction (January–April) to mitigate effects on NARW. Construction Schedule 3 (Table 3.5.7-7), which assumes a 1-year buildout, resulted in the highest number of sea turtle exposures[3] assuming 10 dB of noise attenuation. Without mitigation, an estimated 2 green sea turtles, 42 Kemp's ridley sea turtles, 14 leatherback sea turtles, and 299 loggerhead sea turtles are expected to be exposed to sound levels exceeding recommended injury thresholds (Table 3.5.7-8). An estimated 4 green sea turtles, 137 Kemp's ridley sea turtles, 73 leatherback sea turtles, and 2,944 loggerhead sea turtles could be exposed to sound levels exceeding recommended behavioral thresholds. Assuming 10 dB of noise attenuation, 1 green sea turtle, 3 Kemp's ridley sea turtles, and 2 leatherback sea turtles, and 15 loggerhead sea turtles are expected to be exposed to sound levels exceeding recommended injury thresholds; an estimated 2 green sea turtles, 51 Kemp's ridley sea turtles, 24 leatherback sea turtles, and 915 loggerhead sea turtles could be exposed to sound levels exceeding recommended behavioral thresholds (Table 3.5.7-8).

**Table 3.5.7-7. Days of pile driving for each pile type, hammer type, and driving schedule under Construction Schedule 3**

| Construction Month | Number of Days | | |
|---|---|---|---|
| | WTG Monopile 15-Meter Diameter MHU4400S (1 pile/day) | WTG Monopile 15-Meter Diameter IHCS2500 (2 piles/day) | OSS Jacket 5-Meter Diameter IHCS2500 (4 piles/day) |
| May | 9 | 3 | 0 |
| Jun | 8 | 16 | 6 |
| Jul | 10 | 15 | 6 |
| Aug | 0 | 25 | 6 |
| Sep | 1 | 12 | 6 |
| Oct | 13 | 6 | 0 |
| Nov | 3 | 1 | 0 |
| Dec | 1 | 0 | 0 |
| Total # of Days | 45 | 78 | 24 |

Source: Summarized from COP Volume II, Appendix II-L1, Table 3; Atlantic Shores 2024.
Note: Construction Schedule 3 is presented as it resulted in the highest number of sea turtle exposures among the construction schedules modeled.

[3] Each exposure represents an individual animal exposed to sound levels exceeding the recommended acoustic thresholds.

**Table 3.5.7-8. Number of sea turtles estimated to be exposed to behavioral and injury thresholds with and without noise mitigation[1]**

| Species | 0 dB Attenuation | | 10 dB Attenuation | |
|---|---|---|---|---|
| | Behavioral | Injury | Behavioral | Injury |
| Green | 4 | 2 | 2 | 1 |
| Kemp's ridley | 137 | 42 | 51 | 3 |
| Leatherback | 73 | 14 | 24 | 2 |
| Loggerhead | 2,944 | 299 | 915 | 15 |

Source: Summarized from COP Volume II, Appendix II-L1, Table 21; Atlantic Shores 2024.
[1] Schedule 3: up to two 49-foot-diameter (15-meter-diameter) WTG or met tower monopile and four 16-foot-diameter (5-meter-diameter) OSS jacket piles per day.

As described in Section 3.5.7.3, pile driving can result in behavioral and physiological effects on sea turtles. Atlantic Shores has proposed measures to avoid, minimize, and mitigate impacts of pile-driving noise on sea turtles, including utilization of PSOs to monitor and enforce appropriate clearance and shutdown zones (SEA-03, SEA-04; Appendix G, Table G-1), noise-reducing technologies and potential use of soft starts (SEA-06; Appendix G, Table G-1), and scheduling pile driving to avoid completion after dark when sea turtles are difficult to observe (SEA-05; Appendix G, Table G-1). Atlantic Shores has stated that pile driving could be initiated at any time during a 24-hour period if there is an approved nighttime piling plan. If Atlantic Shores requests to conduct nighttime pile driving, BOEM will require Atlantic Shores to develop an Alternative Monitoring Plan for pile driving that incorporates devices that meet or exceed the standards currently being used to monitor the full extent of the established shutdown and clearance zones with the same efficiency as daytime monitoring (e.g., mounted thermal/infrared camera systems, hand-held or wearable night vision devices, infrared spotlights) to detect protected marine mammal and sea turtle species. The plan will be reviewed and approved by NMFS and BOEM. If the plan does not sufficiently address the concerns and demonstrate the efficacy of the technology for the Alternative Monitoring Plan for Nighttime Pile Driving, then nighttime impact pile driving would not occur. Specifically, no new piles could be initiated after dark if BOEM and NMFS do not approve the nighttime monitoring plan and the technology proposed. If there is no approved plan, pile driving during nighttime hours could only occur if unforeseen circumstances prevent the completion of pile driving during daylight hours and it is necessary to continue piling during the night to protect the asset integrity or safety. When nighttime pile driving cannot be avoided, or when inclement weather limits visibility, night vision devices such as night vision binoculars and/or infrared cameras would be used to monitor for sea turtle presence in the clearance and shutdown zones (SEA-04; Appendix G, Table G-1). With these measures in place, no significant injuries to sea turtles are expected. Temporary behavioral and physiological effects are expected to occur, but stock- or population-level effects are unlikely.

Vibratory pile driving would be used for installation of temporary offshore cofferdams at the exit point of HDD for each of the export cable landfalls. Non-impulsive noise associated with vibratory pile driving has the potential to result in physiological or behavioral effects in sea turtles. Sound measurements by Illingworth and Rodkin (2017) were used to conduct underwater sound propagation modeling for vibratory pile driving of the temporary cofferdams to support Atlantic Shores' LOA application. The maximum root mean squared sound pressure level recorded in the Illingworth and Rodkin (2017) study was 170 dB re 1 µPa, which is below the recommended behavioral threshold for non-impulsive sounds (i.e., 175 dB re 1 µPa). Therefore, it is extremely unlikely that sea turtles would be exposed to sound levels exceeding their recommended behavioral or physiological thresholds during vibratory pile driving of the temporary cofferdams. Additionally, vibratory pile driving would not occur between Memorial Day and Labor Day and would therefore occur outside of the peak sea turtle density period. Given the relatively low anticipated source levels associated with vibratory pile driving of cofferdams and the seasonal restriction on this activity, noise impacts associated with vibratory pile driving of cofferdams are unlikely to occur.

**Noise: Operational WTGs.** As discussed in Section 3.5.7.3, operating WTGs generate non-impulsive underwater noise that is audible to sea turtles. However, maximum noise levels anticipated from operating WTGs are below recommended thresholds for sea turtle injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. WTGs associated with the Proposed Action are expected to be larger than WTGs operating currently (maximum of 6.15 MW) and may therefore produce higher noise levels. As the best available data indicates that sound levels produced by operating WTGs would be below sea turtle behavior and injury thresholds, WTG noise impacts on sea turtles associated with the Proposed Action are expected to be minimal. However, if the larger WTGs installed for the Proposed Action produce sound levels that exceed recommended thresholds, WTG noise may result in minor impacts on sea turtles.

**Noise**: **Cable laying.** As described in Section 3.5.7.3, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and cable protection installation. Underwater noise levels associated with cable-laying activities are expected to exceed 120 dB re 1 µPa in a 98,842-acre (40,000-hectare) area surrounding the source (Nedwell and Howell 2004; Taormina et al. 2018). The Proposed Action includes noise-producing activities associated with laying of 1,025 miles (1,650 kilometers) of export, interlink, and interarray cables. The impacts of the Proposed Action are not expected to exceed the noise impacts of cable-laying activities under Alternative A, which are not expected to result in adverse effects on sea turtles given the limited duration of noise exposure based on the mobile nature of the ensonified area.

**Noise: Vessels.** As described in Section 3.5.7.3, vessels associated with the Proposed Action would generate low-frequency (generally 10 to 500 Hz), non-impulsive noise that could elicit behavioral or stress responses in sea turtles (NSF and USGS 2011; Samuel et al. 2005). It is estimated that up to 51 vessels could be utilized during construction and installation of the Proposed Action, though a maximum of 16 vessels are expected to operate at one time for a given construction and installation activity. Project vessel traffic may result in behavioral responses in sea turtles, but these responses would dissipate once the vessel leaves the area. Therefore, effects of vessel noise on individual sea turtles are expected to be short term and localized.

**Noise: Summary of impacts.** Noise generated from Project activities would include impulsive (e.g., impact pile driving, some HRG surveys) and non-impulsive sources (e.g., vibratory pile diving, some HRG surveys, vessels, aircraft, cable laying or trenching, dredging, turbine operations). Of those activities, only impact pile driving could cause injury-level effects (i.e., PTS) in sea turtles. All noise sources have the potential to cause TTS and/or behavioral effects. The mitigation measures proposed to reduce the effects of underwater noise on sea turtles are expected to be effective in limiting the potential for PTS; however, the potential for some PTS and TTS and/or behavioral effects remains. The intensity of this IPF is considered medium for impact pile driving, as PTS thresholds would be exceeded and low for all other activities, as TTS and/or behavioral thresholds would be exceeded. The predicted effects would be permanent in the case of some PTS effects and short term with respect to behavioral effects. The geographic extent is considered localized for PTS effects and extensive for behavioral disturbance effects. The frequency of the activity causing the effect is considered infrequent for impact pile driving, vibratory pile driving, aircraft, cable laying, and dredging noise; frequent for HRG survey noise; and continuous for WTG operational noise. With effective mitigation measures, such as use of a noise attenuation system during impact pile driving, as well as a pile-driving monitoring plan and operational sound field verification plan, impacts on individual sea turtles are anticipated but not at the population level. Therefore, noise impacts on sea turtles are anticipated to be minor.

**Presence of structures**: The Proposed Action would include construction of up to 200 WTGs, up to 10 OSSs, and 1 permanent met tower, and installation of up to 268 acres (108 hectares) of hard scour protection around the foundations, and up to 595 acres (241 hectares) of hard cable protection (294 and 301 acres [119 and 122 hectares] around the export and interarray cables, respectively) (Appendix D, Table D.A2-2; COP Volume I, Table 4.4-2; Atlantic Shores 2024). As described in Section 3.5.7.3, the installation of WTGs, OSSs, and hard protection could result in hydrodynamic changes, entanglement or ingestion of lost fishing gear, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption.

The presence of WTGs, OSSs, and the met tower could alter local hydrodynamic patterns at a fine scale, which could have localized impacts on prey distribution and abundance. However, these localized impacts may not translate to impacts on sea turtle prey species.

The presence of structures may have an artificial reef effect, resulting in increased recreational fishing activity in the vicinity of the WTGs and OSSs. An increase in fishing activity would increase risk of entanglement or ingestion of lost fishing gear, which can lead to sea turtle injury or death. Atlantic Shores has proposed the removal of marine debris caught on Offshore Project structures, when safe and practicable, to reduce the risk of sea turtle entanglement (SEA-02; Appendix G, Table G-1). The artificial reef effect could also result in beneficial impacts on sea turtles due to prey aggregation. The aggregation of prey species would increase sea turtle foraging opportunities around offshore wind facility structures, potentially leading to increased residence times around the WTGs. However, the artificial reef effect could also attract sea turtle predators (i.e., sharks) (Paxton et al. 2020). Predator attraction may result in increased risk of predation for sea turtles.

The presence of offshore wind facility structures could result in sea turtle avoidance and displacement, which could potentially move sea turtles into areas with lower habitat value or with a higher risk of vessel collision or fisheries interactions. Any avoidance or displacement is expected to be short term. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of wind energy facilities or result in gear shifts. Risk of interaction with fishing vessels is not expected to be greater than current risk, but gear shifts that result in an increased number of vertical lines in the water would increase the risk of sea turtle interactions with fishing gear. Disruption of normal behaviors, such as foraging and migration, could occur due to the presence of offshore structures. Although migrations could be temporarily interrupted as sea turtles stop to forage or rest around structures, the presence of structures is not expected to result in measurable changes in sea turtle migratory patterns.

Given that the presence of structures increases risk of injury or mortality due to interactions with lost recreational fishing gear, but population-level effects are unlikely to occur, the presence of structures are expected to have minor adverse impacts on sea turtles. The presence of structures may also result in minor beneficial impacts due to the artificial reef effect.

**Traffic:** Construction and installation, O&M, and decommissioning of the Proposed Action would result in increased vessel traffic due to Project vessels transiting to and from the Offshore Project area. As described in Section 3.5.7.3, vessel strikes, which could result in injury or death, are an increasing concern for sea turtles, which can be difficult to detect given their small size and proportion of time spent submerged. Conditions that limit visibility (e.g., darkness, turbid water) further decrease detection and avoidance probabilities. Risk of injury or death would be highest for loggerheads, which have the highest density in the Project area. Vessel strike is most likely to occur when Project vessels are transiting to and from the Project area as that is when vessels would be moving at the highest speeds.

Atlantic Shores expects up to 51 vessels to be used during construction and installation of the Project, though a maximum of 16 vessels are expected to operate at one time for a given construction and installation activity. Impacts associated with Project traffic during the O&M phase of the Project would be lower due to less simultaneous vessel activity. Atlantic Shores generally expects 5 to 11 vessels to operate at a given time, though up to 22 vessels may be required in some repair scenarios. The increase in traffic due to the Proposed Action would only represent a relatively small increase in overall traffic in the geographic analysis area. Atlantic Shores has proposed vessel strike avoidance procedures, including adherence to marine wildlife viewing and safe boating guidelines (NMFS 2021f) and training for vessel crew on sea turtle spotting and identification, observation reporting protocol, and vessel strike avoidance procedures (SEA-01; Appendix G, Table G-1). Additionally, Atlantic Shores would comply with the Project Design Criteria and Best Management Practices developed to mitigate effects on protected species during offshore wind data collection (BOEM 2021b), including avoiding transiting through areas of visible jellyfish aggregations or floating vegetation during times of year when sea turtles are known to occur in the area or slowing to 4 knots (7 kilometers per hour) if such areas cannot be avoided due to operational safety concerns. Atlantic Shores has proposed additional measures to avoid, minimize, and mitigate impacts on marine mammals associated with vessel traffic that would also minimize impacts on sea turtles (MAR-04; Appendix G, Table G-1). Given the relatively small increase in vessel traffic compared to existing traffic, the measures that would be taken to minimize vessel traffic impacts, and the patchy distribution of sea turtles in the Project area, the increased collision risk associated with the increase in vessel traffic due to Project vessels may affect individual sea turtles but would not be expected to have stock- or population-level impacts on sea turtles. Therefore, impacts of vessel traffic are anticipated to be minor.

### *Impacts of the Connected Action*

As described in Chapter 2, *Alternatives,* bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). Installation of a new bulkhead and maintenance dredging, conducted in coordination with Atlantic City's dredging of the adjacent berths, have been proposed in Atlantic City's Inlet Marina, where the Atlantic City O&M facility would be located. Bulkhead installation and dredging may affect sea turtles. These activities in Atlantic City's Inlet Marina would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead and dredging activities are considered to be a connected action under NEPA and are evaluated in this section. BOEM expects the connected action to affect sea turtles through the following primary IPFs.

**Noise:** Underwater anthropogenic noise sources associated with the connected action would include pile driving and vessels during construction. As described in Section 3.5.7.3, these noise sources have the potential to affect sea turtles through behavioral or physiological effects. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

The connected action would include installation of approximately twenty-two 50-inch (1.3-meter) corrugated steel sheet piles. It would also include installation of six 4-foot (1.2-meter) steel piles and one hundred twelve 1-foot (0.3-meter) timber piles to support three floating docks and 16 dolphins. The total length for the proposed bulkhead is 541 feet (165 meters). The final design and scope of proposed activities for the connected action, including dimensions and construction methodologies, mitigation measures, and other details, is subject to change following ongoing design work and permit review and approval. Final details will be included in the respective approved permits. Pile driving generates noise that can result in behavioral effects, and physiological effects in the case of impact pile driving, in sea turtles. Bulkhead work would be conducted under a USACE Nationwide Permit 13, which would not authorize any activities that are likely to directly or indirectly jeopardize the continued existence of any ESA-listed species, including sea turtles.

As described in Section 3.5.7.3, vessels associated with the connected action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in sea turtles. During dredging three vessels are expected to be used: a dredge vessel, a tug, and a scow. Any effects of vessel noise on individual sea turtles are expected to be temporary and localized. Based on the small volume of vessel traffic associated with the connected action, vessel noise impacts would be extremely unlikely to occur and any effects are anticipated to be negligible.

**Port utilization:** In-water activities for the connected action include dredging, which may affect sea turtles through physical interactions with the dredge and increased suspended sediments, as described in Section 3.5.7.3. Habitat disturbance and modification associated with dredging may also affect benthic prey species.

Dredging for the connected action could affect sea turtles through physical interactions (i.e., impingement, entrainment, or capture). Dredging in the Atlantic City Inlet Marina would primarily utilize a hydraulic cutterhead dredge, though a mechanical dredge may be used to access small marina, canal, or lagoon areas. As noted in the evaluation of impacts for the Proposed Action, neither cutterhead nor mechanical dredging is expected to capture, injure, or kill sea turtles (NMFS 2018; USACE 2020). Additionally, sea turtles are unlikely to occur within Atlantic City Inlet Marina. Therefore, effects of physical interactions with the dredge are not expected to occur.

Dredging for the connected action would result in temporary increases in suspended sediment concentrations in the associated area. As described in Section 3.5.7.3, increased suspended sediment concentrations could result in behavioral effects on sea turtles or physiological effects on sea turtle prey species. Any behavioral effects would be too small to be detected (NMFS 2020), and no effects are anticipated if sea turtles swim through the area of elevated suspended sediment. Increased suspended sediment concentrations could also affect prey species. However, any effects on sea turtles or their prey species would be localized and short term, as described in Section 3.5.7.3. Given the localized and temporary or short-term nature of the effects and the unlikely presence of sea turtles, any effects of increased suspended sediments on sea turtles are anticipated to be negligible.

Habitat disturbance and modification associated with dredging could result in short-term reductions in foraging habitat or short-term effects on prey availability for some sea turtle species. Benthic communities would be expected to recover within 1 year of disturbance (NMFS 2017). Maintenance dredging for the connection action is not expected to have a substantial impact on benthic community composition following recolonization of the dredge area or to alter the sediment composition compared to the existing substrate in the dredge area. Although habitat disturbance and modification may result in reductions in foraging habitat availability or prey availability, these reductions would be short term, and there would be no changes in the benthic community composition. Additionally, sea turtle foraging in the Project area for the connected action is extremely unlikely, and the affected area would be very small relative to available sea turtle foraging habitat. Therefore, any effects on sea turtles due to habitat disturbance and modification would be negligible.

**Traffic:** The connected action would result in increased vessel traffic during installation of the new bulkhead and maintenance dredging. As described in Section 3.5.7.3, vessel strikes could result in injury or death of sea turtles.

Only a small number of vessels (i.e., three) would be used for maintenance dredging. All construction vessels would be operating at slow speeds (i.e., 10 knots [19 kilometers per hour] when transiting in the action area for the connection action and 4 knots [7 kilometers per hour] when dredging). Additionally, sea turtles are not generally found in the Project area for the connected action. Based on the low volume of traffic and unlikely sea turtle presence in the Project area for the connected action, vessel strikes associated with Project traffic for the connected action would be extremely unlikely to occur. If a vessel strike were to occur, any impacts on sea turtles are anticipated to be minor as no population-level effects would be anticipated.

### *Cumulative Impacts of Alternative B – Proposed Action*

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned activities, including offshore wind activities, and the connected action. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to impacts on sea turtles include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; and onshore development activities. The connected action would involve installation of a new bulkhead and maintenance dredging at Atlantic City Inlet Marina. Ongoing and planned offshore wind activities in the geographic analysis area for sea turtles include the construction and installation, O&M, and decommissioning of 27 planned offshore wind projects.

**Accidental releases:** The cumulative impacts on sea turtles related to exposure to accidental releases from ongoing and planned activities would likely be undetectable. The incremental impacts of the Proposed Action would not increase the risk of accidental releases beyond that described under the No Action Alternative and would therefore be undetectable.

**Cable emplacement and maintenance**: The 576 acres (233 hectares) of seabed disturbance associated with installation of export and interarray cables for the Proposed Action represents 0.8 percent of the 72,273 acres (29,248 hectares) of seabed expected to be disturbed on the OCS due to existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D.A2-1). Additionally, Project dredging is expected to represent a small proportion of dredging that would occur for ongoing and planned activities, including the Proposed Action. The incremental contributions of the construction and installation of the Proposed Action to the combined impacts of cable emplacement and maintenance associated with ongoing and planned activities would be noticeable.

**Electric and magnetic fields and cable heat**: The 1,025 miles (1,650 kilometers) of submarine cables associated with the Proposed Action represent 7 percent of the 13,869 miles (22,320 kilometers) of subsea cables anticipated for existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D.A2-1). The incremental contributions of the Proposed Action to the combined EMFs and cable heat generated by ongoing and planned activities would be noticeable given the small area that would be affected by the Project.

**Gear utilization:** The incremental contributions of the Proposed Action to gear utilization on the OCS associated with ongoing and planned activities would be noticeable.

**Lighting:** The incremental contributions of the Proposed Action to light on the OCS associated with ongoing and planned activities would be undetectable given the large volume of existing vessel traffic, and any artificial light penetrating the sea surface is expected to be localized and minimal.

**Noise:** The loudest sources of noise are expected to be pile driving, assuming piled foundations are selected, followed by vessels. The up-to-211 structures for the Proposed Action represent less than 7 percent of the 3,192 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D.A2-2), although some foundations for the Project and at other planned wind farms may be installed without impact pile driving. The incremental contributions of construction and installation and O&M of the Proposed Action to the cumulative noise impacts associated with ongoing and planned activities would be noticeable given the magnitude of ongoing and planned activities.

**Port utilization:** As port expansion is not proposed for the Project, the Proposed Action would not contribute to the cumulative impacts of port utilization associated with ongoing and planned activities in the geographic analysis area.

**Presence of structures:** The up-to-211 structures for the Proposed Action represent less than 7 percent of the 3,192 offshore wind structures anticipated on the OCS for existing and planned offshore wind farms, including the Proposed Action (Appendix D, Table D.A2-3. The incremental contributions of the Proposed Action to the cumulative impacts due to the presence of structures associated with ongoing and planned activities would be noticeable.

**Traffic:** The incremental contributions of the Proposed Action to the combined impacts of vessel traffic associated with ongoing and planned activities would be undetectable given the large volume of existing vessel traffic in the geographic analysis area.

### *Conclusions*

**Impacts of Alternative B – Proposed Action.** Impacts of construction and installation, O&M, and decommissioning of the Proposed Action would range from **negligible to minor adverse** impacts across individual IPFs and could include **minor beneficial** impacts. Adverse impacts would result mainly from pile-driving noise. Beneficial impacts could result from the presence of structures. Impact determinations for each IPF are provided in the following paragraphs.

Adverse impacts associated with accidental releases, EMF, aircraft noise, cable-laying noise, dredging noise, and vessel noise are expected to be negligible due to being unlikely to occur or too small to be measured.

Adverse impacts associated with cable emplacement and maintenance (including the potential use of hopper dredging for sand bedform clearance), gear utilization, light, G&G survey noise, pile-driving noise, WTG noise, the presence of structures, and vessel traffic are expected to be minor. These impacts are generally expected to be localized and short term, although some may be long term. Adverse effects on individual sea turtles may occur due to these impacts, but no stock- or population-level effects are anticipated.

Habitat conversion and prey aggregation associated with the presence of structures could result in minor beneficial impacts due to increased foraging opportunities for sea turtles. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. These effects would be localized and are not expected to affect individual fitness.

Considering all IPFs together, BOEM anticipates that adverse impacts associated with the Proposed Action would be **minor** because impacts would be detectable and measurable but would not result in population-level effects.

BOEM expects that the connected action alone would have negligible impacts on sea turtles.

**Cumulative Impacts of Alternative B – Proposed Action.** Cumulative impacts on sea turtles from ongoing and planned activities, including the Proposed Action, would range from **negligible to minor adverse** across individual IPFs and would also include **minor beneficial** impacts. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Considering all IPFs together, BOEM anticipates that the cumulative impacts would result in **minor** impacts on sea turtles because impacts would be detectable and measurable but not result in population-level impacts. The main drivers for this impact rating are gear utilization, pile-driving noise, the presence of structures, and vessel traffic. The Proposed Action would contribute to the overall impact rating primarily through pile-driving noise and the presence of structures.

#### 3.5.7.6 Impacts of Alternative C on Sea Turtles

Alternative C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) would avoid or minimize impacts on two AOCs identified by NMFS within the Lease Area that have pronounced bottom features (e.g., ridges, swales) and produce valuable habitats.

##### *Onshore Activities and Facilities*

Impacts associated with onshore activities and facilities for Alternative C would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.7.5).

##### *Offshore Activities and Facilities*

Offshore activities would not differ between the Proposed Action and Alternative C. However, the location of interarray and export cable routes may differ somewhat. Differences in location would be minor but would avoid one or, in the case of Alternative C4 or the combination of Alternatives C1 and C2, both AOCs. The avoidance or minimization of impacts on these valuable habitat areas would reduce cable emplacement impacts, potentially benefit benthic foraging sea turtle species. Though avoidance or minimization of impacts on these valuable habitats may benefit some sea turtle species, this benefit would not measurably reduce construction and installation impacts on sea turtles.

The number of WTG and OSS facilities may also differ under Alternative C. Under Alternative C, up to 29 WTGs and 1 OSS may be removed, which may also reduce the length of the interarray cables. A reduction in the number of WTGs and OSSs, and a reduction in the length of interarray cable, would reduce impacts due to cable emplacement and maintenance, EMF, noise, and the presence of structures. Although impacts would be reduced, BOEM anticipates that O&M impacts on sea turtles under Alternative C would not be measurably different from those anticipated under the Proposed Action.

### *Cumulative Impacts of Alternative C*

The contribution of Alternative C to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternative C would be the same level as described under the Proposed Action.

### *Conclusions*

**Impacts of Alternative C.** Impacts of Alternative C would not be measurably different than the impacts of the Proposed Action. Therefore, impacts of construction and installation, O&M, and decommissioning of Alternative C would range from **negligible to minor adverse** impacts across individual IPFs and could include **minor beneficial** impacts due to the presence of structures and increased feeding potential. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. Overall, BOEM anticipates that adverse impacts associated with Alternative C would be **minor** because impacts would be detectable and measurable but would not result in population-level effects.

**Cumulative Impacts of Alternative C.** The cumulative impacts on sea turtles from ongoing and planned activities, including Alternative C, would range from **negligible to minor adverse** across individual IPFs and would also include **minor beneficial** impacts. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative C, would result in **minor** impacts on sea turtles because impacts would be detectable and measurable but not result in population-level impacts.

## 3.5.7.7 Impacts of Alternatives D and E on Sea Turtles

Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) would include an alteration in WTG layout and number to minimize visual impacts. Alternative E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would include modifications to WTG layout to minimize impacts on existing ocean uses by creating a 0.81-nautical mile (1,500-meter) to 1.08-nautical mile (2,000-meter) setback between Atlantic Shores South and Ocean Wind 1 (OCS-A 0498).

### *Onshore Activities and Facilities*

Impacts associated with onshore activities and facilities for Alternatives D and E would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.7.5).

### *Offshore Activities and Facilities*

Offshore activities would not differ between the Proposed Action and Alternatives D and E. However, the location or number of WTGs would differ under Alternatives D and E. Under Alternative D, up to 31 WTGs may be removed. Under Alternative E, up to 5 WTGs may be removed or microsited. Any reduction in the number of WTGs may also reduce the length of the interarray cable. A reduction in the number of WTGs, and a reduction in the length of interarray cable, would reduce cable emplacement and noise impacts. Reduction in the number of WTGs may also reduce impacts due to EMFs, light, O&M-related noise, and the presence of structures. Although impacts would be reduced, BOEM anticipates that construction and installation impacts on sea turtles under Alternatives D and E would not be measurably different from those anticipated under the Proposed Action.

### *Cumulative Impacts of Alternatives D and E*

The contribution of Alternatives D and E to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternatives D and E would be the same level as described under the Proposed Action.

### *Conclusions*

**Impacts of Alternatives D and E.** Impacts of Alternatives D and E would not be measurably different than the impacts of the Proposed Action. Therefore, impacts of construction and installation, O&M, and decommissioning of Alternatives D and E would range from **negligible to minor adverse** across individual IPFs and could include **minor beneficial** impacts due to the presence of structures. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. Overall, BOEM anticipates that adverse impacts associated with Alternatives D and E would be **minor** because impacts would be detectable and measurable but would not result in population-level effects.

**Cumulative Impacts of Alternatives D and E.** Cumulative impacts on sea turtles from ongoing and planned activities, including Alternative D or E, would range from **negligible to minor adverse** across individual IPFs and would also include **minor beneficial** impacts. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative D or E, would result in **minor** impacts on sea turtles because impacts would be detectable and measurable but not result in population-level impacts.

## 3.5.7.8 Impacts of Alternative F on Sea Turtles

Under the Proposed Action, a variety of foundation types may be used for the Project. Alternative F (Foundation Structures) allows for an evaluation of impacts associated with specific foundation types. Under Alternative F1, monopiles and piled jacked foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (monopile or piled jacket), up to 5 medium OSSs (piled jacket), or up to 4 large OSSs (piled jacket) for Project 1 and Project 2. Under Alternative F2, mono-bucket, suction bucket jacket, and suction bucket tetrahedron base foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs (mono-bucket or suction bucket jacket), up to 5 medium OSSs (suction bucket jacket), or up to 4 large OSSs (suction bucket jacket), for Project 1 and Project 2. Under Alternative F3, gravity-pad tetrahedron and GBS foundations would be used for up to 200 WTGs, 1 permanent met tower (Project 1), and up to 10 small OSSs, up to 5 medium OSSs, or up to 4 large OSSs, with GBS for Project 1 and Project 2.

#### *Onshore Activities and Facilities*

Impacts associated with onshore activities and facilities for Alternative F would be identical to the impacts of onshore activities and facilities associated with the Proposed Action (Section 3.5.7.5).

#### *Offshore Activities and Facilities*

Though all potential offshore activities under Alternative F were evaluated under the Proposed Action, sub-alternatives of Alternative F may exclude some activities evaluated under the Proposed Action. Activities would not differ between the Proposed Action and Alternative F1. Under Alternatives F2 and F3, no impact pile driving would be conducted. Therefore, there would be no underwater noise impacts on sea turtles due to impact pile driving. The avoidance of impact pile-driving noise effects would reduce overall construction and installation impacts on sea turtles under Alternatives F2 and F3 compared to the Proposed Action.

Offshore impacts under some sub-alternatives may be reduced due to reductions in habitat conversion associated with some foundation types. Suction bucket foundations, Alternative F2, would result in the greatest area of habitat conversion due to scour protection, and these foundations were evaluated under the Proposed Action. Alternatives F1 and F3 would result in a reduction in scour protection compared to the Proposed Action and Alternative F2. Such reductions would reduce O&M impacts due to the presence of structures. Less scour protection would result in loss of less soft-bottom habitat, which could benefit Kemp's ridley sea turtles as they forage in this type of habitat. It would also result in a lower artificial reef effect, which may reduce foraging opportunities compared to the Proposed Action and Alternative F2 but may also reduce risk of entanglement in lost recreational fishing gear. Given that Alternatives F1 and F3 could result in reductions in both adverse and beneficial impacts, impacts on sea turtles under these alternatives are not expected to be measurably different from those anticipated under the Proposed Action. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

#### *Cumulative Impacts of Alternative F*

The contribution of Alternative F to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on sea turtles of ongoing and planned activities in combination with Alternative F would be the same level as described under the Proposed Action.

*Conclusions*

**Impacts of Alternative F.** Impacts of Alternative F1 would not be measurably different than the impacts of the Proposed Action. Therefore, impacts of construction and installation, O&M, and decommissioning of Alternative F1 would range from **negligible** to **minor** adverse across individual IPFs and could include **minor beneficial** impacts due to the presence of structures. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. Overall, BOEM anticipates that adverse impacts associated with Alternative F1 would be **minor** because impacts would be detectable and measurable but would not result in population-level effects.

Impacts of Alternatives F2 and F3 would be measurably different from the impacts of the Proposed Action due to the avoidance of impact pile-driving noise effects. However, this difference would not result in a lower impact determination. Therefore, impacts of construction and installation, O&M, and decommissioning of Alternatives F2 and F3 would range from **negligible to minor adverse** across individual IPFs and could include **minor beneficial** impacts due to the presence of structures. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. Overall, BOEM anticipates that adverse impacts associated with Alternatives F2 and F3 would be **minor** because impacts would be detectable and measurable but would not result in population-level effects.

**Cumulative Impacts of Alternative F.** Cumulative impacts on sea turtles from ongoing and planned activities, including Alternative F1, F2, or F3, would range from **negligible to minor adverse** across individual IPFs and would also include **minor beneficial** impacts. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including Alternative F, would result in **minor** impacts on sea turtles because impacts would be detectable and measurable but not result in population-level impacts.

### 3.5.7.9 Proposed Mitigation Measures

Additional mitigation measures identified by BOEM and cooperating agencies as a condition of federal permitting, or through agency-to-agency negotiations, are described in detail in Appendix G, Tables G-2, G-3, and G-4 and summarized and assessed in Table 3.5.7-9. If one or more of the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts on sea turtles could be further reduced.

**Table 3.5.7-9. Proposed mitigation measures – sea turtles**

| Measure | Description | Effect |
|---|---|---|
| Vessel strike avoidance for marine mammals and sea turtles | The Lessee must continue to implement vessel strike avoidance measures to include the identified vessel speed restrictions and minimum separation distances for crew transfer vessels agreed to in the Applicant-proposed measures (Table G-1, Measure # LOA-4). | This measure would ensure effective separation distances from sea turtles, which will reduce potential interactions between Project-related vessels and sea turtles. |
| Marine debris awareness training | Vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP must complete marine trash and debris awareness training annually. The Lessee must submit an annual report describing its marine trash and debris awareness training process and certify that the training process was followed for the previous calendar year. | Marine debris and trash awareness training would minimize the risk of sea turtle ingestion of or entanglement in marine debris. |
| Pile Driving Monitoring Plan | The Lessee must prepare and submit a Pile Driving Monitoring Plan detailing all plans and procedures for sound attenuation as well as for monitoring ESA-listed sea turtles during all impact and vibratory pile driving. | This measure would ensure adequate monitoring and mitigation is in place during pile driving, which would minimize the potential exposure of sea turtles to injurious or disturbing sound levels during foundation installation. |
| PSO coverage | PSO coverage must be sufficient to reliably detect sea turtles at the surface in clearance and shutdown zones to execute any pile driving delays or shutdown requirements. | PSO coverage would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. |
| Sound field verification | If the clearance and/or shutdown zones are expanded due to the verification of sound fields from Project activities, PSO coverage must be sufficient to reliably monitor the expanded clearance and/or shutdown zones. | Sound field verification would increase the accountability of underwater noise mitigation during pile driving. |
| Adaptive shutdown zones | BOEM and USACE may consider reductions in the shutdown zones based upon sound field verification of a minimum of three piles. However, BOEM/USACE would ensure that the shutdown zone is not reduced to less than 984 feet (500 meters) for ESA-listed sea turtles. | Shutdown zones would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. |
| Monitoring zones for sea turtles | The Lessee must monitor the full extent of the area where noise would exceed the root-mean-square sound pressure level (SPL) 175 dB re 1 µPa behavioral | Monitoring zones for sea turtles would minimize the potential for |

| Measure | Description | Effect |
|---|---|---|
| | disturbance threshold for ESA-listed sea turtles for the full duration of all pile-driving activities and for 30 minutes following the cessation of pile-driving activities and record all observations in order to ensure that all take that occurs is documented. | exposure to sound levels above recommended thresholds during impact pile driving. |
| Look out for sea turtles and reporting | Project vessels must adhere to the following vessel strike avoidance measures:<br>• Vessels operating north of the Virginia/North Carolina border between June 1 and November 30 must have a trained lookout posted to observe for sea turtles;<br>• Vessels operating south of the Virginia/North Carolina border must have a trained lookout posted year-round to observe for sea turtles;<br>• Lookouts will review https://seaturtlesightings.org/ before each trip and report sea turtle observations in the vicinity of the planned transit to all vessel operators/captains and lookouts;<br>• Lookout will monitor a 984-foot (500-meter) vessel strike avoidance zone; vessel operator will slow down to 4 knots (7 kilometers per hour) if a sea turtle is sighted within 328 feet (100 meters) of the vessel's forward path then proceed away from the sea turtle at that speed until a 328-foot (100-meter) separation distance is established;<br>• Vessel operator must shift to neutral if a sea turtle is sighted within 164 feet (50 meters) of the vessel's forward path then proceed away from the turtle at 4 knots (7 kilometers per hour);<br>• Vessel operators must avoid transiting through areas of visible jellyfish aggregations of floating sargassum lines or mats;<br>• All crew members must be briefed on identification of sea turtles, applicable regulations, and best practices for avoiding vessel collisions with sea turtles; and<br>• Vessel transits to and from the Offshore Project area that require PSOs will maintain a speed commensurate with weather conditions and effectively detecting sea turtles prior to reaching the 328-foot (100-meter) avoidance measure. | Measures to minimize vessel interactions would ensure effective monitoring and separation distances, which will reduce the risk of vessel strike. |
| Sampling gear | All sampling gear must be hauled at least once every 30 days, and all gear must be removed from the water and stored on land between survey seasons to minimize risk of entanglement. | The regular hauling of sampling gear would reduce risk of entanglement or effects of entanglement in fisheries survey gear. |
| Gear identification | To facilitate identification of gear on any entangled animals, all trap/pot gear used in Project surveys must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long (0.9-meter-long) strip of black and white duct tape | Gear identification would improve accountability in the case of gear loss. |

| Measure | Description | Effect |
|---|---|---|
| | within 2 fathoms of a buoy attachment. In addition, three additional marks must be placed on the top, middle and bottom of the line using black and white paint or duct tape. | |
| Lost survey gear | All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost survey gear must be reported to NMFS and BSEE. | Recovering lost survey gear would improve accountability in the case of gear loss. |
| Survey training | For any vessel trips where gear is set or hauled for trawl or ventless trap surveys, at least one of the survey staff onboard must have completed Northeast Fisheries Observer Program observer training within the last 5 years or completed other equivalent training in protected species identification and safe handling. Appropriate reference materials must be on board each survey vessel. Atlantic Shores must prepare a training plan that addresses how these survey requirements will be met. | Survey staff training would reduce the risk of entanglement or effects of entanglement in fisheries survey gear. |
| Sea turtle disentanglement | Vessels deploying fixed gear (e.g., pots/traps) must have adequate disentanglement equipment onboard (i.e., knife and boathook). Any disentanglement must occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773). | Sea turtle disentanglement would reduce effects of entanglement in fisheries survey gear. |
| Sea turtle/Atlantic sturgeon identification and data collection | Any sea turtles caught or retrieved in any fisheries survey gear must first be identified to species or species group. Each ESA-listed species caught or retrieved must then be documented using appropriate equipment and data collection forms. Live, uninjured animals must be returned to the water as quickly as possible after completing the required handling and documentation. | Sea turtle identification and data collection would improve accountability for documenting take associated with fisheries surveys. |
| Sea turtle/Atlantic sturgeon handling and resuscitation guidelines | Any sea turtles caught and retrieved in gear used in fisheries surveys must be handled and resuscitated (if unresponsive) according to established protocols provided at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. | Sea turtle handling and resuscitation guidelines would reduce effects of entanglement in fisheries survey gear. |
| Take notification | The Greater Atlantic Regional Fisheries Office Protected Resources Division must be notified as soon as possible of all observed takes of sea turtles occurring as a result of any fisheries survey. | Sea turtle take notification would improve accountability for documenting take associated with fisheries surveys. |
| Monthly/annual reporting requirements | To document the amount or extent of take that occurs during all phases of the Proposed Action, Atlantic Shores must submit monthly reports during the construction | Reporting requirements to document take would improve accountability for documenting sea turtle take associated |

| Measure | Description | Effect |
|---|---|---|
| | phase and during the first year of operation and must submit annual reports beginning in year 2 of operation. | with the Proposed Action. |
| BOEM/NMFS meeting requirements for sea turtle take documentation | BOEM and NMFS will meet twice in the first year of operation to review sea turtle observation records and any incidental take. The agencies will meet annually following the first year of operation. | Meeting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action. |
| Data collection BA BMPs | All Project Design Criteria and Best Management Practices incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance, and operations of the Atlantic Shores South Project as applicable. | Compliance with Project Design Criteria and Best Management Practices for Protected Species would minimize risk to sea turtles during HRG surveys. |
| Alternative Monitoring Plan for pile driving | The Lessee must develop an Alternative Monitoring Plan for pile-driving operations during low-visibility conditions (e.g., darkness, inclement weather) that prevent visual monitoring of the full extent of the clearance and shutdown zones. This plan must include identification of any night vision devices proposed for detection of protected species during low visibility conditions; a demonstration of the capability of the proposed monitoring methodology to detect protected species within the full extent of the clearance and shutdown zones with the same effectiveness as daytime visual monitoring; a discussion of the efficacy of each device proposed for low visibility monitoring; and reporting procedures, contacts, and timeframes. | The development and implementation of an Alternative Monitoring Plan for pile driving would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. |
| Periodic underwater surveys, reporting of monofilament and other fishing gear around WTG foundations | The Lessee must monitor potential loss of fishing gear in the vicinity of WTG foundations by surveying at least 10 of the WTGs located closest to shore in each Project 1 and Project 2 area annually. Survey design and effort may be modified based upon previous survey results after review and concurrence by BOEM. The Lessee must conduct surveys by remotely operated vehicles, divers, or other means to determine the locations and amounts of marine debris. | Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. |
| PDC minimize vessel interactions with protected species (from HRG Programmatic) | All vessels associated with survey activities must comply with the following vessel strike avoidance measure: if a sea turtle is sighted at any distance within the operating vessel's forward path, the vessel operator must slow down to 4 knots and steer away (unless unsafe to do so). The vessel may resume normal vessel operations once the vessel has passed the individual. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. | Compliance with Project Design Criteria to minimize vessel interactions would reduce risk of vessel strike. |
| Operational Sound Field Verification Plan | The Lessee must develop an operational sound field verification plan to determine the operational noises emitted from the offshore wind area. | The development of an Operational Sound Field Verification Plan would |

| Measure | Description | Effect |
| --- | --- | --- |
| | | allow BOEM to confirm that noise impacts of operating WTGs do not exceed predicted impacts based on existing monitoring data and modeling efforts. |
| Sound field verification of foundation installation | The Lessee must submit a Sound Field Verification (SFV) Plan consistent with requirements of the NMFS Biological Opinion. The results of sound field verification must be compared to modeled injury and disturbance isopleths for sea turtles. | The development and implementation of the Sound Field Verification Plan would verify that modeled acoustic ranges to recommended sea turtle thresholds were conservative enough to not underestimate the number of sea turtle exposures during foundation installation. |
| Minimum visibility requirement | In order to commence pile driving at foundations, PSOs must be able to visually monitor a 6,244-foot (1,900 meter) radius for at least 60 minutes immediately prior to commencement.<br>In order to commence pile driving at trenchless installation sites, PSOs must be able to visually monitor a 3,280-foot (1,000-meter) radius from their observation points for at least 30 minutes immediately prior to piling commencement. | The minimum visibility requirement would ensure adequate monitoring during piling, minimizing the potential for exposure to sound levels above recommended thresholds. |
| Reporting | The Lessee must report to BOEM and BSEE within 24 hours of confirmation any incidental take of an endangered or threatened species. | Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action. |
| Sound field verification of foundation installation | The Lessee must conduct thorough SFV monitoring of the first 3 pile installation of the project, the first installation in each calendar year, and any subsequent foundations with differences in installation parameters that may affect sound transmission. Abbreviated SFV must be conducted for all other installations. Atlantic Shores must also submit an SFV Plan that includes measurement procedures and results reporting, approximations of expected variation of key parameters, and selection process for thorough SFV monitoring locations. | Verify that modeled acoustic ranges to recommended sea turtle thresholds were conservative enough to not underestimate the number of sea turtle exposures during foundation installation. |
| Reasonable and Prudent Measures and Terms and Conditions from the NMFS Biological Opinion | The Lessee must comply with measures in the Biological Opinion (see NMFS RPM 1 through RPM 5 and T&C 1 through T&C 5 in Table G-2) and conduct SFV to ensure distances to thresholds for ESA-listed sea turtles are not exceeded during impact pile driving. Atlantic Shores must | Verify that modeled acoustic ranges to recommended sea turtle thresholds were conservative enough to |

| Measure | Description | Effect |
|---|---|---|
| | also report any effects to ESA-listed sea turtles or incidental take of these species. | not underestimate the number of sea turtle exposures during foundation installation and improve accountability for documenting sea turtle take associated with the Proposed Action. |

*Measures Incorporated in the Preferred Alternative*

Mitigation measures required through completed consultations, authorizations, and permits or proposed by BOEM listed in Table 3.5.7-9 and Tables G-2, G-3, and G-4 in Appendix G are incorporated in the Preferred Alternative. These measures, if adopted, would further define how the effectiveness and enforcement of mitigation measures would be ensured and improve accountability for compliance with mitigation measures by requiring the submittal of plans for approval by the enforcing agencies and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with mitigation measures that are already analyzed as part of the Proposed Action, these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.7.5.

### 3.5.7.10 Comparison of Alternatives

Construction and installation, O&M, and decommissioning of Alternatives C, D, E, F1, F2, and F3 would have the same minor adverse impacts on sea turtles as described under the Proposed Action as impacts would be detectable and measurable but would not result in population-level effects, and may include minor beneficial impacts. Alternative C would result in slightly less effects on benthic foraging sea turtles due to the avoidance and minimization of impacts on valuable habitats and the potential removal of up to 29 WTGs, 1 OSS, and associated interarray cables. The combination of Alternatives C1 and C2 would further reduce effects on benthic foraging sea turtles by avoiding impacts on both valuable habitat areas in the Lease Area. Alternatives D and E would result in slightly less effects on sea turtles due to the potential removal of up to 31 WTGs and associated interarray cables. Though Alternatives F2 and F3 would have measurably lower impacts due to avoidance of impact pile-driving noise effects on sea turtles, this reduction in impacts would not result in a lower impact determination.

### 3.5.7.11 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two BOEM-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); two

WTGs would be removed and 1 WTG would be microsited to establish a 0.81 nautical mile (1,500 meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical miles (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative would include up to 195 WTGs,[4] up to 10 OSSs, up to 4 temporary meteorological and oceanographic (metocean) buoys (up to 3 metocean buoys in Project 1, 1 metocean buoy in Project 2), up to 1 permanent met tower (Project 1), and interarray and interlink cables. Micrositing 29 WTGs and 1 OSS and associated interarray cables outside of AOCs 1 and 2 may result in a small decrease in impacts on benthic-foraging sea turtle species (Section 3.5.7.6). The mitigation measure related to the spacing and alignment of permanent structures in the Lease Area would not affect impacts on sea turtles. The mitigation measure to remove the WTG in proximity to the observed Fish Haven would result in a very small decrease in impacts in the Lease Area. Although the Preferred Alternative would reduce impacts on sea turtles, BOEM anticipates that impacts on sea turtles under the Preferred Alternative would not be measurably different from those anticipated under the Proposed Action. Therefore, the Preferred Alternative would result in **minor** adverse impacts on sea turtles, as impacts would be detectable and measurable but would not result in population-level effects and could include **minor beneficial** impacts.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and connected action, would be the same as the Proposed Action: **minor** adverse impacts as impacts would be detectable and measurable but would not result in population-level effects, and could include **minor beneficial** impacts.

[4] 195 WTGs assumes that 197 total positions are available and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and/or a met tower on grid.

### 3.5.8 Wetlands

This section discusses potential impacts on wetlands from the proposed Project, alternatives, and ongoing and planned activities in the wetlands geographic analysis area. The wetlands geographic analysis area, as shown on Figure 3.5.8-1, includes all subwatersheds that intersect the Onshore Project area, which encompasses all wetlands and surface waters that are most likely to experience impacts from the proposed Project. See Section 3.4.2 for a discussion of impacts on water quality.

#### 3.5.8.1 Description of the Affected Environment and Future Baseline Conditions

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3(c)(16)). Wetlands are important features in the landscape that provide numerous beneficial services or functions. Some of these include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, providing aesthetic value, ensuring biological productivity, filtering pollutant loads, and maintaining surface water flow during dry periods. The majority of the wetlands in the geographic analysis area are tidally influenced salt marshes, which provide shelter, food, and nursery grounds for coastal fisheries species, including shrimp, crab, and many finfish. Salt marshes also protect shorelines from erosion by creating a buffer against wave action and by trapping soils. In flood-prone areas, salt marshes reduce the flow of flood waters and absorb rainwater. Tidal wetlands also serve as carbon sinks, holding carbon that would otherwise be released into the atmosphere and contribute to climate change. New Jersey’s coastal wetlands, including those in the geographic analysis area, protect coastal water quality by acting as a sink for land-derived nutrients and contaminants, constitute an important component of coastal food webs, provide valuable wildlife habitat, and protect upland and shoreline areas from flooding and erosion.

The National Wetlands Inventory (NWI) and NJDEP wetland data were used to determine the potential presence of wetlands. NWI information is provided in Appendix B, *Supplemental Information and Additional Figures and Tables*, and NJDEP information is provided in this section. NWI and NJDEP data rely on trained image analysts to identify potential wetlands. Tidal wetlands are areas where the Atlantic Ocean and estuaries meet land, are found below the spring high tide line, and are subject to regular flooding by the tides. Tidal wetlands are typically categorized into two zones, high marsh and low marsh. Non-tidal wetlands, otherwise referred to as freshwater wetlands, are not influenced directly by tides and are typically categorized based on their hydrology and predominant vegetation.

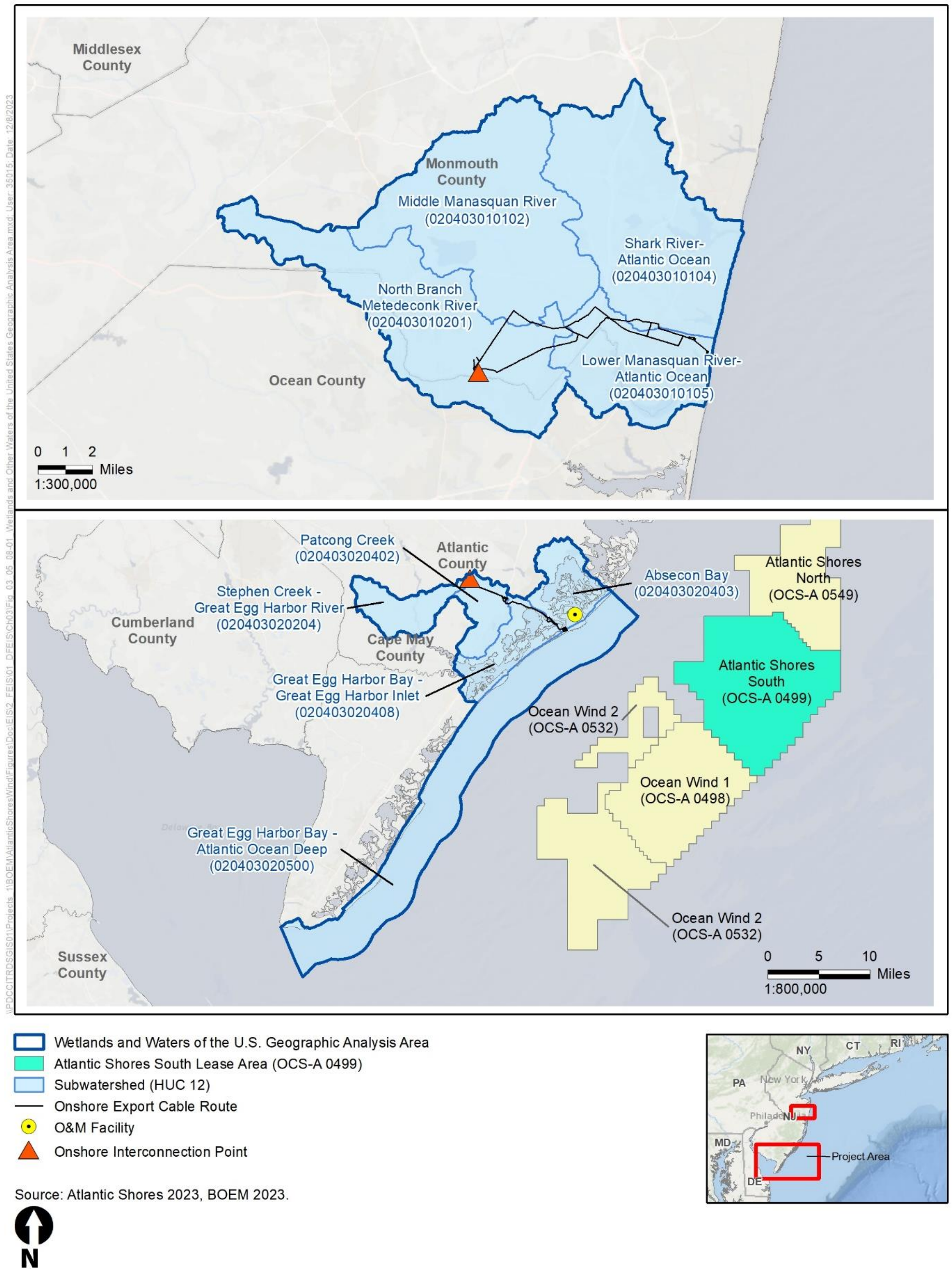



**Figure 3.5.8-1. Wetlands geographic analysis area**

The Cardiff Onshore Project area and the O&M facility in Atlantic City, New Jersey, lie within five watersheds: Absecon Bay (hydrologic unit code [HUC] 12 No. 020403020403), Patcong Creek (HUC 12 No. 020403020402), Stephen Creek-Great Egg Harbor River (HUC 12 No. 020403020204), Great Egg Harbor Bay-Atlantic Ocean Deep (HUC 12 No. 020403020500), and Great Egg Harbor Bay-Great Egg Harbor Inlet (HUC 12 No. 020403020408). All of these watersheds are within the Great Egg Harbor Watershed Management Area. The major watercourses draining these watersheds into the bays include Absecon Creek, Patcong Creek, and the Great Egg Harbor. According to NJDEP wetland data, estuarine wetlands within the Cardiff Onshore Project area are dominated by swaths of tidal marshes (COP Volume II, Appendix II-D1; Atlantic Shores 2024). Tidal wetlands are limited to areas adjacent to Lakes Bay and Absecon Bay shoreline along the interconnection cable route. Freshwater wetlands, dominated by forested/shrub wetland communities, are mapped along Cedar Branch, Mill Branch, and Maple Run within the Cardiff Onshore Project area boundary.

The Larrabee Onshore Project area lies within four watersheds: Shark River-Atlantic Ocean (HUC 12 No. 020403010104), Middle Manasquan River (HUC 12 No. 020403010102), North Branch Metedeconk River (HUC 12 No. 020403010201) and Lower Manasquan River-Atlantic Ocean (HUC 12 No. 020403010105). The Larrabee Onshore Project area lies within both the Barnegat Bay Watershed Management Area and the Monmouth Watershed Management Area. Wetlands in and around Barnegat Bay provide flood protection during storm events, and function to sequester a significant amount of the nitrogen and phosphorous loading to the bay. These coastal wetlands can remove (through deposition and plant growth) approximately 85 percent of the nitrogen and 54 percent of the phosphorus entering the bay from upland sources (NJDEP 2021). The Manasquan River and the Metedeconk River are the major river systems within this area. Based on the NJDEP wetland data, freshwater wetlands are found within the Larrabee Onshore Project area (COP Volume II, Appendix II-D2; Atlantic Shores 2024). According to NJDEP wetland data, freshwater forested/scrub and emergent wetlands are concentrated along the Manasquan River and North Branch Metedeconk River, and their tributaries. Freshwater forested/shrub wetland communities are the dominant community types mapped within the Larrabee Onshore Project area.

As explained in Section 3.4.2, *Water Quality,* the Barnegat Bay Partnership's Comprehensive Conservation and Management Plan aims to protect and restore clean water and healthy living resources in Barnegat Bay and its watershed bay and its watershed. Though Barnegat Bay is within the geographic analysis area, the proposed Project would not cross the Barnegat Bay-Little Egg Harbor estuary and would not affect achievement of goals identified in the plan.

The geographic analysis area contains 50,849 acres (20,578 hectares) of wetlands, according to NJDEP wetland data (NJDEP 2015). Table 3.5.8-1 displays the wetland communities within the geographic analysis area based on NJDEP wetland data.

**Table 3.5.8-1. Wetland communities in the geographic analysis area**

| Wetland Community | Acres | Percent of Total |
|---|---|---|
| **Freshwater** | | |
| Agricultural Wetlands (Modified) | 1,091 | 2.1 |
| Atlantic White Cedar Wetlands | 482 | 0.9 |
| Coniferous Scrub/Shrub Wetlands | 180 | 0.4 |
| Coniferous Wooded Wetlands | 3,316 | 6.5 |
| Deciduous Scrub/Shrub Wetlands | 1,102 | 2.2 |
| Deciduous Wooded Wetlands | 12,968 | 25.5 |
| Disturbed Wetlands (Modified) | 342 | 0.7 |
| Former Agricultural Wetland (Becoming Shrubby, Not Built-Up) | 23 | 0.0 |
| Herbaceous Wetlands | 289 | 0.6 |
| Managed Wetland in Built-Up Maintained Rec Area | 277 | 0.5 |
| Managed Wetland in Maintained Lawn Greenspace | 113 | 0.2 |
| Mixed Scrub/Shrub Wetlands (Coniferous Dominate) | 257 | 0.5 |
| Mixed Scrub/Shrub Wetlands (Deciduous Dominate) | 516 | 1.0 |
| Mixed Wooded Wetlands (Coniferous Dominate) | 5,058 | 9.9 |
| Mixed Wooded Wetlands (Deciduous Dominate) | 3,893 | 7.7 |
| Phragmites Dominate Interior Wetlands | 224 | 0.4 |
| Phragmites Dominate Urban Area | 9 | 0.0 |
| Wetland Rights-of-Way | 587 | 1.2 |
| **Tidal** | | |
| Saline Marsh (High Marsh) | 318 | 0.6 |
| Saline Marsh (Low Marsh) | 17,751 | 34.9 |
| Disturbed Tidal Wetlands | 22 | 0.0 |
| Phragmites Dominate Coastal Wetlands | 935 | 1.8 |
| Freshwater Tidal Marsh | 2 | 0.0 |
| Vegetated Dune Communities | 1,094 | 2.2 |
| **Total** | **50,849** | **100.0** |

Source: NJDEP 2015.

### 3.5.8.2 Impact Level Definitions for Wetlands

As described in Section 3.3, *Definitions of Impact Levels,* this Final EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. The definitions of potential adverse impact levels for wetlands are provided in Table 3.5.8-2. There are no beneficial impacts on wetlands. USACE and NJDEP would define wetland impacts differently than BOEM due to requirements under CWA Section 404 and the New Jersey Freshwater Protection Act (as summarized below).

**Table 3.5.8-2. Definitions of impact levels for wetlands**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | Impacts on wetlands would be so small as to be unmeasurable, and impacts would not result in a detectable change in wetland quality and function. |
| Minor | Adverse | Impacts on wetlands would be minimized; and would be relatively small and localized. If impacts occur, wetland functions and values would completely recover. |
| Moderate | Adverse | Impacts on wetlands would be minimized; however, permanent impacts would be unavoidable. Compensatory mitigation would be required to offset impacts on wetland functions and values, and mitigation measures would have a high probability of success. |
| Major | Adverse | Impacts on wetlands would be minimized; however, permanent impacts would be regionally detectable. Extensive compensatory mitigation would be required to offset impacts on wetland functions and values, and mitigation measures would have a marginal or unknown probability of success. |

New Jersey Administrative Code 7:7A, Freshwater Wetlands Protection Act Rules, defines temporary disturbance as a regulated activity that occupies, persists, or occurs on a site for no more than 6 months. Impacts on wetlands that persist longer than 6 months are considered permanent. USACE defines temporary impacts as those that occur when fill or cut impacts occur in wetlands that are restored to pre-construction contours when construction activities are complete. (e.g., stockpile, temporary access). Conversion of a wetland type is also considered a permanent impact.

Wetlands and waterbodies in New Jersey are under the jurisdiction of NJDEP according to the Freshwater Wetlands Protection Act. A memorandum of agreement between the USACE and NJDEP has provided New Jersey with assumed authority over non-tidal freshwater wetlands greater than 1,000 feet (305 meters) from the head of tide. Wetlands that occur less than 1,000 feet (305 meters) from the head of tide, including tidal wetlands, are under joint jurisdiction of USACE and NJDEP. All Project activities within regulated wetlands and waterbodies would be conducted in compliance with applicable regulatory requirements and conditions of nationwide or individual federal and state permits that may be required for Onshore Project activities (COP Volume II, Section 4.1; Atlantic Shores 2024).

Additionally, all earth disturbances from construction activities would be conducted in compliance with the NJPDES General Permit for Stormwater Discharges Associated with Construction Activities and the approved SWPPP for the Project.

### 3.5.8.3 Impacts of Alternative A – No Action on Wetlands

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

### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for wetlands described in Section 3.5.8.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that may contribute to impacts on wetlands are associated with onshore development activities (see Section D.2 in Appendix D for a description of ongoing and planned activities). Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect wetlands through activities that can have permanent (e.g., fill placement) and short-term (e.g., vegetation removal) impacts on wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss. Climate change–induced sea level rise in the geographic analysis area is also anticipated to continue to affect wetlands. Inundation and rising water levels would result in the conversion of vegetated areas into areas of open water, with a consequent loss of wetland functions associated with the loss of vegetated wetlands. Wetlands have very specific water elevation tolerances; if water is not deep enough, it is no longer a wetland. Slowly rising waters on a gentle, continuously rising surface can result in wetlands migrating landward. In areas where slopes are not gradual or where there are other features blocking flow (e.g., bulkhead or surrounding developed landscape), wetland migration would be slowed or impeded. Rising coastal waters would also continue to cause saltwater intrusion, which occurs when saltwater starts to move farther inland and creeps into freshwater/non-tidal areas. Saltwater intrusion would continue to change wetland plant communities and habitat (i.e., freshwater species to saltwater species) and overall wetland functions. See Appendix D, Table D.A1-24 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for wetlands. There is one ongoing offshore wind activity within the geographic analysis area for wetlands: Ocean Wind 1 in Lease Area OCS-A 0498. The Ocean Wind 1 BL England interconnection cable corridor intersects the Atlantic Shores South Cardiff geographic analysis area. BOEM expects that this planned offshore wind activity would have impacts on wetlands that are similar to impacts described for the Proposed Action, including impacts related to accidental releases and land disturbance.

### *Cumulative Impacts of Alternative A – No Action*

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

Planned non-offshore wind activities that may affect wetlands would primarily include onshore development activities (see Section D.2 in Appendix D for a complete description of ongoing and planned activities). These activities could permanently (e.g., permanent fill placement) and temporarily (e.g., temporary fill placement or vegetation clearing) affect wetlands or areas near wetlands. All projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated for projects to compensate for lost wetlands. See Table D.A1-24 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for wetlands

Impacts on wetlands from planned offshore wind projects may occur if onshore activity from these projects overlaps with the geographic analysis area. The Ocean Wind 2, and Atlantic Shores North projects are within the geographic analysis area.

The sections below summarize the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on wetlands during construction, O&M, and decommissioning of the projects. BOEM expects planned offshore wind development activities to affect wetlands through the following primary IPFs.

**Accidental releases:** During onshore construction of offshore wind projects in the geographic analysis area, oil leaks and accidental spills from construction equipment are potential sources of wetland water contamination. While many wetlands act to filter out contaminants, any significant increase in contaminant loading could exceed the capacity of a wetland to perform its normal water quality functions. Although degradation of water quality in wetlands could occur during construction, decommissioning, and to a lesser extent O&M, due to the small volumes of spilled material anticipated, these impacts would all be short-term, until the source of the contamination is removed. Compliance with applicable state and federal regulations related to oil spills and waste handling would minimize potential impacts from accidental releases. These include the Resource Conservation and Recovery Act, Department of Transportation Hazardous Material regulations, and implementation of a Spill Prevention, Control, and Countermeasure Plan. Impacts from accidental releases on wetlands would be minor because accidental releases would be small and localized, and compliance with state and federal regulations would avoid or minimize potential impacts to wetland quality or functions.

**Land disturbance:** Construction of onshore components (e.g., interconnection cables, onshore substation) for the ongoing Ocean Wind 1 Project, and planned Ocean Wind 2, and Atlantic Shores North projects are anticipated to require clearing, excavating, trenching, fill, and grading, which could result in the loss or alteration of wetlands, causing adverse effects on wetland habitat, water quality, and flood and storage capacity functions. Ocean Wind 1 has estimated that up to 1 acre (0.4 hectare) of permanent disturbance would occur within wooded wetlands and approximately 0.53 and 11.92 acres (0.21 and 4.82 hectares) of temporary wetland impacts could potentially occur as a result of interconnection cable burial at BL England and Oyster Creek, respectively (Ocean Wind 2022).

Fill material permanently placed in wetlands during construction would result in the permanent loss of wetlands, including any habitat, flood and storage capacity, and water quality functions that the wetlands may provide. If a wetland were partially filled and fragmented or if wetland vegetation were trimmed, cleared, or converted to a different vegetation type (e.g., forest to herbaceous), habitat would be altered and degraded (affecting wildlife use) and water quality and flood/storage capacity functions would be reduced by changing natural hydrologic flows and reducing the wetland’s ability to impede and retain stormwater and floodwater. On a watershed level, any permanent wetland loss or alteration could reduce the capacity of regional wetlands to provide wetland functions.

Temporary wetland impacts may occur from a construction activity that crosses or is adjacent to wetlands, such as rutting, compaction, and mixing of topsoil and subsoil. Where construction leads to unvegetated or otherwise unstable soils, precipitation events could erode soils, resulting in sedimentation that could affect water quality in nearby wetlands, as well as alter wetland functions if sediment loads are high (e.g., adverse habitat impacts from burying vegetation). The extent of wetland impacts would depend on specific construction activities and their proximity to wetlands. These impacts would occur primarily during construction and decommissioning; impacts during O&M would only occur if new ground disturbance was required, such as to repair a buried component.

BOEM anticipates that onshore project components from other offshore wind projects would likely be sited in disturbed areas (e.g., along existing roadways), which would avoid and minimize wetland impacts. In addition, BOEM expects the offshore wind projects would be designed to avoid wetlands to the extent feasible. Offshore wind projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. Impacts from land disturbance on wetlands would be moderate because permanent wetland impacts would likely occur and compensatory mitigation would be required.

### *Conclusions*

**Impacts of Alternative A – No Action.** Under the No Action Alternative, wetlands would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Land disturbance from onshore construction periodically would cause temporary and permanent loss of wetlands. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands. BOEM anticipates that the wetland impacts, especially land disturbance, as a result of ongoing activities associated with the No Action Alternative would be **moderate**. Impacts from land disturbance on wetlands would be moderate because permanent wetland impacts would likely occur and compensatory mitigation would be required.

**Cumulative Impacts of Alternative A – No Action.** Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and wetlands would continue to be affected by land disturbance. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on wetlands. Planned activities other than offshore wind primarily include increasing onshore construction. BOEM anticipates that the overall impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would be **moderate** because any activity would be required to comply with federal, state, and local regulations related to the protection of wetlands and mitigation of impacts. BOEM expects the combination of ongoing activities and planned activities other than offshore wind to result in **moderate** impacts on wetlands, primarily driven by land disturbance.

Ongoing and planned offshore wind activities, such as the Ocean Wind 1, Ocean Wind 2, and Atlantic Shores North projects, could cause impacts that would be similar to the impacts of the proposed Atlantic

Shores South Project alone. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands, thereby avoiding or minimizing impacts. If impacts would not be entirely avoided, compensatory mitigation would be anticipated for projects that result in permanent impacts, resulting in overall **moderate** impacts.

Considering the IPFs and regulatory requirements for avoiding, minimizing, and mitigating impacts on wetlands, BOEM anticipates that the overall impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in **moderate** impacts, primarily through land disturbance. Planned offshore wind activities are expected to contribute to the impacts through land disturbance, although the majority of this IPF would be attributable to ongoing non-offshore wind activities.

#### 3.5.8.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The routing variants within the selected onshore landfall locations and interconnection cable routes.

An onshore interconnection cable route(s) with less wetlands within or adjacent to the ROW would have less potential for direct and indirect impacts on wetlands.

#### 3.5.8.5 Impacts of Alternative B – Proposed Action on Wetlands

The Cardiff and Larrabee Onshore Project areas have been sited to maximize the use of existing linear infrastructure, such as roadway, electric utility, and pedestrian/bike lane ROWs. The landfall sites, onshore substations, and converter stations have also been intentionally located in disturbed or developed areas to avoid and minimize potential impacts on wetlands (WET-01; Appendix G, Table G-1). In addition, the onshore interconnection cables would be installed underground using trenchless construction techniques such as jack-and-bore and HDD at all wetland and waterbody crossings, where feasible, to further avoid impacts on these resources (WET-02, GEO-15; Appendix G, Table G-1). As a result, the only potential IPF on wetlands would be the result of land disturbance, including soil erosion and sedimentation, and stormwater runoff during construction and installation (COP Volume II, Section 4.1.5; Atlantic Shores 2024).

In order to confirm the extent and presence of regulated wetlands, a preliminary field delineation was conducted by Atlantic Shores in June and December 2020, September 2021, June 2022, February 2023, and September 2023 to identify wetlands under the jurisdiction of USACE and the NJDEP. The wetland delineation study encompassed the Cardiff and Larrabee Onshore Project areas in an effort to verify the presence of mapped NWI and NJDEP wetland data and to assess the potential presence of unmapped wetlands. The onshore Project study areas included the interconnection cable routes ROW, substations and converter stations, landfall sites, and the O&M facility. The width of the study area varied depending on the location and property boundaries. The onshore interconnection cable routes ROW study area width was approximately 150 feet (45.7 meters) wide with the anticipated cable alignment being the center; however, in areas such as Atlantic City the study area was narrower.

The Cardiff onshore study area field delineation identified 27 wetlands totaling 16.0 acres (6.47 hectares) and 8 watercourses totaling 10,361 linear feet (3,158 meters). One watercourse, the Clam Creek portion of Absecon Inlet located at the proposed O&M facility, totaling approximately 164 linear feet (50 meters), has been delineated via desktop aerial imagery and has not been field verified. Wetlands identified consist of the following four community types: estuarine emergent (EEM), palustrine open water (POW), palustrine emergent (PEM), and palustrine forested (PFO). Wetland acreage within the onshore interconnection cable route includes 12 EEM wetlands totaling 12.8 acres (5.2 hectares), 1 POW wetland totaling 0.09 acre (0.03 hectare), 13 PEM wetlands totaling 2.8 acres (1.1 hectares), and 3 PFO wetlands totaling 0.3 acre (0.1 hectare). Approximately 14.8 acres (5.9 hectares) of wetlands assessed are considered to have NJDEP exceptional resource value due to their tidal influence and importance to the tidal ecosystem (COP Volume II, Appendix II-D1; Atlantic Shores 2024). Delineated wetlands are largely adjacent to roadways, railroads, electric utility lines, and other developed areas along the Cardiff onshore interconnection cable route. Watercourses within the study area are classified as tidal riverine (10,169 linear feet [3,099 meters]), perennial (93 linear feet [28 meters]) and ephemeral (99 linear feet [30 meters]) streams. The delineated tidal streams and inlets and estuarine wetlands have direct connections to the Great Thorofare that is part of the intra-coastal waterway and provides a direct connection to the Atlantic Ocean. Freshwater, non-tidal wetlands are associated with perennial watercourses Mill Branch and Cedar Branch that occur outside of the Cardiff Onshore Project area and ultimately flow south to the Great Egg Harbor River (COP Volume II, Section 4.1.2; Atlantic Shores 2024).

The Larrabee Onshore study area field delineation identified 27 wetlands totaling 16.02 acres (6.48 hectares) and 19 watercourses totaling 4,063 linear feet (1,238 meters). Wetlands identified consist of the following four community types: POW, PEM, palustrine scrub-shrub (PSS), and PFO. Wetland acreage within the onshore interconnection cable route includes: 3 POW wetlands totaling 0.41 acre (0.16 hectare), 4 PEM wetlands totaling 1.86 acres (0.75 hectare), 2 PSS wetlands totaling 0.23 acre (0.09 hectare), and 20 PFO wetlands totaling 13.52 acres (5.47 hectares). Freshwater, non-tidal wetlands are associated with the Manasquan River, its tributaries, and other streams or drainages within the Larrabee Onshore Project area. Approximately 12.2 acres (4.93 hectares) of wetlands assessed are considered to have NJDEP exceptional resource value due to their proximity and connection to the dune system on the beach or the documented presence of federal and state protected species (COP Volume II, Appendix II-D2; Atlantic Shores 2024). Watercourses within the study area are classified as ephemeral (180 linear feet [55 meters]), intermittent (376 linear feet [115 meters]) and perennial (3,507 linear feet [1,069 meters]) riverine systems and are associated with the Metedeconk River, Manasquan River, and their tributaries. These features are located within deciduous and mixed forest habitats along the onshore interconnection cable routes and cross via culvert under existing paved roads and pedestrian/bike lanes (COP Volume II, Section 4.1.3; Atlantic Shores 2024). None of the wetlands or watercourses are tidal or are within 1,000 feet (305 meters) of the head of tide. As such, all delineated wetlands and watercourses are expected to be under the jurisdiction of the NJDEP under the New Jersey Freshwater Wetlands Protection Act.

Authorization from USACE and NJDEP is required prior to the discharge of dredged or fill materials in jurisdictional wetlands, pursuant to CWA Section 404, and CWA Section 401 and the New Jersey Freshwater Wetlands Protection Act of 1987, respectively. CWA Section 404 requires that all appropriate and practicable steps be taken first to avoid and minimize impacts on jurisdictional wetlands; for unavoidable impacts, compensatory mitigation is required to replace the loss of wetlands and associated functions.

**Accidental releases:** Onshore construction activities would require heavy equipment use and HDD activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Atlantic Shores would develop and implement a Spill Prevention, Control, and Countermeasure Plan to minimize impacts on water quality (prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). In addition, all wastes generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates the Proposed Action alone would result in minor and short-term impacts on wetlands as a result of releases from heavy equipment during construction and other cable installation activities. All HDD activities would require the preparation and implementation of an Inadvertent Returns Contingency Plan.

**Land disturbance:** Construction impacts on wetlands and related functions would be similar to those described for the No Action Alternative. The primary wetland impacts under the Proposed Action would be excavation, rutting, compaction, mixing of topsoil and subsoil, and potential alteration due to clearing at HDD entry pit locations. These impacts would be mostly temporary in non-wooded wetlands, as restoration would be conducted in accordance with applicable NJDEP permit requirements. Following installation of interconnection cables within wetlands, topography would be restored and soils would be decompacted to avoid long-term impacts on soils and hydrology. Long-term changes from wooded to herbaceous wetlands could occur if clearing is required in wooded wetlands. Loss of wetland could occur if permanent placement of fill is required in wetlands. Placement of fill within a wetland or permanent conversion of wooded wetlands to herbaceous or shrub/scrub wetlands within the permanent easement would constitute a permanent impact on wetlands. Other long-term impacts on wetlands would include clearing wooded wetlands within the temporary workspace. While these would be allowed to revert to forested wetland condition, the recovery could take decades or longer. Atlantic Shores has estimated that approximately 0.65 acre (0.26 hectare) of temporary and 0.61 acre (0.24 hectare) of permanent disturbance in wetlands may occur as a result of Project interconnection cable installation. Approximately 52 percent of the proposed wetland impacts are temporary and would occur in both emergent and forested wetlands. Following construction, temporary disturbance areas would be restored to pre-existing conditions and revegetated.

The onshore interconnection cables for both Cardiff and Larrabee have the potential to cross several wetland features. At these locations, the onshore interconnection cables would be installed using trenchless technology (e.g., jack-and-bore, pipe jacking, or HDD) beneath wetlands where crossing is necessary to minimize direct impacts on these resources. Entry/exit work areas would be in disturbed upland areas to further avoid impacts to wetlands. Approximately 3.0 acres (1.2 hectares) of wetland along portions of the Cardiff and Larrabee onshore interconnection cable routes would be avoided by trenchless technology methods. Table 3.5.8-3 provides a summary of the potential temporary and permanent impacts resulting from construction of the Atlantic Shores South Project as well as impacts avoided using trenchless installation technologies (COP Volume II, Section 4.1.6; Atlantic Shores 2024). Based on the wetland delineation reports (COP Volume II, Appendix II-D1 and D2; Atlantic Shores 2024), Atlantic Shores has confirmed no presence of wetlands at the Atlantic or Monmouth landfall locations or the Cardiff and Larrabee POIs (COP Volume II, Section 4.1.6; Atlantic Shores 2024). Wetlands also do not occur shoreward of the bulkhead at the proposed O&M facility Project area, and therefore wetlands would not be impacted as a result of construction of the proposed O&M facility (COP Volume II, Section 4.1.6; Atlantic Shores 2024).

NJDEP–regulated adjacent transition areas may also be affected by clearing and soil disturbance. Water quality within wetlands could be affected by sedimentation from nearby exposed soils. To prevent indirect impacts on wetlands and waterbodies, such as soil erosion and sedimentation from land-disturbing construction activities, Atlantic Shores would comply with an approved Soil Erosion and Sediment Control Plan, and would obtain coverage under a NJPDES General Permit, and prepare a SWPPP for the Project. In accordance with these plans, all Monmouth, Ocean, and Atlantic County Soil Conservation District BMPs including, but not limited to dust abatement, installation of silt fencing, filter socks, and inlet filters, would be implemented to minimize or avoid potential effects (WET-03; Appendix G, Table G-1). Atlantic Shores would also provide Environmental/Construction Monitor(s) with applicable erosion and sedimentation and stormwater management control plans and permit conditions, to ensure that BMPs are functional (WET-05; Appendix G, Table G-1). Additionally, once construction is completed, areas of temporary disturbance would be returned to pre-construction conditions, and at the onshore substations and converter stations land would be appropriately graded, graveled, or revegetated to prevent future erosion (WET-04; Appendix G, Table G-1).

Impacts on wetlands would be avoided and minimized by locating the substations and/or converter stations, cable routes, and work areas for the Cardiff and Larrabee onshore cable corridors within upland areas. Atlantic Shores would identify compensatory mitigation based on the requirements of USACE and NJDEP. Mitigation would likely include a combination of onsite restoration of wetlands temporarily impacted during construction, wetland enhancement, and wetland establishment (creation) or mitigation banking credit purchase. In summary, potential adverse impacts on wetlands would be temporary and permanent, and localized. The impacts of land disturbance on wetlands resulting from the Proposed Action would be moderate because, although impacts on wetlands would be minimized, compensatory mitigation would likely be necessary due to unavoidable permanent impacts.

**Table 3.5.8-3. Wetlands and waterbodies direct impact summary**

| Wetland/Waterbody Type | Potential Project Area Impacts (acres) | | Impacts Avoided by Using Trenchless Installation (acres) |
|---|---|---|---|
| | Temporary | Permanent | |
| Estuarine Emergent Wetland | 0 | 0.002 | 2.2 |
| Palustrine Emergent Wetland | 0.0508 | 0.5 | 0.2 |
| Palustrine Forested Wetland | 0.6 | 0.11 | 0.6 |
| Palustrine Scrub-Shrub | 0 | 0 | 0.001 |
| Tidal/Riverine | 0 | 0.5 | 9.9 |
| Non-tidal/Perennial | 0.01 | 0 | 0.17 |
| Non-tidal/Intermittent | 0.002 | 0.0005 | 0 |
| Non-tidal/Ephemeral | 0.0002 | 0 | 0 |

Source: COP Volume II, Section 4.1-6; Atlantic Shores 2024.

### *Impacts of the Connected Action*

No wetlands are located within the portion of the O&M facility study area, where the connected action activities would occur. However, a 0.08-acre (0.03-hectare) estuarine, emergent wetland is located between a paved parking lot and Clam Creek within the O&M facility study area. The maintenance dredging area within the Clam Creek portion of Absecon inlet is classified as a tidal waterbody. The bulkhead site and dredging activities would be conducted within an approximately 20.61-acre (8.3-hectare) site within Atlantic City's Inlet Marina area. The connected action could affect adjacent estuarine, emergent wetlands through the following IPFs: discharges/intakes and presence of structures.

**Discharges/Intakes:** Localized increases in TSS resulting in localized turbidity would be expected during Clam Creek dredging and during removal and installation of the bulkhead and piles. BMPs used during construction would minimize TSS increases in the water column. These measures include use of turbidity curtains during dredging in the basins, use of an environmental bucket, and slow withdrawal of the bucket through the water column. Pile driving would result in minimal and localized increases in turbidity (i.e., 5 to 10 mg/L above ambient within 300 feet [91 meters] of the activity). Turbidity associated with the Project activities would be minimal and temporary in nature and would have negligible impacts on any adjacent estuarine wetlands, as resuspended sediments would dissipate relatively quickly with the tidal currents.

**Presence of structures:** Wetlands and waterbodies do not occur shoreward of the bulkhead at the proposed O&M facility Project area and would not be impacted as a result of construction of the proposed O&M facility. The existing bulkhead is an approximately 250-foot (76-meter) structure consisting of deteriorated steel sheet piles, timbers, and concrete. The existing bulkhead is missing sections, leading it to become unstable and increasing the potential for erosion. Repair and/or replacement of the existing bulkhead is required in order to stabilize the shoreline and prevent additional erosion and would be necessary regardless of whether the Proposed Action is implemented. Atlantic Shores proposes to construct a new 541-foot (165-meter) bulkhead composed of corrugated steel sheet pile. It is anticipated that the new bulkhead would be supported by anchor piles.[1] There is the potential that permanent impacts on 0.02 acre (0.008 hectare) of tidal/riverine waters, that occur along the boundary of the O&M facility, could be affected by the installation of the proposed new bulkhead.

### *Cumulative Impacts of Alternative B – Proposed Action*

The cumulative impact analysis of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities, and the connected action. Ongoing and planned non-offshore wind activities related to tidal energy projects, marine minerals extraction, port expansions, military use, oil and gas activities, and onshore development activities would contribute to impacts on wetlands through the primary IPFs of accidental releases and land disturbance. The connected action could affect nearby wetlands through discharges/intakes and presence of structures; however, anticipated impacts are negligible.

**Accidental releases:** The Proposed Action would contribute an undetectable increment to the cumulative accidental release impacts on wetlands from ongoing and planned activities including offshore wind. Impacts would likely be short term and minor due to the low risk and localized nature of the most likely spills, the use of an OSRP for projects, and regulatory requirements for the protection of wetlands. These impacts would occur primarily during construction, but also during operation and decommissioning to a lesser degree. Given the low probability of these spills occurring, BOEM does not expect ongoing and planned activities, including offshore wind, to contribute to impacts on wetlands resulting from accidental releases.

**Land disturbance:** The Proposed Action would contribute noticeable incremental impacts to the cumulative land disturbance impacts from ongoing and planned activities including offshore wind. Impacts would likely be temporary to permanent and moderate due to the permanent wetland impacts that would require compensatory mitigation. Impacts due to onshore land use changes are expected to include a gradually increasing amount of wetland alteration and loss. The future extent of land disturbance from ongoing and planned non-offshore wind activities over the next 34 years is not known with as much certainty as the extent of land disturbance that would be caused by the Proposed Action, but based on regional trends is anticipated to be similar to or greater than that of the Proposed Action. The Ocean Wind 1 Project, which has a similar geographic analysis area as the Atlantic Shores South Project, would result in approximately 1 acre (0.4 hectare) of permanent disturbance and approximately 12.45 acres (5.03 hectares) of temporary wetland disturbance (Ocean Wind 2022).

If other planned projects were to overlap the geographic analysis area or even be co-located (partly or completely) within the same ROW corridor that the Proposed Action would use, then the impacts of those projects on wetlands would be of the same type as those of the Proposed Action alone; the degree of impacts may increase, although the location and timing of future activities would influence

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[1] The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the respective approved permits.

this. For example, repeated construction in a single corridor would be expected to have less impact on tidal wetlands than construction in an equivalent area of undisturbed wetland. Any work in wetlands would require a CWA Section 404 permit from USACE or NJDEP (or both) and a Section 401 Water Quality Certification from NJDEP; any wetlands permanently lost would require compensatory mitigation.

BOEM would not expect normal O&M activities to involve further wetland alteration. The onshore cable routes and associated substation and converter station facilities and POIs generally have no maintenance needs unless a fault or failure occurs; therefore, O&M is not expected to affect wetlands. In the event of a fault or failure, impacts would be expected to be temporary and negligible. Vehicle and equipment use would occur along roads using the manholes within the splice vaults and transition vaults for access and within previously developed areas such as onshore substations. Decommissioning of the Onshore Project components would have similar impacts as construction.

#### *Conclusions*

**Impacts of Alternative B – Proposed Action.** In summary, the activities associated with the proposed Atlantic Shores South Project may affect wetlands through temporary disturbance and permanent impacts from activities within or adjacent to these resources. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), construction of the Proposed Action would likely have **moderate** impacts on wetlands. The connected action activities would have no impacts on wetlands as wetlands do not occur within the area where activities are proposed.

**Cumulative Impacts of Alternative B – Proposed Action.** The incremental impacts contributed by the Proposed Action to the cumulative impacts on wetlands would be noticeable. BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with the impacts on wetlands from ongoing and planned activities including offshore wind would likely be **moderate**. Wetland impacts would be considered moderate because the Proposed Action would contribute to the overall impact rating through temporary and permanent impacts from cable installation and onshore construction activities. Measurable impacts would be relatively small, and the resource would likely recover completely when the affecting agent (e.g., temporary construction activity) is gone and remedial or mitigating action is taken.

### 3.5.8.6 Impacts of Alternatives C, D, E, and F on Wetlands

**Impacts of Alternatives C, D, E, and F.** The impacts on wetlands of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would be the same as those of the Proposed Action because these alternatives would differ only with respect to offshore components, and offshore components of the proposed Project have no potential impacts on wetlands. The impacts resulting from the land disturbance IPF associated with onshore construction under Alternatives C through F on wetlands are expected to be moderate and would be the same as those of the Proposed Action.

**Cumulative Impacts of Alternatives C, D, E, and F.** The contribution of Alternatives C through F to the impacts of ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on wetlands from ongoing and planned activities in combination with each of these alternatives would be the same level as described under the Proposed Action.

#### *Conclusions*

**Impacts of Alternatives C, D, E, and F.** Alternatives C through F would have the same **moderate** impacts on wetlands as the Proposed Action. The overall impacts on wetlands would not be significantly different because onshore components would remain the same for all alternatives.

**Cumulative Impacts of Alternatives C, D, E, and F.** The contribution of Alternatives C through F to the impacts on wetlands would be the same as that of the Proposed Action: noticeable. BOEM anticipates that the cumulative impacts associated with Alternatives C through F, when combined with ongoing and planned activities, would likely be **moderate**.

### 3.5.8.7 Proposed Mitigation Measures

No measures to mitigate impacts on wetlands have been proposed for analysis. Atlantic Shores will identify compensatory mitigation based on the requirements of USACE and NJDEP as part of the Section 404 permitting process.

### 3.5.8.8 Comparison of Alternatives

None of the other action alternatives would affect the types, placement, or areal extent of the onshore components of the Project. All of the other action alternatives would therefore have the same impacts to wetlands as for the Proposed Action.

### 3.5.8.9 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two BOEM-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical miles (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately

150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative is expected to have the same impacts as the Proposed Action on wetlands. Activities associated with the Preferred Alternative would have **moderate** impacts on wetlands due to the developed and urbanized landscape that dominates the geographic analysis area and measures taken to avoid, minimize and mitigate.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and connected action, would result in similar impacts as the Proposed Action: **moderate**.

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### 3.6.3 Demographics, Employment, and Economics

This section discusses potential impacts on demographic, employment, and economic conditions from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area, as shown on Figure 3.6.3-1. Potential impacts on specific industries are discussed in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, and Section 3.6.8, *Recreation and Tourism*. This section focuses on potential changes that could affect overall demographics, employment, and economic trends in the geographic analysis area. The demographics, employment, and economics geographic analysis area includes the counties where proposed onshore infrastructure and potential port cities are located as well as the counties closest to the WTA: Atlantic, Cape May, Gloucester, Monmouth, Ocean, and Salem Counties in the State of New Jersey; Portsmouth City in the Commonwealth of Virginia;[1] and Nueces and San Patricio Counties in the State of Texas. Ports in Gloucester and Salem Counties, New Jersey, and Portsmouth City, Virginia, may be used to support Project construction and O&M. A port in Nueces and San Patricio Counties, Texas, may be used to support Project construction only. Atlantic City Harbor, Atlantic County, New Jersey, would be the site of the proposed O&M facility for the Project. These counties are the most likely to experience beneficial or adverse economic impacts from the proposed Project.

Tables B.4-1 through B.4-7 in Appendix B, *Supplemental Information and Additional Figures and Tables*, provide detailed demographic and employment information for these areas, which are most likely to be directly affected (note that all tables cited in this section are located in Appendix B). Data for the States of New Jersey, Virginia, and Texas are provided for reference. This section also considers the counties that may be affected by visual or recreation and tourism impacts, which may have impacts on property values (i.e., Atlantic, Cape May, Monmouth, and Ocean Counties in New Jersey). For these counties, data on the economic value of the Ocean Economy and tourism and recreation are provided in Tables B.4-8 through B.4-10 in Appendix B. The usage of ports (within Gloucester and Salem Counties in New Jersey, Portsmouth City in Virginia, and Nueces and San Patricio Counties in Texas) may have broad impacts on the Ocean Economy due to the anticipated increase in economic activity at these locations; therefore, data on the Ocean Economy was collected for these locations as well. Table B.4-11 in Appendix B provides data on the estimated number of jobs created throughout construction and development, as well as operation and decommissioning.

[1] Portsmouth City is a county-equivalent area according to the U.S. Census Bureau.

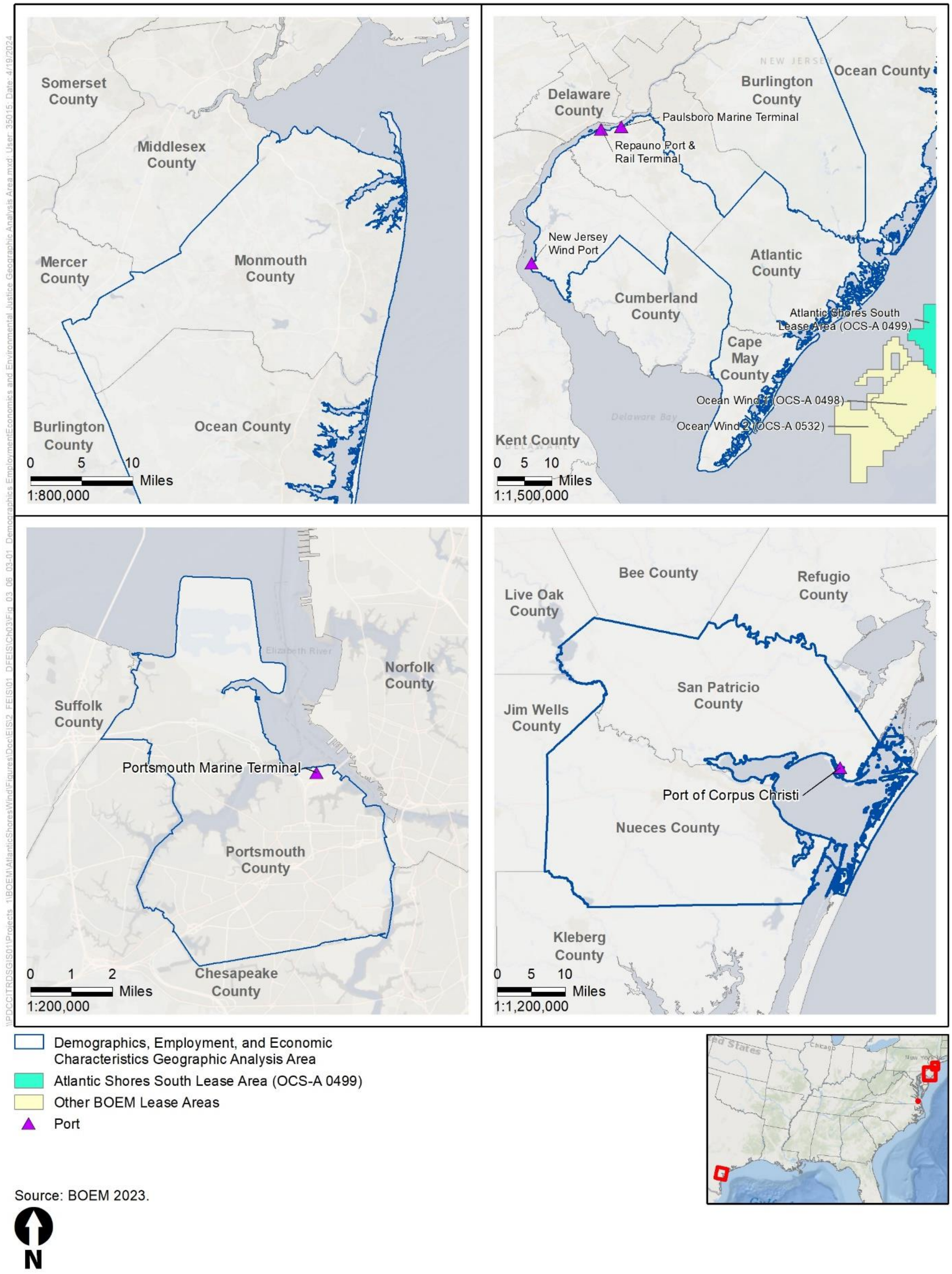



**Figure 3.6.3-1. Demographics, employment, and economics geographic analysis area**

### 3.6.3.1 Description of the Affected Environment and Future Baseline Conditions

*Atlantic, Cape May, Monmouth, and Ocean Counties*

Atlantic, Cape May, Monmouth, and Ocean Counties in New Jersey are some of the most densely populated coastal counties in the U.S. They are notable for coastal activities such as swimming, fishing, surfing, and sailing over the 127 miles (204 kilometers) of ocean beaches along the Jersey Shore from Sandy Hook to Cape May. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of visitors each year and benefit from high tourism employment. Many coastal amenities such as beaches do not directly generate employment, as they are accessible to the public for free, but stimulate the recreation and tourism businesses (COP Volume II, Section 7.3.1; Atlantic Shores 2024).

Data on population and demographics for the State of New Jersey and for Atlantic, Cape May, Monmouth, and Ocean Counties are provided in Tables B.4-1 and B.4-2 in Appendix B. The population of Monmouth and Ocean Counties grew by 2.1 percent and 10.5 percent, respectively, from 2010 to 2020, while the population of Atlantic and Cape May Counties declined by 0.01 percent (relatively no change) and 2.1 percent, respectively. Atlantic, Cape May, Monmouth, and Ocean Counties comprised 17.8 percent of New Jersey's population during that period (U.S. Census Bureau 2020). The population of Atlantic and Cape May Counties declined between 2010 and 2019, while the population of Monmouth and Ocean Counties and the State of New Jersey increased over the same period.

Table B.4-3 in Appendix B includes data on age distribution within the affected geographies. Of these counties, Monmouth County has the lowest percentage of residents over age 65 (17.1 percent), but still greater than in the State of New Jersey overall (15.9 percent).

Ocean County occupies about 629 square miles (1,629 square kilometers) of land area and contains 33 municipalities including its mainland and barrier island beaches. Ocean County is the second largest county in New Jersey (COP Volume II, Section 7.1.1.1; Atlantic Shores 2024). Atlantic County occupies about 556 square miles (1,440 square kilometers) of land in the coastal region of New Jersey. Atlantic County has three barrier islands along its eastern coast, which, like the other barrier islands in New Jersey, are separated from the mainland by the Intracoastal Waterway. Monmouth County occupies 469 square miles (1,215 square kilometers) of land area, including the northernmost barrier island, Sandy Hook (COP Volume II, Section 7.1.1.1; Atlantic Shores 2024). Cape May County occupies 251 square miles (650 square kilometers) of land area on the southern tip of New Jersey. The eastern part of Cape May County is composed of five barrier islands extending 32 miles (52 kilometers) from Cape May City to Ocean City. These barrier island beaches contain most of the county's infrastructure and are the heart of Cape May County's economy (Cape May County 2005).

The economies of Atlantic, Cape May, Monmouth, and Ocean Counties rely on tourism and visitors, and the counties have higher proportions of seasonal housing than New Jersey as a whole. Tables B.4-4 and B.4-5 in Appendix B include housing data for the geographic analysis area. Throughout New Jersey, 3.8 percent of housing units are seasonally occupied, compared to 4.8 percent in Monmouth County, 13.4 percent in Atlantic County, 13.8 percent in Ocean County, and 50.8 percent in Cape May County

(U.S. Census Bureau 2015-2019). About 95,000 year-long residents lived in Cape May County in 2020 (U.S. Census Bureau 2020). During summer months, the population increases to at least eight times the size of the permanent winter population because of tourism (Cape May County 2022). In 2013, Cape May County estimated its summer population at 796,695, or about eight times the permanent population (Cape May County 2013). Table B.4-6 in Appendix B presents economic data on residents in the affected environments. In 2019, unemployment was 4.9 percent in Monmouth County, 5.1 percent in Ocean County, 6.8 percent in Cape May County, and 8.4 percent in Atlantic County, compared to 5.5 percent in New Jersey (U.S. Census Bureau 2015–2019).

Table B.4-7 in Appendix B includes data on at-place employment by industry in the geographic analysis area. The industries that employ workers reflect recreation and tourism's importance to these counties. A greater proportion of workers in these counties are employed in accommodation and food services (31.1 percent in Atlantic County, 18.8 percent in Cape May County, 9.9 percent in Monmouth County, and 8.9 percent in Ocean County) than in New Jersey as a whole (7.7 percent) (U.S. Census Bureau 2019). With the exception of Atlantic County (10.5 percent), the proportion of jobs in retail trade (15.2 percent in Cape May County, 13.9 percent in Monmouth County, and 15.2 percent in Ocean County) in each county is greater than in New Jersey as a whole (11.0 percent) (U.S. Census Bureau 2019).

NOAA tracks economic activity dependent upon the ocean in its "Ocean Economy" data, which generally includes, among other categories, commercial fishing and seafood processing, marine construction, commercial shipping and cargo-handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal tourism and recreation. Table B.4-8 in Appendix B includes data on the Ocean Economy gross domestic product (GDP) for the affected geographies within the visual and recreation and tourism study areas. In Atlantic, Cape May, Monmouth, and Ocean Counties, coastal tourism and recreation account for 95.8 percent, 86.1 percent, 92.3 percent, and 86.6 percent of the overall Ocean Economy GDP, respectively (NOAA 2019). The "living resource" sector of the Ocean Economy is smaller but contributes to the identity of local communities as well as tourism. This includes commercial fishing, aquaculture, seafood processing, and seafood markets.

Of the four coastal counties, Monmouth County has the largest coastal tourism and recreation economy (Table B.4-9 in Appendix B). In 2019, Monmouth County had approximately 1,300 establishments, 18,000 employees, $403.5 million in total wages, and $770.6 million in GDP resulting from tourism and recreation. New Jersey overall had approximately 8,000 establishments, 99,000 employees, $2.3 billion in total wages, and $4.6 billion in GDP resulting from tourism and recreation in 2019 (NOEP 2019).

In addition to the significant Ocean Economy tourism and recreation sector, Table B.4-10 in Appendix B presents the data for the affiliated employment and industry sectors within the four counties. Employment sectors include marine construction, living resources, offshore mineral extraction, ship and boat building, tourism and recreation, and marine transportation. In 2019, Atlantic, Cape May, Monmouth, and Ocean Counties generated approximately 57,000 jobs within the Ocean Economy. The tourism and recreation jobs account for 97.9 percent, 93.4 percent, 97.1 percent, and 95.1 percent of the overall Ocean Economy employment for those four counties, respectively (NOAA 2019).

### *Gloucester and Salem Counties*

Compared to Atlantic, Cape May, Monmouth, and Ocean Counties, which have more ocean-based economies with seasonal work and recreation and tourism, Salem County, which is along the Delaware Bay, and Gloucester County, which is on the Delaware River, are less reliant on coastal industries. However, these counties contain three of the potential ports that may be used to support project construction (the Paulsboro Marine Terminal and the Repauno Port and Rail Terminal are in Gloucester County and the New Jersey Wind Port is in Salem County). The Ocean Economy supports 8,293 jobs in Gloucester and 1,955 jobs in Salem County, with marine transportation being the largest Ocean Economy sector within both counties (6,384 and 1,226 jobs, respectively). While the Ocean Economy GDP in 2019 totaled $416.8 million in Gloucester, it made up only 3.2 percent of the county's total GDP. Similarly, Salem's total Ocean Economy GDP in 2019 was approximately $118.9 million, comprising 4.1 percent of the total county GDP (Table B.4-8 in Appendix B).

The population of Gloucester County grew by 4.9 percent from 2010 to 2020 while the population of Salem County decreased by 1.9 percent (U.S. Census Bureau 2020). The share of New Jersey's population in Gloucester and Salem Counties is approximately 4.0 percent. Median age in Gloucester and Salem Counties (41 and 42 years, respectively) is slightly older than in New Jersey as a whole (40 years) (U.S. Census Bureau 2015–2019).

Gloucester and Salem Counties are also less dependent on tourism than their coastal counterparts. The percentages of housing units that are seasonally occupied in these counties are 0.3 and 0.7 percent, respectively, compared to 4.8 to 50.8 percent for the coastal counties (U.S. Census Bureau 2015–2019). Transportation and warehousing, utilities, and manufacturing are more important to the economies of Salem County, as a larger portion of the workers in this county work in those sectors than those in New Jersey as a whole. Manufacturing, retail trade, and wholesale trade have greater representation in Gloucester County than in New Jersey (U.S. Census Bureau 2019).

### *Portsmouth City, Virginia*

Portsmouth City is an independent city within the Commonwealth of Virginia. The city is one of the smaller affected geographies, with a total population of 97,915 in 2020, a 2.6 decrease from 2000 (U.S. Census Bureau 2020). The median age in Portsmouth is 35, with most residents falling within the 35 to 64 age group. While there is a negligible share of seasonal housing units within the housing supply (0.2 percent), roughly 10.7 percent of employees in Portsmouth work in the entertainment, recreation, accommodation, and food services industry sectors. As is the case with many of the affected areas, the largest industry sector of employment in Portsmouth is health care and social assistance (24.7 percent) (U.S. Census Bureau 2019).

In 2019, the Ocean Economy GDP for Portsmouth City totaled $1.45 billion. Roughly 5 percent, or $76.1 million, of the Ocean Economy GDP is attributed to the tourism and recreation sector. The Ocean Economy supports 15,246 jobs across all sectors, including 11,247 in the ship and boat building sector (Table B.4-10 in Appendix B). The Ocean Economy GDP is 23.1 percent of the total GDP in Portsmouth City, the largest share of all affected areas (NOAA 2019).

### *Nueces and San Patricio Counties, Texas*

The Port of Corpus Christi is located in Nueces and San Patricio Counties, Texas. The Port of Corpus Christi may be used to support Project construction.

#### *Nueces County, Texas*

In 2019, the National Ocean Economics Program totaled $1.4 billion in GDP across all ocean sectors in Nueces County. In 2019, Nueces County had approximately $571 million in GDP resulting from tourism and recreation (NOEP 2019). Roughly 3.2 percent of units in Nueces County were seasonal housing units (U.S. Census Bureau 2015–2019).

In 2020, the population of Nueces County totaled 353,178 people, an increase of 12.6 percent from 2000. The age distribution of the population of Nueces County is comparable to that of San Patricio County, with the largest share of residents falling into the 35–64 age bracket and the median age being 36 years old.

The unemployment rate in Nueces County (5.7 percent) is slightly higher than the rate in neighboring San Patricio County and the State of Texas overall (5.1 percent each) (U.S. Census Bureau 2015–2019).

A review of the industries that employ workers in Nueces County (Table B.4-7 in Appendix B) reveals that the county has roughly 13 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors. In terms of other industries that may be affected, Nueces County has a relatively modest proportion of retail trade jobs (9.8 percent). The other sectors with the highest proportion of jobs include health care and social assistance (20.8 percent) and construction (11.1 percent) (U.S. Census Bureau 2019).

In addition to the tourism and recreation sector, Nueces County employs individuals in offshore mineral extraction (2,417 employees) and marine transportation (579 employees). The Ocean Economy GDP is 7.0 percent of the total GDP in Nueces County (NOAA 2019) (see Table B.4-8 in Appendix B).

#### *San Patricio County, Texas*

The Ocean Economy GDP totaled $519.9 million across all ocean sectors in San Patricio County. In 2019, approximately $64.4 million in Ocean Economy GDP came from the tourism and recreation sector (National Ocean Economics Program 2019). Approximately 3.7 percent of housing units in San Patricio County are seasonal housing units (U.S. Census Bureau 2015–2019).

In 2020, the total population of San Patricio County was 68,755 individuals, a 6.1 percent increase from 2010, although the population experienced a slight decline between 2000 and 2010 (-3.5 percent). The age distribution of residents in San Patricio County is similar to that of Nueces County, with the largest share being aged 35–64. The median age of the county’s population is 36 years.

The unemployment rate in San Patricio County is 5.1 percent, which is the same as the rate for Texas overall (U.S. Census Bureau 2015–2019).

A review of the industries that employ workers in San Patricio County (Table B.4-7 in Appendix B) reveals that San Patricio County has 12.5 percent of its jobs in the entertainment, recreation, accommodation, and food services sectors compared to 12.8 percent in Nueces County. In terms of other industries that may be affected, San Patricio County has a relatively high proportion of retail trade jobs (10.6 percent compared to 9.8 percent in Nueces County), and 31.2 percent of jobs are in construction (compared to 11.1 percent in Nueces County) (U.S. Census Bureau 2019).

In San Patricio County, tourism and recreation accounted for 12.4 percent of the overall Ocean Economy GDP, compared to 39.8 percent in Nueces County (NOAA 2019) (see Table B.4-8 in Appendix B). However, the Ocean Economy GDP makes up 22.6 percent of San Patricio County's total county GDP, the second largest share of all affected areas (NOAA 2019) (see Table B.4-8 in Appendix B).

### 3.6.3.2 Impact Level Definitions for Demographics, Employment, and Economics

This Final EIS uses a four-level classification scheme to characterize potential impacts of the alternatives, including the Proposed Action, as shown in Table 3.6.3-1. See Section, 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

**Table 3.6.3-1. Impact level definitions for demographics, employment, and economics**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | No impacts would occur, or impacts would be so small as to be unmeasurable. |
| | Beneficial | Either no effect or no measurable benefit. |
| Minor | Adverse | Impacts would not disrupt the normal or routine functions of the affected activity or geographic place. |
| | Beneficial | Small but measurable benefit on demographics, employment, or economic activity. |
| Moderate | Adverse | The affected activity or geographic place would have to adjust somewhat to account for disruptions due to impacts of the Project. |
| | Beneficial | Notable and measurable benefit on demographics, employment, or economic activity. |
| Major | Adverse | The affected activity or geographic place would experience disruptions to a degree beyond what is normally acceptable. |
| | Beneficial | Large local or notable regional benefit to the economy as a whole. |

### 3.6.3.3 Impacts of Alternative A – No Action on Demographics, Employment, and Economics

When analyzing the impacts of the No Action Alternative on demographics, employment, and economics, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities (see Appendix D, *Ongoing and Planned Activities Scenario*).

### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for demographics, employment, and economics described in Section 3.6.3.1, Description of the Affected Environment and Future Baseline Conditions, would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities other than offshore wind within the geographic analysis area that contribute to impacts on demographics, employment, and economics include ongoing development of onshore solar and wind energy; growth in onshore and offshore development and modest growth in vessel traffic; ongoing installation or upgrades of piers, bridges, pilings, and seawalls or underground infrastructure; ongoing commercial shipping and recreational and commercial fishing; continued port upgrades and maintenance; and ongoing effects from climate change (e.g., damage to property and infrastructure related to sea level rise) (see Section D.2 in Appendix D for a description of ongoing activities). These activities contribute to numerous IPFs including implications for employment and state and regional energy markets; lighting, which can affect the recreational and commercial fishing economies; noise, which can affect residential and other sensitive populations; port utilization, which can affect jobs, populations, and economies; marine traffic, which can affect recreational and commercial fishing, shipping, and recreation and tourism; and land disturbance/onshore construction, which supports local population growth, employment, and economies. See Table D.A1-8 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for demographics, employment, and economics. There is currently one ongoing offshore wind project within the geographic analysis area that could contribute to impacts on demographics, employment, and economics: Ocean Wind 1 in Lease Area OCS-A 0498.

### *Cumulative Impacts of Alternative A – No Action*

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative, inclusive of ongoing activities, in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). In addition to ongoing activities, BOEM anticipates that the impacts of planned activities other than offshore wind development would result from: installation of new submarine cables and pipelines, increasing onshore construction, new barge route and dredging disposal sites, and port maintenance and upgrades (see Appendix D, Section D.2 for a description of planned activities).

Planned offshore wind activities include projects on the Atlantic OCS that have been determined by BOEM to be reasonably foreseeable, excluding the Proposed Action (see Appendix D for a description of planned offshore wind activities).

Offshore wind is a new industry for the Atlantic states and the nation. Although most offshore wind component manufacturing and installation capacity exists outside of the U.S., some studies acknowledge that domestic capacity is poised to increase.

A BVG Associates Limited study (BVG 2017) estimated that the percentage of associated jobs that would be sourced in the U.S. during the initial implementation of offshore wind projects along the U.S. northeast coast would range from 35 to 55 percent. As the offshore wind industry grows in the United

States, this proportion would increase due to growth in the supply chain on the East Coast along with a growing number of maintenance and local operations jobs for established wind facilities. The proportion of jobs associated with offshore wind projected to be within the U.S. is projected to be approximately 65 to 75 percent from 2030 through 2056. Overseas manufacturers of components and specialized ships based overseas that are contracted for installation of foundations and WTGs would comprise the rest of the offshore wind–related jobs outside the U.S. (BVG 2017).

The American Wind Energy Association (AWEA; now known as American Clean Power) estimates that the offshore wind industry will invest between $80 and $106 billion in U.S. offshore wind development by 2030, of which $28 to $57 billion will be invested within the U.S. This figure depends on installation levels and supply chain growth, as other investment would occur in countries manufacturing or assembling wind energy components for U.S.-based projects. While most economic and employment impacts would be concentrated in Atlantic coastal states where offshore wind development will occur—there are over $1.3 billion of announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction—there would be nationwide effects as well (AWEA 2020). The AWEA report analyzes base and high scenarios for direct impacts of offshore wind, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 GW of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030, while the high scenario assumes 30 GW of offshore wind power by 2030 and domestic content increasing to 40 percent in 2025 and 60 percent in 2030. Offshore wind energy development will support $14.2 billion in economic output and $7 billion in value added by 2030 under the base scenario. Offshore wind energy development will support $25.4 billion in economic output and $12.5 billion in value added under the high scenario. The report does not specify where in the U.S. supply chain growth would occur.

The University of Delaware projects that offshore wind power will generate 30 GW along the Atlantic coast through 2030. This initiative would require capital expenditures of $100 billion over the next 10 years (University of Delaware 2021). Although the industry supply chain is global and foreign sources would be responsible for some expenditures, more U.S. suppliers are expected to enter the industry.

Compared to the $14.2 to $25.4 billion in offshore wind economic output (AWEA 2020), the 2020 annual GDP for Atlantic states with planned offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $60.6 billion in Rhode Island to $1.72 trillion in New York (U.S. Bureau of Economic Analysis 2021) and totaled nearly $4.3 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.6 percent of the combined GDP of these states.

The AWEA estimates that in 2030, offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) full-time equivalent (FTE) jobs nationwide, including direct, supply chain, and induced jobs (AWEA 2020). Most offshore wind jobs (about 60 percent) would be created during the temporary construction phase while the remaining 40 percent would be long-term O&M jobs. The RODA in 2020 estimated that offshore wind projects would create 55,989 to 86,138 job-years through 2030 in construction and 5,003 to 6,994 long-term jobs in O&M (Georgetown Economic Services 2020). These estimates are generally consistent with the AWEA study in total jobs supported, although the RODA study concludes that a greater proportion of jobs would be in the construction phase. The two studies conclude that states hosting offshore wind projects would have more offshore wind energy jobs while states with manufacturing and other supply chain activities may generate additional jobs.

In 2019, employment in New Jersey was approximately 4.0 million (Table B.4-6 in Appendix B). While the extent to which there will be impacts on the geographic analysis area is unclear due to the geographic versatility of offshore wind jobs, a substantial portion of the ongoing and planned offshore wind projects in New Jersey would likely be within commuting distance of ports in Atlantic City, Paulsboro, Lower Alloways Creek, and Newark in New Jersey; Portsmouth, Virginia; Charleston, South Carolina; and other ports that would be used for offshore wind manufacturing, staging, and operations and maintenance.

Other planned offshore wind activities in the geographic analysis area for demographics, employment, and economics are limited to the construction and installation, O&M, and decommissioning of Ocean Wind 2 in Lease Area OCS-A 0532 and Atlantic Shores North in Lease Area OCS-A 0549.

In addition to the regional economic impact of a growing offshore wind industry, BOEM expects planned offshore wind development to affect demographics, employment, and economics through the following primary IPFs.

**Cable emplacement and maintenance**: Cable emplacement for planned offshore wind projects could temporarily impact commercial and for-hire recreational fishing businesses based in the geographic analysis area during cable installation and infrequent maintenance (see Section 3.6.1). The economic impact of cable emplacement and maintenance on commercial and for-hire recreational fishing businesses is covered in more detail in Section 3.6.1 and would be localized and short term. As discussed in Section 3.6.1, there are 80 small fishing businesses in the Lease Area that generate approximately 0.25 percent of their total revenue from the Lease Area. There was insufficient for-hire recreational fishing activity in the Lease Area to summarize the revenue generated there. Therefore, any potential impacts on overall demographics, employment, and economics of the affected communities from cable emplacement and maintenance is expected to be negligible to minor.

**Land disturbance:** Land disturbance could result in localized, short-term disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, short term, and both beneficial, in terms of jobs and revenues to local businesses that participate in onshore construction, and adverse, in terms of lost revenue due to construction disturbances. Land disturbance would result in minor beneficial impacts on demographics, employment, and economics due to increased employment, as well as potential negligible adverse temporary effects from noise and traffic. Potential impacts on recreational businesses are described in Sections 3.6.1 and 3.6.8.

**Lighting:** Offshore WTGs require aviation warning lighting that could have economic impacts in certain locations. Aviation hazard lighting from up to 266 planned WTGs in the geographic analysis area as part of the Atlantic Shores North and Ocean Wind 2 Projects, in addition to the 98 WTGs as part of the ongoing Ocean Wind 1 Project, could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions (Appendix D, Table D.A2-1). Visitors may make different decisions on coastal locations to visit, and potential residents may choose to select different residences because of nighttime views of lights on offshore wind energy structures. Ocean Wind 1 would be more than 15 miles (24.1 kilometers) from beach viewpoints. The majority of the WTG positions planned offshore in the geographic analysis area are also anticipated to be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs, and so impacts on demographics, employment, and economics are anticipated to be minor. These lights would be incrementally added over the construction period and would be visible for the operating lives of planned offshore wind activities. Distance from shore, topography, and atmospheric conditions would affect light visibility.

If implemented, ADLS would reduce the amount of time that WTG lighting is visible. Visibility would depend on distance from shore, topography, and atmospheric conditions. Such systems would likely reduce impacts on demographics, employment, and economics associated with lighting. Lighting for transit or construction could occur during nighttime transit or work activities. Construction of the two planned offshore wind projects would occur within the geographic analysis area between 2026 and 2030 (Appendix D, Table D.A2-1). Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction.

**Noise:** Noise from O&M, pile driving, cable laying and trenching, and vessel traffic could result in short-term, localized impacts on commercial and for-hire recreational fishing businesses, recreational businesses, and marine sightseeing activities (see Sections 3.6.1 and 3.6.8).

Onshore construction noise could possibly result in a short-term reduction of economic activity for businesses near installation sites for onshore cables or substations, temporarily inconveniencing workers, residents, and visitors. Noise would have unmeasurable and negligible impacts on demographics, employment, and economics of the affected communities overall.

**Port utilization:** Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would bolster port investment and employment while also supporting jobs and businesses in supporting industries. Ongoing and planned offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area, including the ports of Atlantic City and the Paulsboro Marine Terminal, New Jersey. While simultaneous construction or decommissioning (and, to a lesser degree, operational) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity, it would also generate considerable economic activity and benefit the regional economy and infrastructure investment.

Port utilization would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. Improvements to existing ports and channels would be beneficial to other port activity. Port utilization in the geographic analysis area would occur primarily during development and construction projects, anticipated to occur primarily between 2026 and 2030. Ongoing O&M activities would sustain port activity and employment at a lower level after construction.

Offshore wind activities and associated port investment and usage would have long-term, moderate beneficial impacts on employment and economic activity by providing employment and industries such as marine construction, ship construction and servicing, and related manufacturing. The greatest benefits would occur during offshore wind project construction between 2026 and 2030. If offshore wind construction results in competition for scarce berthing space and port service, port usage could potentially have short- to medium-term adverse impacts on commercial shipping. Overall, port utilization from offshore wind is anticipated to result in beneficial impacts on demographics, employment, and economics due to the creation of new construction jobs that are likely to be supported by the existing workforce in these areas, as well as specialized permanent jobs in amounts unlikely to exacerbate housing conditions.

**Presence of structures:** The potential for up to 378 offshore wind energy structures within the geographic analysis area could affect marine-based businesses (Appendix D, Table D-3). Commercial fishing operators, marine recreational businesses, and shore-based supporting services (such as seafood processing) could experience both short-term impacts during construction and long-term impacts from the presence of structures.

Fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial/for-hire recreational fishing industries (see Section 3.6.1). As a result of fish aggregation and reef effects associated with the presence of offshore wind structures, there would be long-term impacts on commercial fishing operations and support businesses such as seafood processing. These effects could simultaneously provide new business opportunities such as fishing and tourism (see Sections 3.6.1 and 3.6.8).

The views of offshore WTGs could have impacts on certain businesses serving the recreation and tourism industry. Impacts could be adverse for particular locations if visitors and customers avoid certain businesses (i.e., hotels or rental dwellings) due to views of the WTGs; impacts could be neutral or beneficial if views do not affect visitor decisions or influence some visitors positively. Recreation and tourism economies and employment could be impacted if visitors are attracted or deterred from an area due to the presence of visible structures. Visible project components can have an adverse economic effect if the structure or activity is in close proximity to businesses that are highly dependent on an area's views or pristine setting. Depending on attitudes and sensitivities of tourist populations, the presence of WTGs, met towers, OSSs, or maintenance vessels may deter visitors who desire a pristine natural view. Visible structures could also have a positive impact on recreation and tourism economies. Research on wind farms in the United Kingdom and Europe indicate that there is potential for wind farms to be beneficial to tourism economies through wind-based tourism, such as boat tours of wind facilities (ICF 2012). Studies in the U.S. of the BIWF have found beneficial impacts on tourism and recreation economies after the construction of the wind farm. A survey of tourists found no negative impact on trips taken to BIWF after construction and found that, via stated preference, tourists would pay more for tourism and recreation experiences with views of wind turbines (Trandafir et al. 2020). A study found that after installation of the BIWF, catch of black sea bass and Atlantic cod increased as these species are attracted to the turbine structures, while there was no statistical difference in catch for most other fish species (Wilbur et al. 2022). See also Section 3.6.8.

Overall, the presence of offshore wind structures would have continuous, long-term minor beneficial and negligible to minor adverse impacts on demographics, employment, and economics. The commercial fishing industry is anticipated to be able to adjust to changes in fishing practices to maintain the viability of the industry in the presence of offshore wind structures. The presence of structures could also result in beneficial impacts for the recreational fishing and tourism industries.

**Traffic:** Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses and investment in ports. The magnitude of increased vessel traffic is described in more detail in Section 3.6.6, *Navigation and Vessel Traffic*, and would depend upon the vessel traffic volumes generated by each offshore wind project, the extent of concurrent or sequential construction of wind energy projects, and the ports selected for each project). Construction of three ongoing and planned offshore wind projects could occur within the New York and New Jersey lease areas and the geographic analysis area between 2026 and 2030, with a maximum of three projects under construction concurrently during those years (Appendix D, Table D.A2-1). Impacts of short-term, increased vessel traffic during construction could include increased vessel traffic congestion, delays at ports, and a risk for collisions between vessels. Increased vessel traffic would be localized near affected ports and offshore construction areas. Congestion and delays could increase fuel costs (i.e., for vessels forced to wait for port traffic to pass) and decrease productivity for commercial shipping, fishing, and recreational vessel businesses, whose income depends on the ability to spend time out of port. Increased vessel traffic would have continuous, long-term beneficial impacts and short-term negligible to minor adverse impacts on the economy and employment during all project phases due to the implementation of environmental protection measures.

### *Conclusions*

**Impacts of Alternative A – No Action**. Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends. Ongoing activities would continue to sustain and support economic activity and growth within the geographic analysis area based on anticipated population growth and ongoing development of businesses and industry. Tourism and recreation would continue to be important to the economies of the coastal areas, especially Atlantic, Cape May, Ocean, and Monmouth Counties. Marine industries such as commercial fishing and shipping would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies—including maintaining or increasing their year-round population—and protect environmental resources.

BOEM anticipates that ongoing activities in the geographic analysis area (continued commercial shipping and commercial and recreational fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; the use of small-scale, onshore renewable energy; and the Ocean Wind 1 Project) would have **negligible to minor adverse** and **minor beneficial** impacts on demographics, employment, and economics. Overall, the adverse impacts would be **minor** as they would not disrupt the overall demographics, employment, or economies of the affected communities.

**Cumulative Impacts of Alternative A – No Action**. Under the No Action Alternative, existing environmental trends and activities would continue, and demographics, employment, and economics would continue to be affected by natural and human-caused IPFs. Planned activities for coastal and marine activity, other than offshore wind, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise.

BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area, would result in **negligible to minor adverse** impacts and **moderate beneficial** impacts on ocean-based employment and economics, primarily because of the continued operation of existing marine industries, especially commercial and recreational fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise. Increased investment in land and marine ports, shipping, and logistics capability is expected to result along with component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. Additional manufacturing and servicing businesses would result either in the geographic analysis area or other locations in the U.S. if supply chains develop as expected. While it is not possible to estimate the extent of job growth and economic output within the geographic analysis area specifically, there will be notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially specialized job training, because of offshore wind development.

While many of the jobs generated by offshore wind projects are temporary construction jobs, the combination of these jobs over multiple projects would create notable benefits during project construction phases. This would particularly be the case as the domestic supply chain for offshore wind evolves over time. Offshore wind projects also support long-term O&M jobs (up to 25 to 35 years from project commissioning); long-term tax revenues; long-term economic benefits of improved ports and other industrial land areas; diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce. Therefore, BOEM anticipates that there would be cumulative moderate beneficial impacts from planned offshore wind activities in the geographic analysis area, combined with ongoing activities and planned activities other than offshore wind.

BOEM anticipates overall **minor** adverse and **moderate beneficial** impacts on demographics, employment, and economics associated with planned offshore wind activities. Planned offshore wind activities are expected to affect commercial and for-hire fishing businesses and marine recreational businesses (tour boats, marine suppliers) primarily through cable emplacement, noise, and vessel traffic during construction, and the presence of offshore structures during operations. These IPFs would temporarily disturb marine species and displace commercial or for-hire fishing vessels, which could cause conflicts over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also lead to increased navigational constraints and risks and potential gear damage and loss for commercial fisheries. However, temporary disturbances such as from noise and traffic would not be expected to result in measurable adverse impacts on population, employment, or economics. It is expected that temporary adverse effects would be minimized and would not disrupt community cohesion or the economies of the affected areas. The long-term presence of structures would likely have beneficial impacts on the commercial fishing and recreation and tourism economies as well.

#### 3.6.3.4 Relevant Design Parameters and Potential Variances in Impacts

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

- Overall size of the Project (approximately 1,510 MW for Project 1 and undetermined for Project 2) and number of WTGs (up to 200);
- The extent to which Atlantic Shores hires local residents and obtains supplies and services from local vendors;
- The port(s) selected to support construction, installation, and decommissioning; and
- The design parameters (e.g., spacing and number of WTGs) that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity (see Chapter 2, *Alternatives*).

The size of the Project would affect the overall investment and economic impacts; fewer WTGs would mean less materials purchased, fewer vessels, and less labor and equipment required. Beneficial economic impacts within the geographic analysis area would depend on the proportion of workers, materials, vessels, equipment, and services that can be locally sourced, and the specific ports used by the Project.

#### 3.6.3.5 Impacts of Alternative B – Proposed Action on Demographics, Employment, and Economics

The Proposed Action's beneficial impacts on demographics, employment, and economics depend on what proportion of workers, materials, vessels, equipment, and services can be locally sourced. The Proposed Action includes a number of EPMs to this end, including establishment of an O&M facility in

Atlantic City, New Jersey, to be staffed primarily with local workers; hiring of a diverse and local workforce recruited from local training programs; and locally sourced construction materials and other supplies, to the extent possible and practical (DEM-01 through DEM-09, Appendix G, Table G-1).

In a study conducted by BW Research Partnership on behalf of E2, a national, nonpartisan group of advocates for policies that benefit both the economy and environment, every $1.00 spent building an offshore wind farm is estimated to generate $1.83 for New Jersey's economy (E2 2018). Atlantic Shores submitted a cost-benefit analysis (CBA) as part of its Application as required by N.J.A.C. 14:86.5(a)(11). Levitan & Associates, Inc. (LAI) conducted an independent CBA to ensure that all projects were compared on a consistent basis. Content provided by the Applicants helped inform LAI's independent CBA. LAI's CBA resulted in a value of 1.246, which meets the eligibility requirements of positive economic and environmental net benefits to the State (BPU 2022).

Atlantic Shores estimates that the Proposed Action would support the following employment in New Jersey alone in direct, indirect, and induced FTE job-years: an estimated 13,360 direct FTE job-years during the 10-year development and construction period (an average of 1,336 FTE jobs annually), and 19,925 direct FTE job-years during approximately 34 years of operations and decommissioning (approximately 586 FTE jobs annually), in addition to 17,640 indirect and 22,165 induced FTE job-years during all phases (COP Volume II; Atlantic Shores 2024).

According to the Evaluation Report prepared for BPU on applications submitted in response to their Offshore Wind Solicitation #2, Atlantic Shores' application contained comprehensive technical information covering its economic benefits, including firm in-State spending and job guarantees to mitigate various uncertainty factors; Atlantic Shores guarantees O&M jobs for the 20-year OREC term (LAI 2021).

The Proposed Action would generate employment during construction and installation, O&M, and decommissioning of the Project. The Proposed Action would support a range of positions for professionals such as engineers, environmental scientists, financial analysts, administrative personnel; trade workers such as electricians, technicians, steel workers, welders, and ship workers; and other construction jobs during construction and installation of the Proposed Action. O&M would create jobs for maintenance crews, substation and turbine technicians, and other support roles. The decommissioning phase would also generate professional and trade jobs and support roles. Therefore, all phases of the Proposed Action would lead to local employment and economic activity.

Assuming that conditions are similar to those of the Vineyard Wind 1 project, job compensation (including benefits) is estimated to average between $88,000 and $96,000 for the construction phase, with occupations including engineers, construction managers, trade workers, and construction technicians (BOEM 2021). O&M occupations would consist of turbine technicians, plant managers, water transportation workers, and engineers, with average annual compensation of approximately $99,000 (BOEM 2021). A study from the New York Workforce Development Institute provided estimates of salaries for jobs in the wind energy industry that concur with Vineyard Wind 1's projections. The expected salary range for trade workers and technicians ranges from $43,000 to $96,000, $65,000 to

$73,000 for vessel crews and officers, and $64,000 to $150,000 for managers and engineers (Gould and Cresswell 2017).

The hiring of local workers would stimulate economic activity through increased demand for housing, food, transportation, entertainment, and other goods and services. A large number of seasonal housing units are available in the vicinity of the Project. During the summer, competition for temporary accommodations may arise, leading to higher rents. However, this effect would be temporary during the active construction period and could be reduced if construction is scheduled outside the busy summer season. Permanent workers are expected to reside locally; there is adequate housing supply to accommodate the increase in the local workforce.

Tax revenues for state and local governments would increase as a result of the Project. Equipment, fuel, and some construction materials would likely be purchased from local or regional vendors. These purchases would result in short-term impacts on local businesses by generating additional revenues and contributing to the tax base. Once the Project is operational, property taxes would be assessed on the value of the onshore facilities. The increased tax base during operations would be a long-term, beneficial impact on local governments in the affected area.

According to the BPU OREC Award, ratepayers could see an increase in their monthly energy bill of $2.21 for residential customers, $20.18 for commercial customers, and $172.25 for industrial customers (BPU 2022).

The reasonably foreseeable environmental trends and impacts of the Proposed Action, in addition to ongoing activities, are described by IPFs below.

### *Onshore Activities and Facilities*

**Land disturbance:** Construction of the Proposed Action would require onshore cable installation and new substation and/or converter station construction, and modification of existing substations for the POI. The disturbance of businesses near the onshore cable routes and substation and/or converter station construction sites and POI sites would result in localized, short-term, minor disruptions; however, it is not expected that construction activities would result in an adverse impact on demographics, employment, or economics because normal economic trends would not be affected. It is anticipated that the impacts from decommissioning of the Project would be similar to the impacts from construction and installation. Onshore construction would be scheduled to occur outside of the summer tourist season (i.e., Memorial Day through Labor Day) and in accordance with local noise ordinances (DEM-08, Appendix G, Table G-1).

**Lighting:** During O&M, onshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Impacts related to structure lighting would have negligible impacts on demographics, employment, and economics as such lighting would not be expected to disrupt normal business operations.

**Noise:** Construction and installation, O&M, and decommissioning, of the proposed substations and/or converter stations would generate noise. The disturbances during construction and installation and decommissioning would be temporary and localized, and extend only a short distance beyond the work area. In both instances noise would have localized, short-term, and negligible impacts on demographics, employment, and economics.

Infrequent trenching from cable-laying activities also produce noise. This noise could temporarily disrupt onshore recreational businesses. The use of trenchless technology at natural and sensitive landfall locations where possible would minimize direct impacts from construction noise. Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Operational activity would occur at the O&M facility in Atlantic City, New Jersey, as vessels transport workers to and from the offshore wind farm for daily maintenance. Noise impacts would be limited to vessel traffic and typical daily activities at the O&M facility and would not be significantly noisier than existing land uses in the area.

**Port utilization:** Proposed Action activities at ports would support port investment and employment and would also support jobs and businesses in supporting industries and commerce. Atlantic Shores plans to utilize five ports to support construction of the proposed Project:

- New Jersey Wind Port (Salem County)
- Paulsboro Marine Terminal (Gloucester County, New Jersey)
- Portsmouth Marine Terminal (City of Portsmouth, Virginia)
- Repauno Port and Rail Terminal (Gloucester County, New Jersey)
- Port of Corpus Christi (Nueces and San Patricio Counties, Texas)

These ports would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. The economic benefits associated with port utilization would be greatest during construction when the most jobs and most economic activity at ports supporting the Proposed Action would occur. The Proposed Action would have a minor beneficial impact on demographics, employment, and economics from port utilization due to greater economic activity and increased employment at ports used by the Proposed Action.

During O&M, port activities would be concentrated at the onshore O&M facility for the Project in Atlantic City, New Jersey, and the following ports: (1) New Jersey Wind Port (Salem County), (2) Paulsboro Marine Terminal (Gloucester County, New Jersey), (3) Portsmouth Marine Terminal (City of Portsmouth, Virginia), and (4) Repauno Port and Rail Terminal (Gloucester County, New Jersey).

The O&M facility would help to diversify the local economy by providing a source of skilled, year-round jobs. The number of workers at the O&M facility would fluctuate seasonally and by Project phase and would be dependent on the final engineering design and service strategy (COP Volume II; Atlantic Shores 2024). The Proposed Action would have a minor beneficial impact on demographics, employment, and economics from port utilization due to greater economic activity and increased employment at ports used by the Proposed Action.

**Traffic**: During construction and installation and decommissioning of the onshore facilities (e.g., onshore substations and/or converter stations and buried duct banks, upgrades to the POI), vehicular traffic would increase, and construction equipment would be present at the landfall site, along the buried interconnection cable route, at the proposed onshore substations and/or converter stations, and at the POIs. While this activity would result in short-term traffic effects, it would be largely confined to roads and previously disturbed/developed sites (COP Volume II, Section 5.2.4; Atlantic Shores 2024) and, therefore, would be expected to have negligible adverse impacts on demographics, employment, and economics.

### *Offshore Activities and Facilities*

**Lighting:** The anticipated increase in vessel traffic would result in growth in the nighttime traffic of vessels with lighting during construction and installation, O&M, and decommissioning. Lighting from vessels would occur during nighttime Project construction or maintenance. This lighting would be visible from coastal businesses, especially near the ports used to support Proposed Action construction. Short-term vessel lighting is not anticipated to discourage tourist-related business activities and would not affect other businesses; therefore, the impact of vessel lighting would be short term and negligible adverse during construction and installation and decommissioning.

During O&M, offshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Offshore, aviation hazard lighting on WTGs could affect employment and economics in these areas if the lighting discourages visits or vacation home rentals or purchases in coastal locations where the Proposed Action's WTG lighting is visible. Atlantic Shores would implement an ADLS, if permitted, to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity to the wind farm (COP Volume II, Section 5.2.6; Atlantic Shores 2024). Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on the local economy. Impacts related to structure lighting would have localized, long-term, and negligible adverse impacts on demographics, employment, and economics.

**Noise:** The Proposed Action could increase noise levels during construction and installation, O&M, and decommissioning. During construction and installation, noise from vessel traffic could have economic effects on commercial fishing businesses and recreational businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (see Section 3.6.1).

Offshore pile driving proposed for foundation installation and nearshore vibratory piling proposed for the cofferdam installation and associated noise would have localized, short-term, and negligible impacts on demographics, employment, and economics.

Infrequent trenching from cable-laying activities emit noise. This noise could temporarily disrupt commercial fishing, marine recreational businesses, and onshore recreational businesses. Noise from trenching and trenchless technology would affect marine life populations, which would in turn affect commercial and recreational fishing businesses (see Section 3.6.1). Impacts on marine life would also affect onshore recreational businesses due to noise near public beaches, parks, residences, and offices (see Section 3.6.8). Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Vessel noise could affect marine species relied upon by commercial fishing businesses, marine recreational businesses, recreational boaters, and marine sightseeing activities. Vessel traffic would occur between ports (outside the recreation and tourism geographic analysis area) and offshore wind work areas. Most vessel traffic would travel to the WTG installation area, with fewer vessels needed along the cable installation routes. Noise from vessels would have short-term, intermittent, negligible impacts on demographics, employment, and economics.

**Presence of structures:** The Proposed Action would result in the presence of structures visible during construction and installation and O&M. During Project construction, viewers on the Jersey Shore may see the upper portions of tall equipment such as mobile cranes. These cranes would move from turbine to turbine as construction progresses, and thus would not be long-term fixtures. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a short-term, negligible impact on demographics, employment, and economics.

The Proposed Action would add up to 200 WTGs, up to 10 OSSs, and up to 1 met tower with foundations and scour protection, and cable protection, where needed, along the interarray and offshore export cables. These structures could affect marine businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) through impacts such as entanglement and gear loss/damage, navigational hazards and risk of allisions, fish aggregation, habitat alteration, and space use conflicts. These structures may cause vessel operators to reroute, which would affect their fuel costs, operating time, and revenue. Due to the risk of gear entanglement, fisheries using bottom gear may be permanently displaced, which would result in moderate impacts on the commercial and for-hire recreational fisheries (see Section 3.6.1). However, the Project would not be expected to disrupt community cohesion, and loss of revenues from fisheries is expected to be minimal. There may be positive impacts on fisheries that result from presence of structures. Thus, this IPF would result in continuous, long-term, and minor impacts on demographics, employment, and economics.

Offshore wind structures could encourage fish aggregation and generate reef effects that attract recreational fishing vessels. These effects would only affect the minority of recreational fishing vessels that reach the wind energy facilities. This would have long-term, negligible benefits on demographics, employment, and economics. Offshore structures associated with the Proposed Action could increase economic activity associated with offshore sightseeing because these structures create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons. These forms of marine life could attract private or commercial recreational sightseeing vessels. This would have long-term, negligible beneficial impacts on demographics, employment, and economics.

Views of WTGs could have impacts on businesses serving the recreation and tourism industry. The presence of offshore wind structures could affect shore-based activities, surface water activities, wildlife and sightseeing activities, diving/snorkeling, and recreational boating routes (see Section 3.6.8). The Project's offshore wind energy facilities would be located a minimum of 8.7 miles (14 kilometers) east of the New Jersey coast (COP Volume I, Section 1.1; Atlantic Shores 2024). The majority of landward Project visibility (155 square miles [401 square kilometers]) occurs within 10–20 miles (16–32 kilometers) of the Project over uninhabited inland bays. Areas of potential visibility diminish significantly between 30 and 40 miles (48 and 64 kilometers) (see Section 3.6.9, *Scenic and Visual Resources*; see also COP Volume II, Section 5.1; Atlantic Shores 2024). From many viewpoints along the coast the Project would not be visible (i.e., those locations at which all WTGs would be beyond 20 miles [32 kilometers]), and from the vast majority of sites substantial portions of the full WTG array would not be visible, even during the relatively rare occurrence of days with very clear viewing conditions. Under less clear conditions, which are estimated to occur during 75 percent of the daylight hours, a smaller portion of the WTA and WTGs would be visible (COP Volume II, Section 5.2.3; Atlantic Shores 2024).

There have been various studies of the effects of onshore wind farms on property values. Hoen et al. (2013) analyzed housing prices from home sales occurring within 10 miles (16 kilometers) of onshore wind facilities in nine U.S. states and found no statistical evidence that home values were affected in the post-announcement/pre-construction or post-construction periods. The MassCEC also commissioned a report—*Relationship between Wind Turbines and Residential Property Values in Massachusetts* (Atkinson-Palombo and Hoen 2014)—to study if home values were affected by their proximity to onshore WTGs. The study analyzed 122,198 home sales occurring between 1998 and 2012 of homes located within 5 miles (8 kilometers) of 41 Massachusetts wind turbines. Results of this study indicated that there were no effects on nearby home prices resulting from the development of a wind farm in a community. Additionally, a 2017 study found that when placed more than 8 miles (13 kilometers) from shore, there is a minimal effect on vacation rental values associated with offshore wind farms (Lutzeyer et al. 2017). Brunner et al. (2024) and Guo, Wenz, and Maximilian (2024) find evidence of adverse effects of onshore wind farms in the United States on property values within a short distance, but that these effects wane over time.

There have been two studies of the effects of offshore wind farms on property values. Jensen et al. (2018) did not find any statistically notable impacts on property values from two wind farms offshore of Denmark; the closest turbines in that study were located 5.6 miles (9 kilometers) offshore. Dong and Lang (2022) did not identify any statistically notable effects of the Block Island Wind Farm on property values on Block Island or on the Rhode Island mainland. Note that the wind turbines analyzed in these two studies were smaller than those proposed for the Atlantic Shores Project. However, the Atlantic Shores Project would be located farther from shore than the Block Island Wind Farm and the wind farms analyzed in Jensen et al. (2018). Therefore, the impacts of the Proposed Action on property values are expected to be negligible to minor.

**Traffic:** The Proposed Action would generate vessel traffic in the Project area and to and from the ports supporting Project construction and installation and decommissioning, as well as O&M. Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning.

The vessel traffic generated by the Proposed Action alone would result in increased business for marine transportation and supporting services in the geographic analysis area with continuous, short-term, and minor beneficial impacts during construction. Vessel traffic associated with the Proposed Action could also result in temporary, periodic congestion within and near ports, leading to potential delays and an increased risk for collisions between vessels and allisions, which would result in economic costs for vessel owners and port owners. As a result of potential delays from increased congestion and increased risk of damage from collisions/allisions, the Proposed Action could result in minor short-term disruptions to businesses, but these disruptions would be negligible as it is anticipated that community cohesion would remain intact.

### *Impacts of the Connected Action*

As described in Chapter 2, improvements to the existing marine infrastructure within an approximate 20.6-acre (8.3-hectare) site at the Atlantic City, New Jersey, Inlet Marina area are planned in connection with construction of the O&M facility of the Proposed Action. The connected action includes construction of a new 541-foot (165-meter) bulkhead composed of corrugated steel sheet pile to replace the existing and deteriorating 250-foot (76-meter) bulkhead.[2] Additionally, the connected action would include maintenance dredging at the site to be accomplished via hydraulic cutterhead dredge with pipeline or mechanical dredge. Atlantic Shores is proposing to implement the construction of the new bulkhead, and the City of Atlantic City would complete the maintenance dredging at the site.

BOEM expects the connected action to affect demographics, employment, and economics through the following primary IPFs.

**Noise:** Installation of sheet piles for construction of the new bulkhead may include impact or vibratory pile driving and vessel operation, which would generate intermittent noise during the construction period. As discussed in Section 3.6.1, because there is minimal fishing activity near the marina where the connected action would be sited, displacement of fish and invertebrates associated with behavioral impacts of noise is not expected to result in measurable revenue loss for commercial or recreational fisheries. Therefore, any impacts on marine industries are likely to be negligible.

[2] The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the respective approved permits.

Construction vessel activity would also generate noise during connected action activities. Such vessel noise would be localized and temporary, ceasing once the vessel leaves the area. Therefore, any impacts on demographics, employment, and economics would be negligible.

**Port utilization:** The connected action would facilitate conversion of a retired marine terminal to the Proposed Action's O&M facility, thereby resulting in an increase in port utilization. The connected action would be sited in Atlantic City, which generates approximately $19 million in annual revenue from commercial fisheries (see Section 3.6.1). Commercial and for-hire recreational fishing vessels traveling to and from Atlantic City may experience delays from increased vessel traffic associated with the connected action. Impacts from port utilization associated with the Proposed Action are expected to be localized and long term, occurring during the construction and O&M periods. Impacts on demographics would be negligible. There would be minor beneficial impacts on employment and economics.

Because there is minimal fishing activity near the marina where the connected action would be sited, displacement of fish and invertebrates associated with dredging is not expected to result in measurable revenue loss for commercial or recreational fisheries or industries.

### *Cumulative Impacts of Alternative B – Proposed Action*

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

#### *Onshore Activities and Facilities*

**Land disturbance:** The extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations and/or converter stations and POIs for planned offshore wind energy projects. Land disturbance is anticipated to have a negligible impact on demographics, employment, and economics as any potential impacts would be temporary and unmeasurable. Therefore, the incremental impacts contributed by the Proposed Action when combined with ongoing and planned projects would be negligible.

**Lighting:** The incremental impacts contributed by the Proposed Action to the cumulative onshore lighting impacts on demographics, employment, and economics would be undetectable. Cumulative impacts on demographics, employment, and economics from lighting would be unmeasurable and therefore negligible.

**Noise:** The O&M facility for the Ocean Wind 1 and 2 projects would also be located in Atlantic City and would contribute similar noise in a localized area at the facility. The incremental impacts contributed by the Proposed Action to the cumulative noise impacts on demographics, employment, and economics would be short term and undetectable. Construction of the Project is anticipated to overlap with construction of the three ongoing and planned offshore wind projects in the geographic analysis area for up to 2 years (2026–2028), potentially contributing to increased noise impacts during simultaneous construction activity. While operational activity would overlap, noise impacts during operations would be far less than during construction. Combined noise impacts on demographics, employment, and economics would be unmeasurable and therefore negligible.

**Port utilization:** Other offshore wind energy activity would provide business activities at the same ports as the Proposed Action as well as other ports within the geographic analysis area. Port investments are ongoing and planned in response to offshore wind activity. Maintenance and dredging of shipping channels are expected to increase, which would benefit other port users.

The Proposed Action's incremental impacts combined with impacts of other ongoing and planned activities would result in cumulative long-term, moderate beneficial impacts on port utilization, and the associated trained and skilled offshore wind workforce would contribute to economic activity in port communities and the region as a whole.

**Traffic:** The Proposed Action's incremental onshore traffic impacts would be undetectable. Combined onshore traffic impacts on demographics, employment, and economics would be unmeasurable and therefore negligible.

*Offshore Activities and Facilities*

**Lighting:** Between 2024 and 2030, there may be 11 offshore wind projects within the New York and New Jersey lease areas, not including Atlantic Shores South (Appendix D, Table D-3). WTG lighting in planned offshore wind activities would be visible from the same locations as the Proposed Action in addition to New Jersey coastal locations.

The incremental impacts contributed by the Proposed Action to the cumulative impacts on demographics, employment, and economics from offshore lighting would be noticeable. However, the cumulative impact would be negligible on demographics, employment, and economics as any impact would be unmeasurable.

**Noise:** Construction of the Proposed Action is anticipated to overlap with construction of the three ongoing and planned offshore wind projects in the geographic analysis area for up to 2 years (2026–2028), potentially contributing to increased noise impacts during simultaneous construction activity (Appendix D, Table D.A2-1). However, noise impacts during operations would be far less than during construction (see COP Volume II, Section 7.3.2.3; Atlantic Shores 2024).

Noise would result from operating WTGs and from maintenance and repair operations at the offshore wind energy facilities where commercial and recreational fishing operators and recreational boaters use areas of the OCS (see Section 3.6.1). That noise would mostly occur in areas close to WTGs, which would be spaced 0.6 nautical mile (1.1 kilometers) to 1 nautical mile (1.9 kilometers) apart, and would therefore not likely contribute to noticeable cumulative noise impacts. O&M vessels would typically work within the offshore wind facilities on a daily basis but would be few in number and moving between locations (i.e., temporary). Noise from O&M activities would have localized, intermittent, long-term, negligible impacts on demographics, employment, and economics associated with these uses.

The incremental noise impacts contributed by the Proposed Action combined with impacts from ongoing and planned activities including offshore wind on demographics, employment, and economics would be short term and negligible during construction and installation, as any impacts would be unmeasurable.

**Presence of structures:** WTGs from other planned offshore wind projects could also be visible from coastal and elevated locations in the geographic analysis area. Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year.

The Proposed Action would contribute an undetectable increment to the combined impact on demographics, employment, and economics from presence of structures. Cumulative impacts are anticipated to be minor, as any potential impacts would not disrupt normal economic activities and the overall economies of the affected communities. Presence of structures would also have beneficial impacts, such as by providing sightseeing opportunities and fish aggregation that benefit recreational businesses.

**Traffic:** Increased vessel traffic from the Proposed Action and other ongoing and planned activities including planned offshore wind would produce demand for supporting marine services, with noticeable beneficial impacts on employment and economics during all Project phases, including minor to moderate beneficial impacts during construction and decommissioning and negligible beneficial impacts during operations. The increased vessel traffic would also have long-term, continuous adverse impacts on marine businesses during all Project phases, with minor adverse impacts during construction and decommissioning and negligible adverse impacts during operations.

### *Conclusions*

**Impacts of Alternative B – Proposed Action**. BOEM anticipates that the Proposed Action would have negligible to minor adverse impacts on demographics within the analysis area as the Project is not anticipated to change normal economic trends compared with the No Action condition. While it is likely that some workers would relocate to the area due to the Proposed Action, this volume of workers would not be substantial compared to the current population and housing supply. The Proposed Action alone would affect employment and economics through job creation, expenditures on local businesses, tax revenues, grant funds, and support for additional regional offshore wind development, which would have minor beneficial impacts. Construction would have a minor beneficial impact on employment and economics due to jobs and revenue creation over the short duration of the construction period. The beneficial impact of employment and expenditures during O&M would be modest in magnitude over the approximately 30-year duration of the Project (Table 3.6.3-2). Although tax revenues and grant funds would be modest, they would also provide a beneficial impact on public expenditures and local workforce and supply chain development for offshore wind. When the Project is decommissioned, the impacts on demographics, employment, and economics would be **minor beneficial** due to the employment and labor necessary to remove wind facility structures and equipment. After decommissioning, the Proposed Action would no longer affect employment or produce other offshore wind-related revenues.

**Table 3.6.3-2. Anticipated Project schedule**

| Phase | Start | End | Duration (Years) |
|---|---|---|---|
| **Project 1** | | | |
| Development | 2018 | 2024 | 7 |
| Construction | 2025 | 2027 | 3 |
| Operations | 2028 | 2057 | 30[1] |
| Decommissioning | 2058 | 2060 | 3 |
| **Project 2** | | | |
| Development | 2018 | 2024 | 7 |
| Construction | 2026 | 2029[2] | 3 |
| Operations | 2029 | 2058 | 30[1] |
| Decommissioning | 2059 | 2061 | 3 |

Source: COP Volume II, Table 7.1-10; Atlantic Shores 2024.
[1] Atlantic Shores' Lease Agreement OCS-A 0499 includes a 25-year operating term, which may be extended or otherwise modified in accordance with applicable regulations in 30 CFR Part 585.
[2] HRG survey activities are included in the construction timeframe; all other construction activities are anticipated to be completed in 2028 (COP Volume II, Table 4.1-1; Atlantic Shores 2024).

While the Proposed Action's investments in wind energy would largely benefit the local and regional economies through job creation, workforce development, and income and tax revenue, adverse effects on individual businesses and industry sectors would also occur (see Sections 3.6.1 and 3.6.8). Short-term increases in noise during construction, cable emplacement, land disturbance, and the long-term presence of offshore lighting and structures would have negligible adverse impacts on demographics, employment, and economics. The commercial fishing industry and other businesses that depend on local seafood production would experience impacts during construction and operations (see Section 3.6.1). Overall, the impacts on commercial and for-hire recreational fisheries and onshore seafood businesses would be expected to result in minimal loss of revenues, and the amount of fishing activity that could be affected within the Lease Area is a small fraction of the amount of fishing activity in the geographic analysis area. The IPFs associated with the Proposed Action alone would also result in minor impacts, both beneficial and adverse, on certain recreation and tourism businesses (see Section 3.6.8).

In summary, the Proposed Action would have negligible to minor adverse impacts and negligible to minor beneficial impacts on demographics, employment, and economics resulting from individual IPFs. Overall, the Proposed Action would have **minor adverse** impacts and **minor beneficial** impacts on demographics, employment, and economics in the geographic analysis area.

BOEM expects that the connected action alone would have negligible adverse impacts on demographics, employment, and economics, and minor beneficial impacts on employment and economics.

**Cumulative Impacts of the Proposed Action.** BOEM anticipates that cumulative impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including planned offshore wind would result in **negligible to minor adverse** and **moderate beneficial** impacts on demographics, employment, and economics in the geographic analysis area primarily because of potential impacts on commercial fishing and recreational businesses associated with the presence of structures and increased vessel traffic, which would not disrupt overall demographic and economic trends; and because of positive economic and fiscal impacts from job creation and port utilization. The beneficial impacts would primarily be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the adverse impacts would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions/allisions during construction, and land disturbance. Overall, the adverse impacts would be **minor** as they would not disrupt the overall demographics, employment, or economies of the affected communities.

#### 3.6.3.6 Impacts of Alternatives C, D, E, and F on Demographics, Employment, and Economics

**Impacts of Alternatives C, D, E, and F**. Alternatives that could install fewer WTGs (Alternatives C [Habitat Impact Minimization/Fisheries Habitat Impact Minimization], D [No Surface Occupancy at Select Locations to Reduce Visual Impacts], and E [Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1]), or use a range of foundation types (Alternative F [Foundation Structures]) would not have measurable impacts on demographics, employment, and economics that are materially different from the impacts of the Proposed Action. Alternatives C, D, and E would all include a reduction in the number of WTGs compared to the Proposed Action. Therefore, the beneficial impacts on employment and the economy would be somewhat less than with the Proposed Action because there would be fewer construction workers or shorter employment durations for workers, and less supply chain spending; however, these benefits would still be considered long term and minor beneficial. Adverse impacts from Alternatives C, D, E, and F on demographics, employment, and economics would still be expected to be minor.

*Onshore Activities and Facilities*

**Cumulative Impacts of Alternatives C, D, E, and F.** The incremental onshore impacts during the construction and installation, O&M, and decommissioning periods of the Project by Alternatives C, D, E, and F combined with impacts on the demographics, employment, and economics of the affected communities from ongoing and planned projects would be similar to those described for the Proposed Action.

*Offshore Activities and Facilities*

**Cumulative Impacts of Alternatives C, D, E, and F.** The combined, incremental offshore impacts during the construction and installation, O&M, and decommissioning periods of the Project by Alternatives C, D, E, and F and the ongoing and planned projects would be similar to those described for the Proposed Action.

*Conclusions*

**Impacts of Alternatives C, D, E, and F**. The Project’s impacts during the construction, O&M, and decommissioning periods as a result of Alternatives C, D, E, and F on the demographics, employment, and economics of the geographic analysis area would be similar to those described for the Proposed Action. Beneficial impacts would be considered long term and **minor beneficial,** primarily due to the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements. Adverse impacts due to aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions/allisions during construction, and land disturbance would be expected to be **minor** because any impacts would not be expected to disrupt normal demographic, employment, and economic trends.

**Cumulative Impacts of Alternatives C, D, E, and F.** The cumulative impacts contributed by the Project and ongoing and planned activities including offshore wind on demographics, employment, and economics would be negligible to minor and **moderate beneficial** because of similar conditions as the Proposed Action. Overall, the adverse impacts would be **minor** as they would not disrupt the overall demographics, employment, or economies of the affected communities.

#### 3.6.3.7 Proposed Mitigation Measures

No measures to mitigate impacts on demographics, employment, and economics have been proposed for analysis.

#### 3.6.3.8 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F from would be similar to those of the Proposed Action. The beneficial effects would be considered long term and minor beneficial. Adverse impacts from Alternatives C, D, E, and F on demographics, employment, and economics would be minor.

#### 3.6.3.9 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical miles (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative incorporates the same workforce training and local hiring initiatives proposed in the Proposed Action. The Preferred Alternative would include up to 195 WTGs,[3] up to 10 OSSs, up to 1 permanent met tower, interarray and interlink cables, 2 onshore substations

[3] 195 WTGs assume that 197 total positions are available and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

and/or converter stations, 1 O&M facility, and up to 8 transmission cables making landfall at two New Jersey locations: Sea Girt and Atlantic City. All permanent structures must be located in the uniform grid spacing and the total number of permanent structures constructed (WTGs, OSSs, and met tower) would not exceed 197.

The Preferred Alternative is not expected to result in substantial changes to demographics, employment, and economics relative to the Proposed Action. Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on demographics, employment, and economics including new hiring and economic activity. The Preferred Alternative would include a reduction in the number of WTGs compared to the Proposed Action (up to eight fewer). Therefore, the beneficial impacts on employment and the economy would be somewhat less than with the Proposed Action because there would be fewer construction workers or shorter employment durations for workers, and less supply chain spending; however, these benefits would still be considered long-term and minor beneficial. Accordingly, impacts of the Preferred Alternative alone would remain of the same level as for the Proposed Action: **minor adverse** and **minor beneficial**.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and connected action, would result in impacts similar to those for the Proposed Action: negligible to minor adverse and **moderate beneficial**. Overall, the adverse impacts would be **minor** as they would not disrupt the overall demographics, employment, or economies of the affected communities.

### 3.6.4 Environmental Justice

This section discusses environmental justice impacts from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area for environmental justice, as shown on Figures 3.6.4-1 through 3.6.4-8, includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties or incorporated cities in closest proximity to the WTA and the offshore and inshore ECCs: New Castle County in Delaware; Atlantic, Gloucester, Monmouth, Ocean, and Salem Counties in New Jersey; Delaware and Philadelphia Counties in Pennsylvania; the City of Portsmouth in Virginia; and the Port of Corpus Christi in Nueces and San Patricio Counties, Texas. These counties and incorporated cities are the most likely to experience beneficial or adverse environmental justice impacts from the proposed Project related to onshore and offshore construction and use of port facilities.

Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major using the four-level classification scheme outlined in Section 3.6.4.2, *Impact Level Definitions for Environmental Justice*. A determination of whether impacts are “disproportionately high and adverse” (DHAI) in accordance with EO 12898 is provided in the conclusion sections for the Proposed Action and action alternatives.

#### 3.6.4.1 Description of the Affected Environment and Future Baseline Conditions

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Subsection 1-101). When determining whether environmental effects are DHAI, agencies are to consider whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Native American tribe, including ecological, cultural, human health, economic, or social impacts; and whether the effects appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997). Although the analysis below focuses on DHAI, it also identifies benefits to environmental justice, as appropriate for a more complete picture of the impacts of offshore wind activities.

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA 2021a). EO 12898 directs federal agencies to actively scrutinize the following issues with respect to environmental justice as part of the NEPA process (CEQ 1997):

- The racial and economic composition of affected communities;
- Health-related issues that may amplify project effects to minority or low-income individuals; and

- Public participation strategies, including community or tribal participation in the NEPA process.

In line with EO 12898, this assessment is focused on low-income and minority populations in the geographic analysis area for environmental justice, where these populations could potentially be impacted by activities associated with the proposed Project. This analysis considers both geographically defined populations and geographically dispersed sets of individuals who experience common conditions (e.g., migrant workers or Native Americans) and who may be impacted by Project activities.

### *USEPA Environmental Justice Community Definition*

According to USEPA guidance and as identified in EO 14096, environmental justice analyses must address DHAI on overburdened communities of minority populations (i.e., residents who are non-white, or who are white but have Hispanic ethnicity) and low-income populations when they comprise over 50 percent of an affected area. Low-income populations are those that are two times the annual statistical poverty thresholds from the U.S. Department of Commerce, Bureau of the Census Population Reports, Series P-60 on Income and Poverty (USEPA 2016). Environmental justice analyses must also address affected areas where minority or low-income populations are "meaningfully greater" than the minority percentage in the "reference population"—defined as the population of a larger area in which the affected population resides (i.e., a county, state, or region depending on the geographic extent of the analysis area). CEQ and USEPA guidance do not define *meaningfully greater* in terms of a specific percentage or other quantitative measure. For the purposes of this analysis, an environmental justice community is defined as the union of federal- and, if available, state-specific criteria.

### *State of New Jersey Environmental Justice Community Definition*

New Jersey, following N.J.S.A 12:1D-157, identifies an overburdened community (OBC) as a U.S. Census block group that meets one or more of the following criteria (NJDEP 2021a):

- At least 35 percent of the households qualify as low-income households (at or below twice the poverty threshold as determined by the U.S. Census Bureau);
- At least 40 percent of the residents identify as minority or as members of a state-recognized tribal community; or
- At least 40 percent of the households have limited English proficiency (without an adult that speaks English "very well" according to the U.S. Census Bureau). For the purposes of this analysis, limited English proficiency is defined as meeting the U.S. Census criteria for "linguistic isolation," specifically households where no one over the age of 14 speaks only English or English very well.

Due to the presence of state-specific criteria, for New Jersey, OBCs are defined as the union of USEPA's (see *USEPA Environmental Justice Community Definition* for more detail) and New Jersey's criteria.

OBCs in the New Jersey portion of the geographic analysis area census block groups that meet the specific criteria are clustered around larger cities and towns near potential cable landing sites and potential ports in Atlantic City (Figure 3.6.4-2), Paulsboro (Figure 3.6.4-3), and the Cardiff onshore cable route substation (Figure 3.6.4-4).

### *Commonwealth of Virginia Environmental Justice Community Definition*

The Commonwealth of Virginia, following the Virginia Environmental Justice Act of 2020, identifies an environmental justice community as a U.S. Census block group that meets one or more of the following criteria (Commonwealth of Virginia, 2020):

- The population of color, expressed as a percentage of the total population of such area, is higher than the population of color in the Commonwealth expressed as a percentage of the total population of the Commonwealth; or
- Any census block group in which 30 percent or more of the population is composed of people with low income (defined as: "having an annual household income equal to or less than the greater of: an amount equal to 80 percent of the median income of the area in which the household is located, as reported by [U.S.] Department of Housing and Urban Development, and 200 percent of the Federal Poverty Level").

Due to the presence of state-specific criteria, for the Commonwealth of Virginia, environmental justice communities are defined as the union of USEPA's (see *USEPA Environmental Justice Community Definition* for more detail) and Virginia's criteria.

Environmental justice communities in the Virginia portion of the geographic analysis area census block groups that meet the specific criteria are clustered around larger cities and ports near Portsmouth Virginia (Figure 3.6.4-5).

### *State of Texas Environmental Justice Community Definition*

The State of Texas does not provide specific thresholds for defining environmental justice; thereby, USEPA guidance will be used to define environmental justice communities in Texas. Environmental justice communities in the Texas portion of the geographic analysis area census block groups that meet the specific criteria are clustered around the Port of Corpus Christi (Figure 3.6.4-6).

### *State of Delaware Environmental Justice Community Definition*

Delaware, following House Bill Number 466, identifies an environmental justice community as a U.S. Census block group that meets one or more of the following criteria (State of Delaware 2022, Section 6003A):

- 35 percent or more of the residents are below 185 percent of the federal poverty level;
- At least 25 percent or more of the residents identify as minority, or as members of state or federally recognized tribal communities, or as immigrants to the U.S., as defined by the U.S. Census Bureau;

- 25 percent or more of the households have limited English proficiency as defined by the U.S. Census Bureau; or
- Geographic locations that potentially experience harms and risk as determined by the Environmental Justice Board.

Due to the presence of state-specific criteria, for Delaware, environmental justice communities are defined as the union of the USEPA's (see *USEPA Environmental Justice Community Definition* for more detail) and Delaware's criteria.

Environmental justice communities in the Delaware portion of the geographic analysis area census block groups that meet the specific criteria are present throughout New Castle County (Figure 3.6.4-7) and are along the Delaware River, which is being used for the New Jersey Wind Port, the Paulsboro Marine Terminal, and the Repauno Port and Rail Terminal (Figure 3.6.4-1)

### *State of Pennsylvania Environmental Justice Community Definition*

Pennsylvania, following work by the Environmental Justice Work Group in 2001, identifies an environmental justice community as a U.S. Census block group that meets one or more of the following criteria (State of Pennsylvania Environmental Justice Work Group 2001):

- A minimum of 30 percent for a minority community designation; or
- A minimum of 20 percent for a low-income community.

Due to the presence of a state-specific criteria, for Pennsylvania, environmental justice communities are defined as the union of the USEPA's (see *USEPA Environmental Justice Community Definition* for more detail) and Pennsylvania's criteria.

Environmental justice communities in the Pennsylvania portion of the geographic analysis area census block groups that meet the specific criteria are present throughout Delaware and Philadelphia Counties (Figure 3.6.4-8) and are along the Delaware River, which is being used for the Paulsboro Marine Terminal, and the Repauno Port and Rail Terminal (Figure 3.6.4-1).

### *Environmental Justice Criteria Trends in the Geographic Analysis Area*

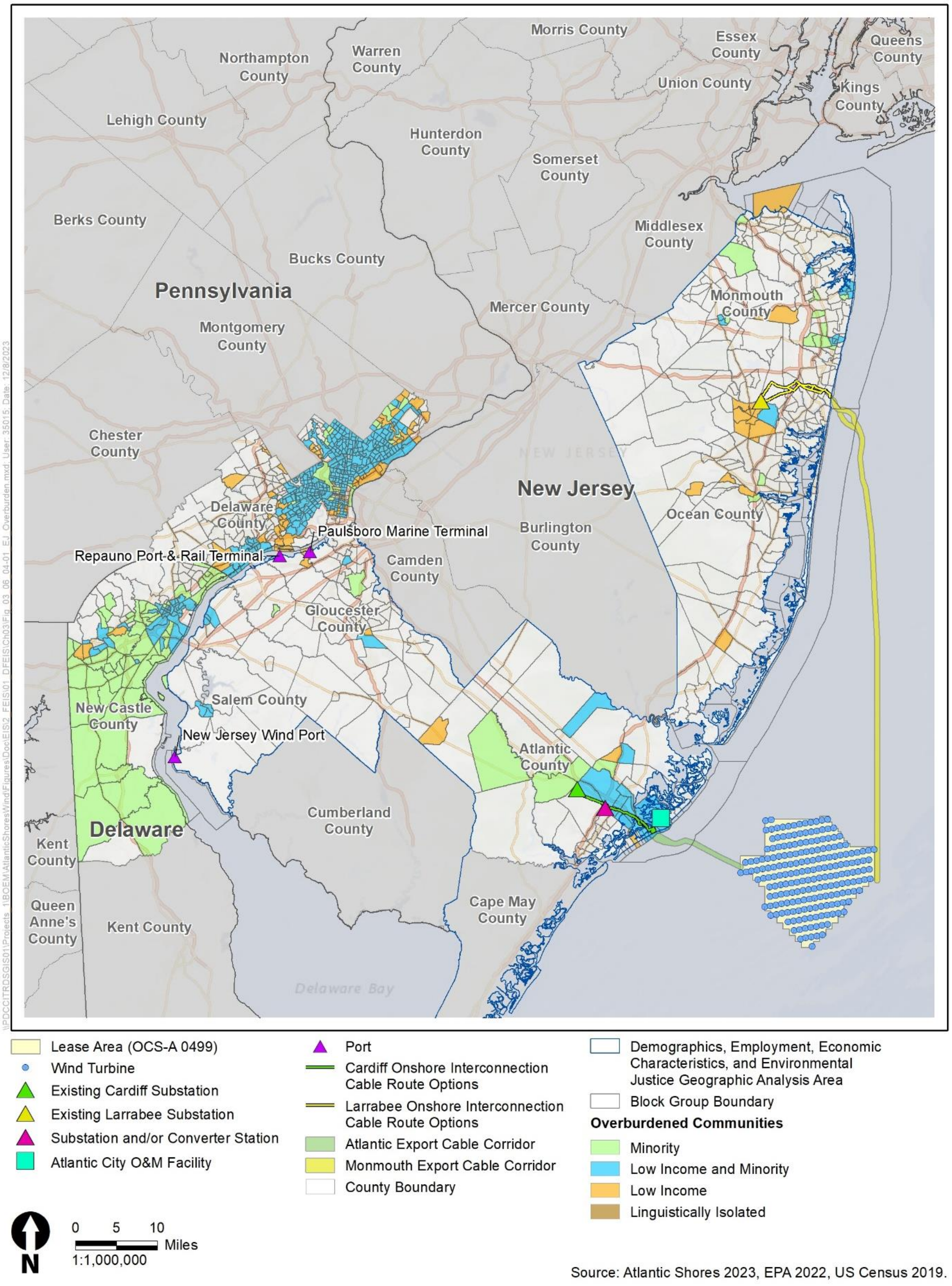
Table 3.6.4-1 summarizes trends for non-white populations and the percentage of residents with household incomes below the federally defined poverty line in the cities and counties studied in the geographic area of analysis. The non-white population percentage generally increased throughout the geographic area between 2000 and 2020. The percentage of population living under the poverty level has generally increased from 2000 to 2010 and declined slightly by 2020.

**Table 3.6.4-1. State and county/city minority and low-income status**

| Jurisdiction | Percentage of Population Below the Federal Poverty Level | | | Non-White Population Percentage[1] | | |
|---|---|---|---|---|---|---|
| | 2000 | 2010 | 2020 | 2000 | 2010 | 2020 |
| **State of Delaware** | | | | | | |
| New Castle County | 18.9 | 11.3 | 10.7 | 29.3 | 38.3 | 37.4 |
| *State Total* | 19.3 | 11.8 | 11.4 | 27.5 | 34.2 | 32.3 |
| **State of Pennsylvania** | | | | | | |
| Delaware County | 17.4 | 9.7 | 9.9 | 20.4 | 28.6 | 32.3 |
| Philadelphia County | 31.6 | 26.7 | 23.1 | 57.5 | 63.4 | 61.0 |
| *State Total* | *22.8* | *13.4* | *12.0* | *15.9* | *20.2* | *20.3* |
| **State of New Jersey** | | | | | | |
| Atlantic County | 20.2 | 14.3 | 13.5 | 36.1 | 42.0 | 36.8 |
| Gloucester County | 19.2 | 6.3 | 7.0 | 14.3 | 19.0 | 18.9 |
| Monmouth County | 15.4 | 6.6 | 6.5 | 19.4 | 23.2 | 18.5 |
| Ocean County | 13.7 | 11.2 | 9.9 | 10.1 | 13.9 | 10.3 |
| Salem County | 19.9 | 11.3 | 13.8 | 20.4 | 23.1 | 20.3 |
| *State Total* | *18.4* | *14.9* | *13.6* | *34.0* | *40.6* | *34.3* |
| **State of Texas** | | | | | | |
| San Patricio County | 29.8 | 23.1 | 15.2 | 54.2 | 58.1 | 12.2 |
| Nueces County | 29.0 | 19.6 | 16.2 | 62.3 | 67.3 | 17.6 |
| *State Total* | *25.0* | *17.9* | *14.2* | *47.6* | *54.8* | *30.7* |
| **Commonwealth of Virginia** | | | | | | |
| City of Portsmouth | 16.2 | 18.1 | 16.8 | 54.9 | 59.2 | 60.1 |
| *State Total* | *9.6* | *11.1* | *10.6* | *29.8* | *35.0* | *37.9* |

Sources: USCB 2000a, 2000b, 2010, 2020.
[1] Non-White Population Percentage is considered the White alone, not Hispanic or Latino population.

Figure 3.6.4-1 through 3.6.4-7 show the locations within these counties of census block groups in New Jersey, Virginia, and Texas identified as minority, low-income, or both based on EJ Screen data (USEPA 2021b). Due to the lack of environmental justice community presence near the Monmouth County onshore cable route (Figure 3.6.4-1), no route-specific map is provided.




Source: Atlantic Shores 2023, EPA 2022, US Census 2019.

**Figure 3.6.4-1. Environmental justice populations in the geographic analysis area**

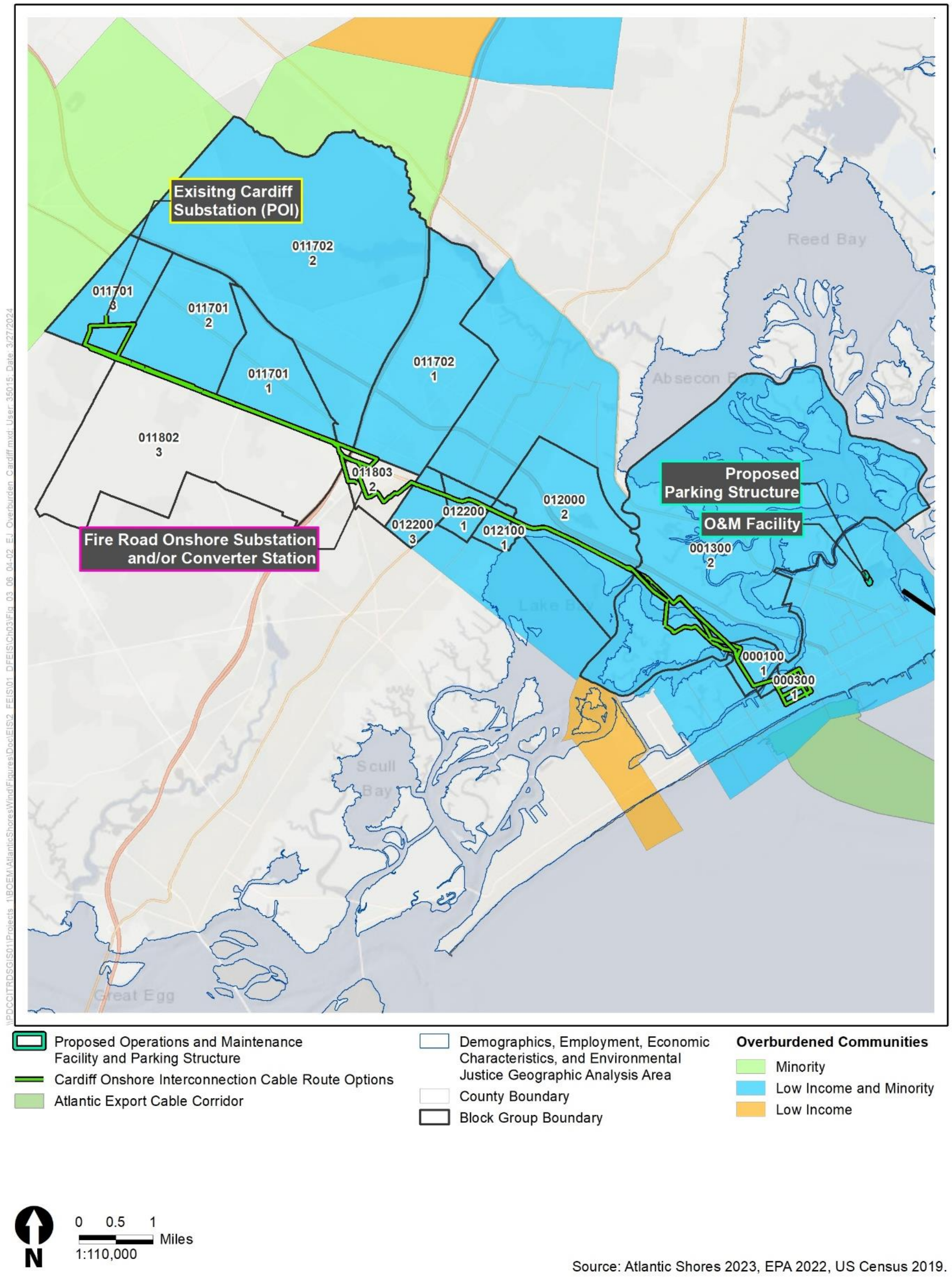



**Figure 3.6.4-2. Environmental justice populations around the Cardiff onshore cable route**

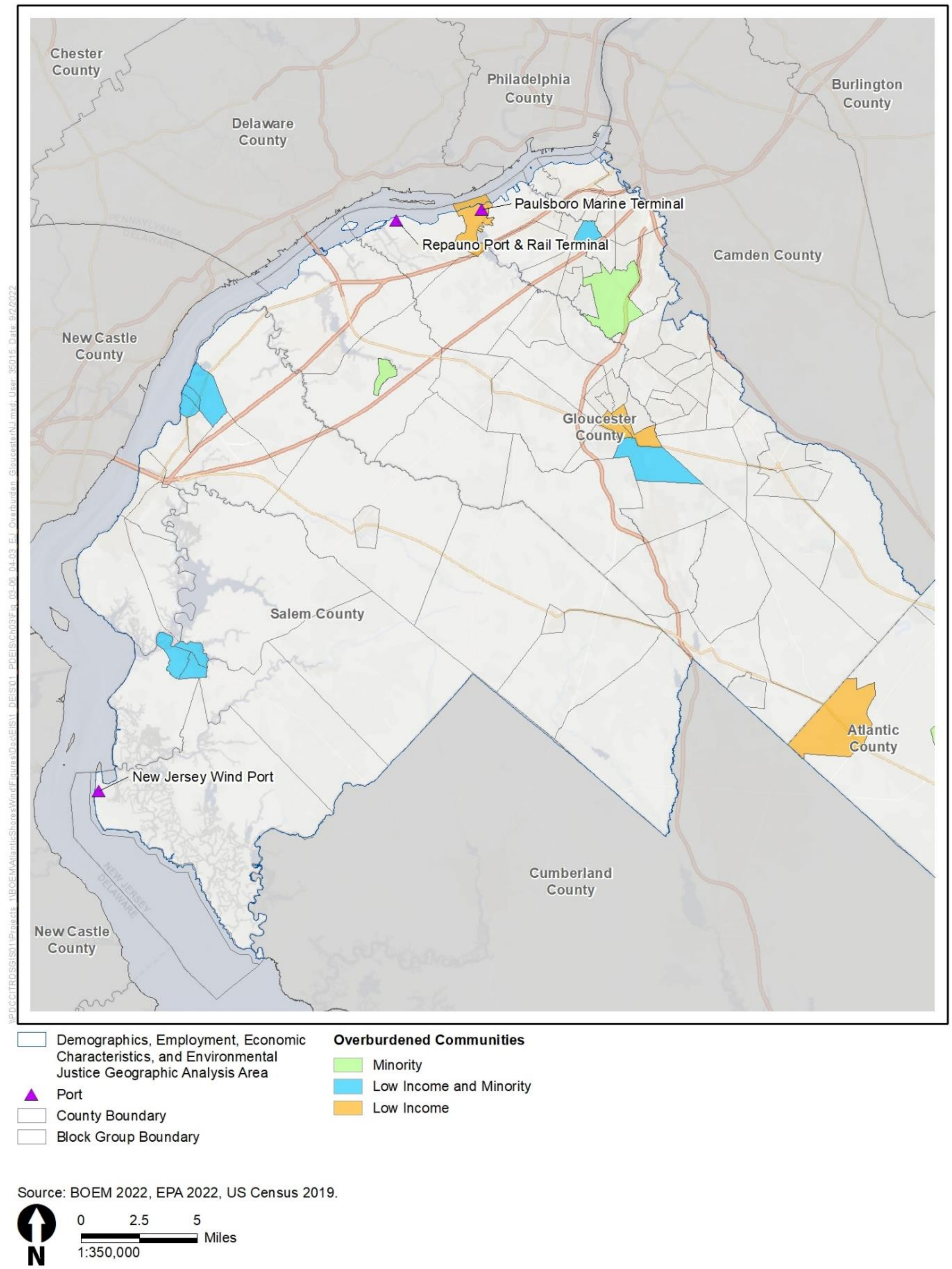



**Figure 3.6.4-3. Environmental justice populations around Gloucester and Salem Counties, New Jersey**

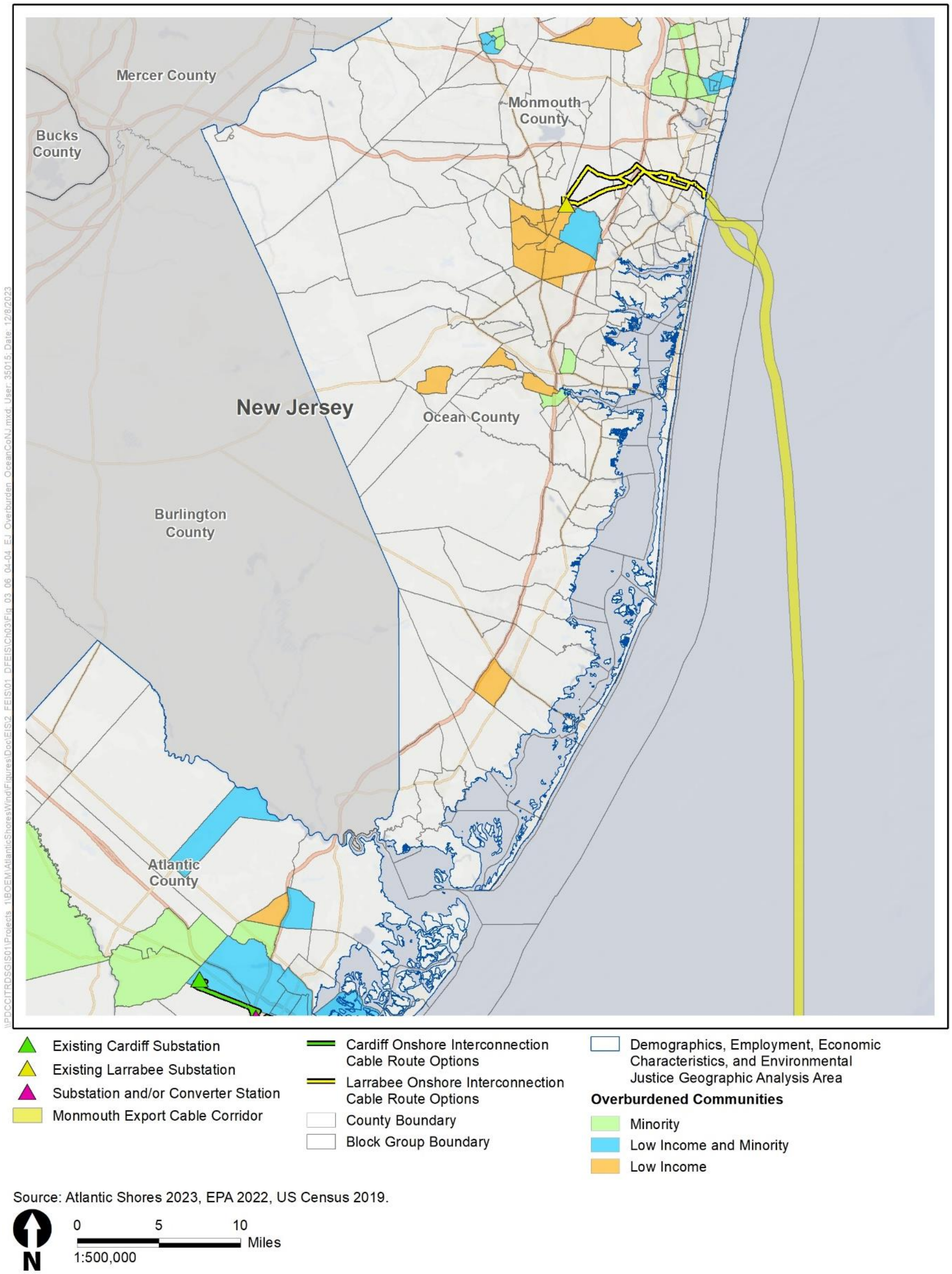



**Figure 3.6.4-4. Environmental justice populations around Ocean and Monmouth Counties, New Jersey**

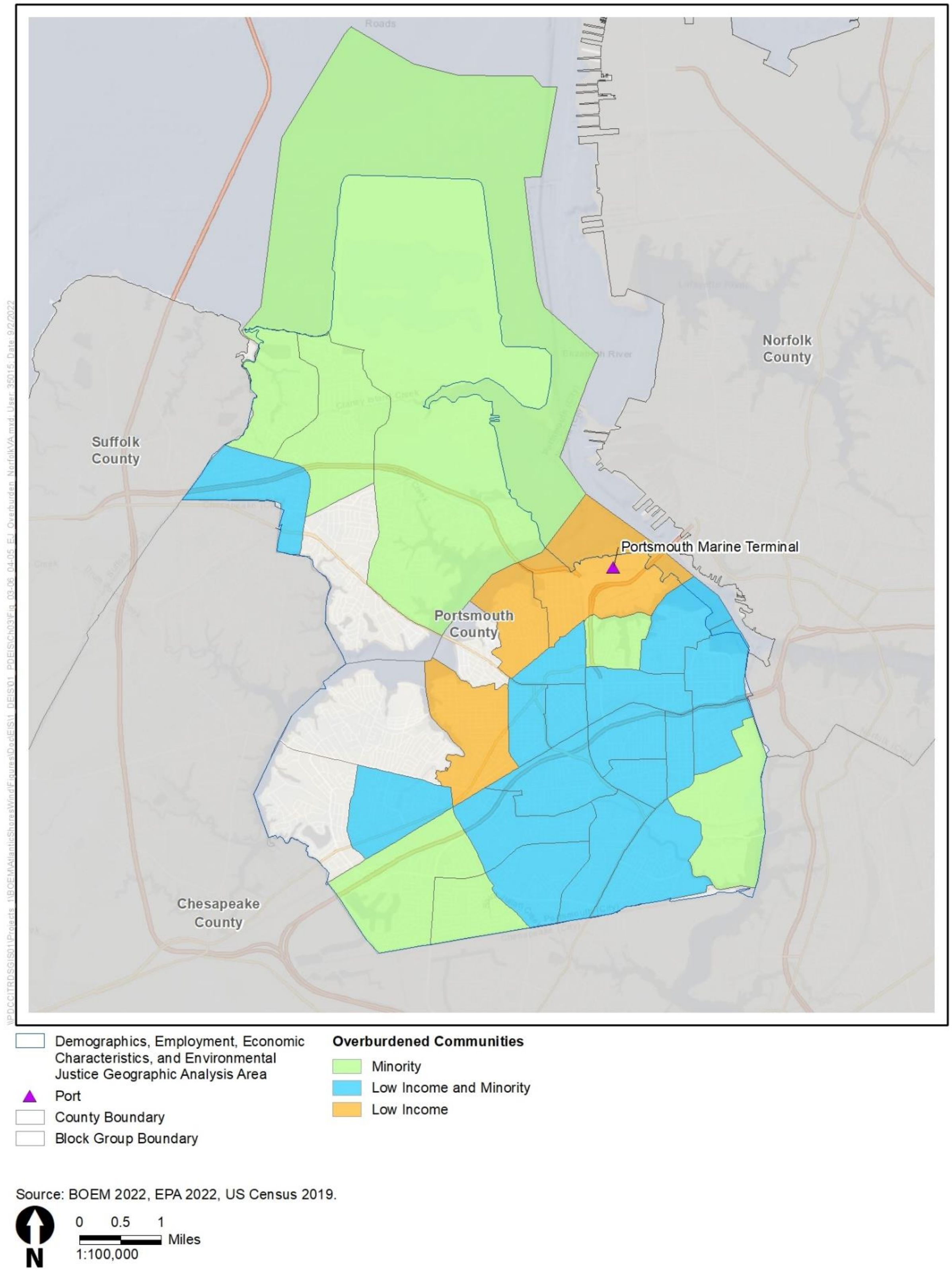



**Figure 3.6.4-5. Environmental justice populations around Portsmouth City, Virginia**

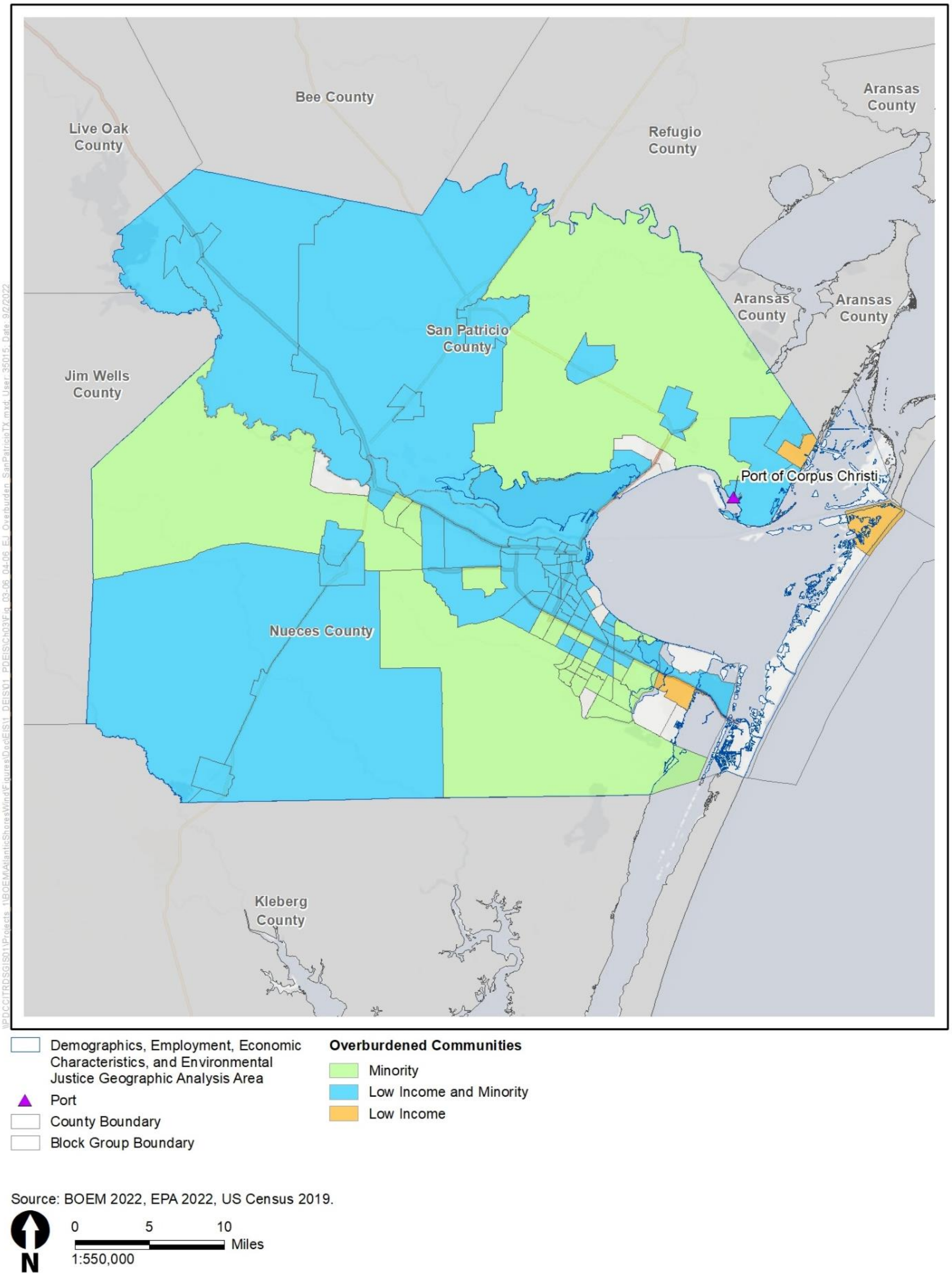



**Figure 3.6.4-6. Environmental justice populations around San Patricio, Texas**

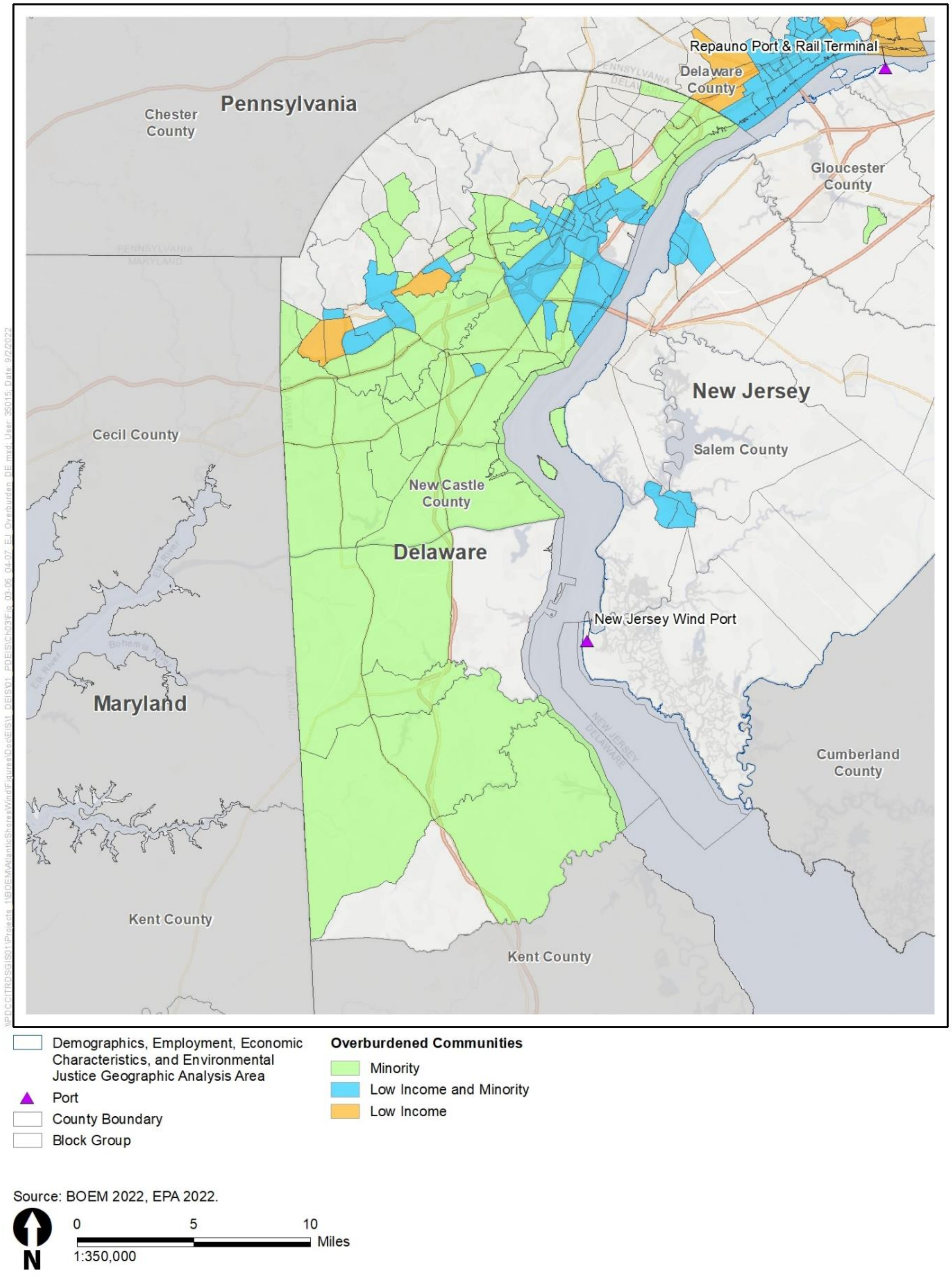



**Figure 3.6.4-7. Environmental justice populations around New Castle County, Delaware**

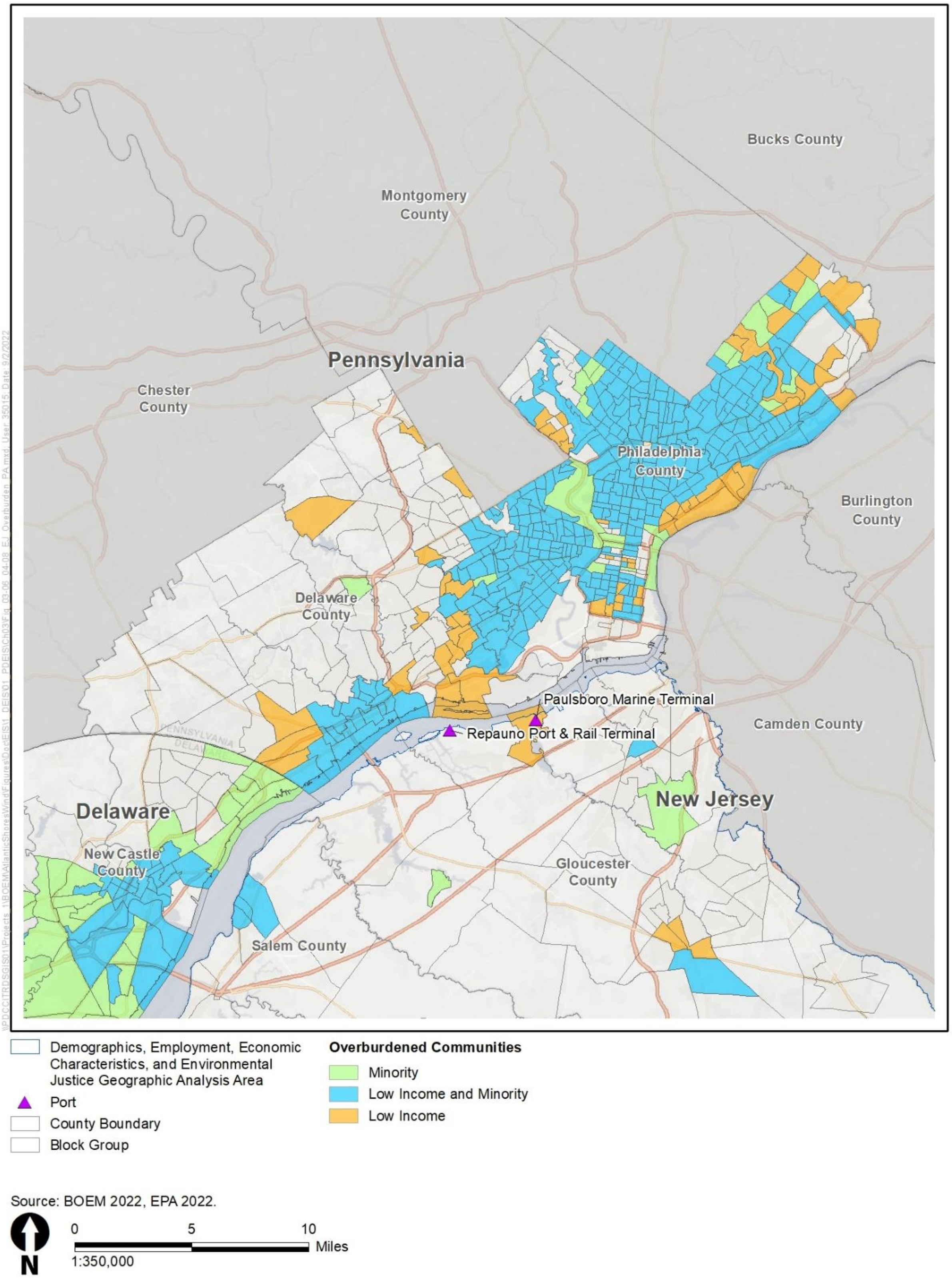



**Figure 3.6.4-8. Environmental justice populations around Delaware and Philadelphia Counties, Pennsylvania**

*Ocean Economy Considerations*

Low-income workers are employed by the commercial fishing and supporting industries that provide employment in marine trades, vessel and port maintenance, and marine industries such as marinas or boat yards, boat builders, and marine equipment suppliers and retailers.

NOAA's social indicator mapping (NOAA 2022) was used to identify low-income or minority populations that also have a high level of recreational or commercial fishing engagement or a high level of recreational or commercial fishing reliance. Due to the negligible contribution to port activity in the Virginia and Texas regions of the geographic analysis area, those ports and surrounding communities were not considered in this portion of the analysis. The NOAA social indicator index was mapped to identified environmental justice communities so as to analyze reliance and engagement of recreational and commercial fishing. The fishing engagement and reliance indices portray the importance or level of dependence of commercial or recreational fishing to coastal communities:

- Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high rank indicates more engagement.
- Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity. A high rank indicates more reliance.
- Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates. A high rank indicates more engagement.
- Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community. A high rank indicates increased reliance.

As shown on Figure 3.6.4-9, the coastal communities of Atlantic City and Brigantine (Atlantic County), and Belmar and South Belmar (Monmouth County), and Barnegat Light (Ocean County) New Jersey, have a high or medium-high level of commercial fishing engagement. Of these communities, only Barnegat Light has high levels of commercial fishing reliance. Within these communities that have a high level of commercial fishing engagement or reliance, Atlantic City is determined to contain environmental justice populations (see Figure 3.6.4-1). The coastal communities of Atlantic City and Brigantine (Atlantic County), and those along the northern end of Barnegat Bay (such as Bayville) New Jersey, have a high level of recreational fishing engagement, as do the coastal communities of Belmar, South Belmar, and Avon-by-the-Sea (Monmouth County), New Jersey (see Figure 3.6.4-9). Within these communities that have a high level of recreational fishing engagement, Atlantic City is determined to contain environmental justice populations. Atlantic City and Brigantine *(*Atlantic County), and Belmar, South Belmar, and Avon-by-the-Sea (Monmouth County), New Jersey, also have moderate levels of recreational fishing reliance (see Figure 3.6.4-9); of these, only Atlantic City in Atlantic County contains an environmental justice population (see Figures 3.6.4-1 and 3.6.4-2 for environmental justice communities in the geographic analysis area). The Atlantic City port that may be used for the Project is in an area with high levels of commercial or recreational fishing engagement or reliance.

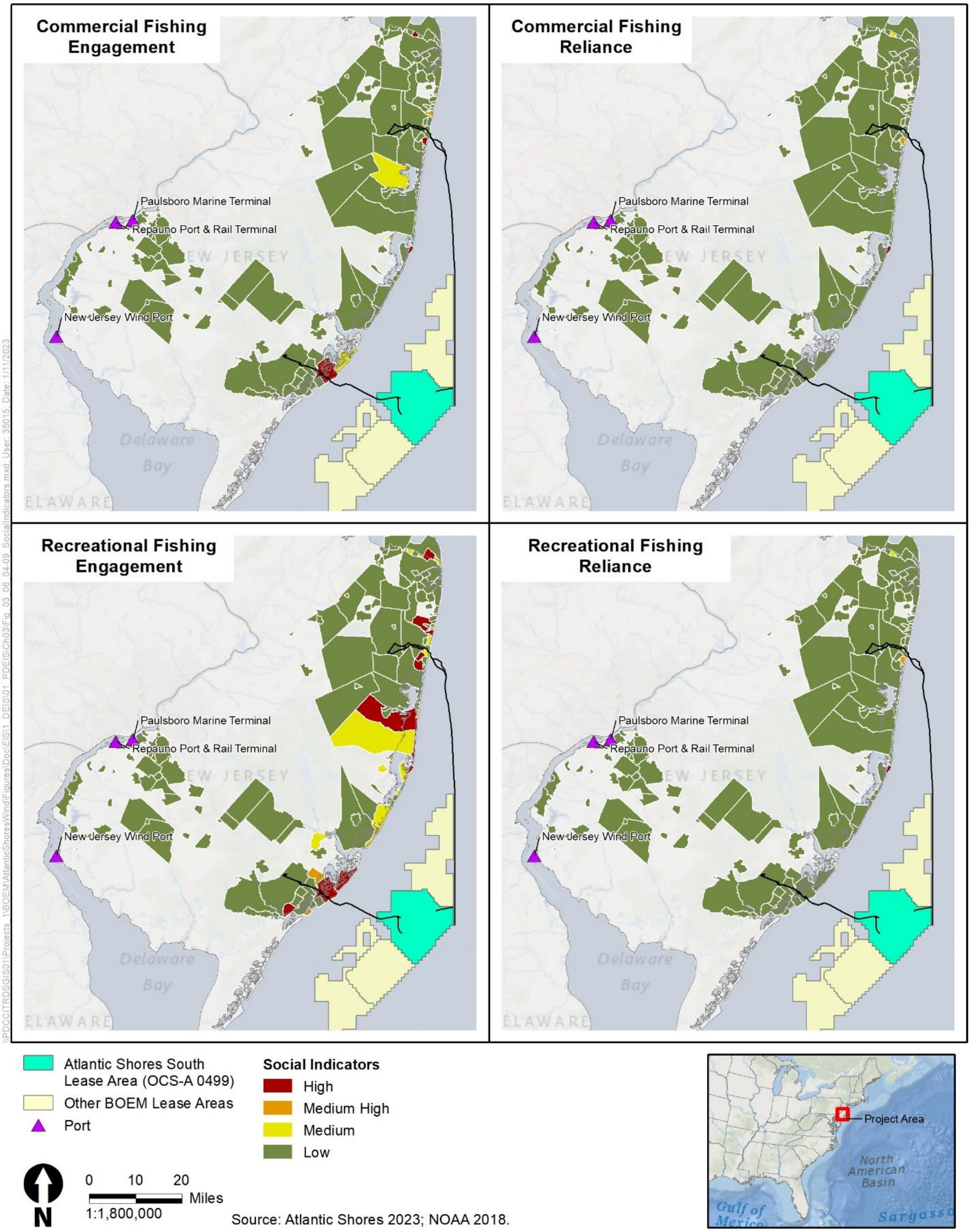



**Figure 3.6.4-9. Fishing engagement and reliance of environmental justice communities in the geographic analysis area**

To better understand the potential impacts on ocean economy activity from the Project, saltwater fishing access locations (NJDEP 2021b) in the geographic analysis area are mapped with identified environmental justice communities (Figure 3.6.4-10). Utilizing the reliance and engagement indices from Figure 3.6.4-9, the Cardiff and Larrabee onshore cable routes as well as the Atlantic City O&M facility are in areas of high commercial and recreational fishing engagement. However, in all three cases, the reliance index values for both commercial and recreational fishing are low. In addition to low reliance at the potentially impacted sites, there are numerous substitute saltwater fishing sites nearby (Figure 3.6.4-10).

NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2022). The gentrification pressure indicators measure factors that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront, including infrastructure. Gentrification indicators are measure factors related to housing disruption, retiree migration, and urban spawl:

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including change in mortgage value. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.
- Retiree migration characterizes communities with a higher concentration of retirees and elderly people in the population including households with inhabitants over 65 years, individuals receiving social security or retirement income, and level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek out the amenities of coastal living.
- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

Mapping for gentrification indices shows medium-high to high levels of housing disruption and retiree migration in coastal communities such as Deal, Spring Lake, Sea Girt (Monmouth County), Brigantine, Margate, and Long Port (Atlantic County), New Jersey, along the New Jersey shore between Atlantic City and Monmouth County, New Jersey, with the exception that Atlantic City has a low level of retiree migration. Urban sprawl across the same area exhibits low to medium pressure. Overall, mapping identifies lower gentrification pressure in the Atlantic City area compared to other nearby coastal areas due to low levels of retiree migration and low levels of urban sprawl.

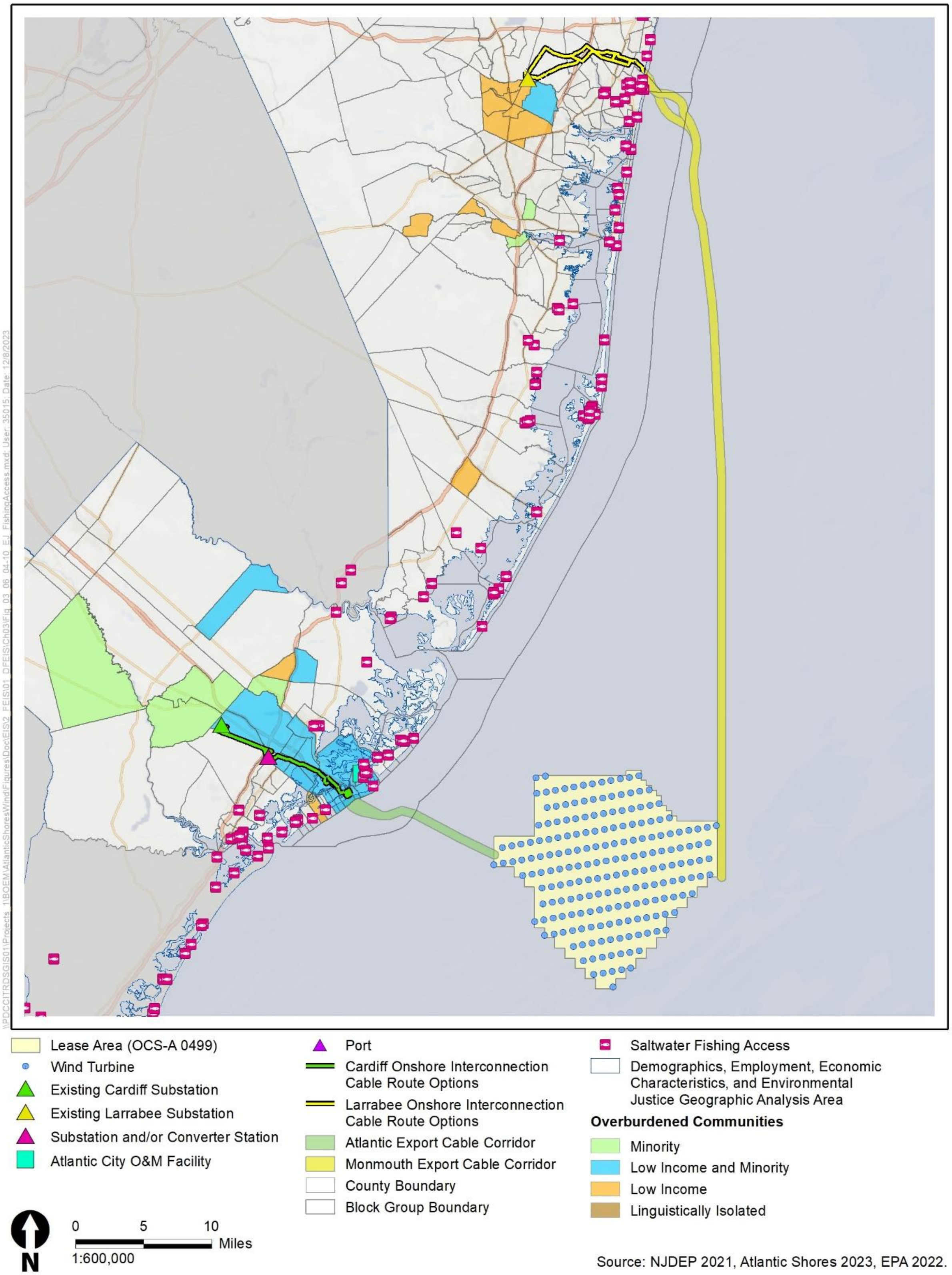



**Figure 3.6.4-10. Saltwater fishing access locations and environmental justice communities in the geographic analysis area**

### *Pre-Existing Health Condition Considerations*

Environmental justice analyses must also address the pre-existing health conditions that exist within the analysis area. In order to estimate these conditions, the Center for Disease Control and Prevention's (CDC's) Environmental Justice Index (CDC 2022) data is analyzed at the county level and presented in Table 3.6.4-2. Atlantic and Gloucester Counties in New Jersey, San Patricio County in Texas, and the City of Portsmouth in Virginia are jurisdictions with utilized ports where pre-existing health conditions were higher than state averages. Philadelphia County, Pennsylvania, and Ocean County, New Jersey, are jurisdictions without ports where pre-existing health conditions were higher than the state average.

**Table 3.6.4-2. State and county/city pre-existing public health conditions within the analysis area**

| Jurisdiction | High Blood Pressure | Asthma | Cancer | Mental Health | Diabetes | 2020 |
|---|---|---|---|---|---|---|
| **State of Delaware** | | | | | | |
| New Castle County | 32.9% | 9.7% | 6.3% | 13.6% | 10.2% | 32.9% |
| *State Total* | 32.9% | 9.7% | 6.3% | 13.6% | 10.2% | 32.9% |
| **State of Pennsylvania** | | | | | | |
| Delaware County | 29.9% | 9.9% | 7.0% | 14.1% | 10.0% | 29.9% |
| Philadelphia County | 34.2% | 12.1% | 5.9% | 18.5% | 13.2% | 34.2% |
| *State Total* | 33.1% | 11.5% | 6.2% | 17.3% | 12.3% | 33.1% |
| **State of New Jersey** | | | | | | |
| Atlantic County | 34.3% | 10.0% | 6.7% | 14.4% | 11.8% | 34.3% |
| Gloucester County | 32.4% | 9.7% | 6.7% | 13.5% | 9.4% | 32.4% |
| Monmouth County | 31.5% | 9.2% | 7.2% | 12.2% | 9.1% | 31.5% |
| Ocean County | 36.1% | 9.7% | 8.1% | 13.7% | 10.2% | 36.1% |
| Salem County | 37.2% | 10.5% | 7.2% | 15.3% | 12.1% | 37.2% |
| *State Total* | 33.7% | 9.6% | 7.3% | 13.3% | 10.0% | 33.7% |
| **State of Texas** | | | | | | |
| Nueces County | 33.8% | 8.5% | 5.7% | 13.8% | 13.4% | 33.8% |
| San Patricio County | 34.9% | 9.0% | 6.2% | 14.3% | 14.0% | 34.9% |
| *State Total* | 33.9% | 8.6% | 5.8% | 13.9% | 13.5% | 33.9% |
| **Commonwealth of Virginia** | | | | | | |
| City of Portsmouth | 37.2% | 10.4% | 6.3% | 15.3% | 13.5% | 37.2% |
| *State Total* | 36.0% | 10.1% | 6.6% | 14.8% | 12.7% | 36.0% |

Source: CDC 2022.

### *Tribal Considerations*

Environmental justice analyses must also address impacts on Native American tribes. Federal agencies should evaluate "interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action," and "recognize that the impacts within…Indian tribes may be different from impacts on the general population due to a community's distinct cultural practices" (CEQ 1997). Factors that could lead to a finding of DHAI to environmental justice populations include loss of significant cultural or historical resources and the impact's relation to other cumulatively significant impacts (USEPA 2016). BOEM is holding ongoing government-to-government consultations on the proposed Project with the following federally recognized tribes: the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, Mashpee Wampanoag Tribe, Mashantucket (Western) Pequot Tribe, Narragansett Indian Tribe, Shawnee Tribe, Shinnecock Indian Nation, and Wampanoag Tribe of Gay Head (Aquinnah). BOEM has asked the following state-recognized tribes to be NHPA Section 106 consulting parties on the proposed Project: the Lenape Indian Tribe of Delaware, Nanticoke Indian Tribe, Nanticoke Lenni-Lenape Tribal Nation, Powhatan Renape Nation, Ramapough Lenape Indian Nation, and Ramapough Mountain Indians. The NHPA Section 106 process for the Project has been formally initiated by BOEM (Appendix A, *Required Environmental Permits and Consultations,* Section A.2.2.3).

With respect to tribal and indigenous peoples, New Jersey formally recognizes the Nanticoke Lenni-Lenape Indians, Powhatan Renape Indians, Ramapough Lenape Indian Nation, and Inter-Tribal People, none of which are federally recognized[1] (USEPA 2021c; State of New Jersey 2021b).

There are no tribal reservations or headquarters in the geographic analysis area, but coastal and inland areas of the region, including the Delaware River area of New Jersey, are part of the Lenni-Lenape Tribe's historical territory (Licht et al. 2009). Offshore regions in the geographic analysis area were likely part of historical sturgeon fishing grounds (Delaware Tribe of Indians 2013). The Nansemond Indian Nation, located in Suffolk, Virginia, is the closest tribe to the City of Portsmouth, Virginia. The Nansemond Indian Nation lived in settlements along the Nansemond River fishing, harvesting oysters, hunting, and farming (Nansemond Indian Nation n.d.). For the three federally and state-recognized tribes in Texas (Alabama-Coushatta Tribe, Kickapoo Traditional Tribe, and Ysleta Del Sur Pueblo), none of their historical territories are in the vicinity of Nueces or San Patricio Counties, Texas.

#### 3.6.4.2 Environmental Consequences

##### *Scope of the Environmental Justice Analysis*

To define the scope of the environmental justice analysis, BOEM reviewed the impact conclusions for each resource analyzed in EIS Section 3.4.1 through Section 3.6.9 to assess whether the Proposed Action and action alternatives would result in major impacts that would be considered "high and adverse" and whether major impacts had the potential to affect environmental justice populations given the geographic extent of the impact relative to the locations of environmental justice populations. Major impacts that had the potential to affect environmental justice populations were further analyzed to determine if IPFs would produce DHAI. Although the environmental justice analysis considers impacts of other ongoing and planned activities, including other planned offshore wind projects, determinations as to whether impacts on environmental justice populations would be DHAI are made for the Proposed Action and action alternatives alone.

[1] *Inter-Tribal People* refers to American Indian people who reside in New Jersey but are members of federally or State-recognized tribes in other states.

As shown on Figure 3.6.4-1, Onshore Project infrastructure—including cable landfalls, onshore export cable routes, onshore substations, and POIs—would be in areas where environmental justice populations have been identified and would thus affect environmental justice populations. Therefore, onshore impacts during construction and installation, O&M, and decommissioning are carried forward for analysis of DHAI in this environmental justice analysis under the *Land disturbance, Noise, Port utilization*, *Noise,* and *Air emissions* IPFs.

Atlantic Shores has identified the following locations for ports that could support construction of the Project: New Jersey Wind Port and Paulsboro Marine Terminal, and Repauno Port and Rail Terminal in New Jersey, Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas. In addition, Atlantic Shores plans to use an O&M facility in Atlantic City for long-term O&M of the Project. As shown on Figure 3.6.4-1 through Figure 3.6.4-7, the ports of Atlantic City Harbor and Paulsboro Marine Terminal in New Jersey, the Portsmouth Marine Terminal in Virginia, and Port of Corpus Christi in Texas and the proposed location for the O&M facility in Atlantic City are in areas where environmental justice populations have been identified. Therefore, port utilization and use of the O&M facility in Atlantic City are carried forward for analysis of DHAI effects in this environmental justice analysis under the *Port utilization* and *Air* e*missions* IPFs.

Construction and installation, O&M, and decommissioning of offshore structures (WTGs, OSSs, and met towers) could have major impacts on some commercial fishing operations that use the Lease Area, with potential for indirect impacts on employment in related industries that could affect environmental justice populations. Cable emplacement and maintenance and construction noise would also contribute to impacts on commercial fishing. The long-term presence of offshore structures (WTGs, OSSs, and met towers) would also have major impacts on scenic and visual resources and viewer experience from some onshore viewpoints that could affect environmental justice populations. Therefore, impacts of construction and installation, O&M, and decommissioning of Offshore Project components is carried forward for analysis of DHAI in this environmental justice analysis under the *Presence of structures*, *Cable emplacement and maintenance*, and *Noise* IPFs.

Section 3.6.2, *Cultural Resources*, determined that construction of offshore wind structures and cables could result in major impacts on ASLFs if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction. BOEM has committed to working with the lessee, consulting parties, Native American tribes, and the New Jersey SHPO to develop specific treatment plans to address impacts on ASLFs that cannot be avoided. Development and implementation of Project-specific treatment plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on ASLFs; however, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts, unless these ASLFs can be avoided. The tribal significance of ASLFs identified in the Lease Area and cable corridors has not yet been determined, and consultation with tribes via NHPA Section 106 consultation and government-to-government consultation is ongoing. No other tribal resources such as cultural landscapes, traditional cultural properties, burial sites, archaeological sites with tribal significance, treaty-reserved rights to usual and accustomed fishing or hunting grounds, or other potentially affected tribal resources have been identified to date. BOEM will continue to consult with Native American tribes throughout development of the EIS and will consider impacts on tribal resources identified through consultation in the environmental justice analysis if they are discovered.

Other resource impacts that concluded less-than-major impacts for the Proposed Action and action alternatives or were unlikely to affect environmental justice populations were excluded from further analysis of environmental justice impacts. This includes impacts related to bats; benthic resources; birds; coastal habitat and fauna; finfish, invertebrates, and EFH; land use and coastal infrastructure; marine mammals; navigation and vessel traffic; recreation and tourism; sea turtles; visual resources; water quality; and wetlands.

### 3.6.4.3 Impact Level Definitions for Environmental Justice

This Final EIS uses a four-level classification scheme to characterize potential environmental justice impacts, as shown in Table 3.6.4-3. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions and the characterization of incremental impacts. A determination of whether impacts are "disproportionately high and adverse" in accordance with EO 12898 is provided in the conclusions sections for the Proposed Action and action alternatives.

Definitions of potential impact levels are provided in Table 3.6.4-3. Determination of a "major" impact corresponds to a "high and adverse" impact for the environmental justice analysis. Major (or high and adverse) impacts will be further analyzed to determine if those impacts would be disproportionately high and adverse for low-income and minority populations.

**Table 3.6.4-3. Impact level definitions for environmental justice**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | Adverse impacts on environmental justice populations would be small and unmeasurable. |
| | Beneficial | Beneficial impacts on environmental justice populations would be small and unmeasurable. |
| Minor | Adverse | Adverse impacts on environmental justice populations would be small and measurable but would not disrupt the normal or routine function of the affected population. |
| | Beneficial | Environmental justice populations would experience a small and measurable improvement in human health, employment, facilities, or community services, or other economic or quality-of-life improvement. |
| Moderate | Adverse | Environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts. |
| | Beneficial | Environmental justice populations would experience a notable and measurable improvement in human health, employment, facilities, or community services, or other economic or quality-of-life improvement. |
| Major | Adverse | Environmental justice populations would have to adjust to significant disruptions due to notable and measurable adverse impacts. The affected population may experience measurable long-term effects. |

| Impact Level | Impact Type | Definition |
|---|---|---|
| | Beneficial | Environmental justice populations would experience a substantial long-term improvement in human health, employment, facilities, or community services, or other economic or quality-of-life improvements. |

### 3.6.4.4 Impacts of Alternative A – No Action on Environmental Justice

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

#### Impacts of Alternative A – No Action

Under the No Action Alternative, baseline conditions for environmental justice described in Section 3.6.4.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities that have the potential to affect environmental justice populations include undersea transmission lines, gas pipelines and submarine cables, tidal energy projects, dredging and port improvement projects, marine minerals use and ocean-dredged material disposal, military use, marine transportation, fisheries use management, and monitoring surveys, global climate change, oil and gas activities, and onshore development activities (see Appendix D, Section D.2). These activities would contribute to periodic disruptions to environmental justice communities but are typical occurrences along the New Jersey coastline and would not substantially affect environmental justice communities. See Appendix D, Table DA-9 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for environmental justice. There is currently one ongoing offshore wind project within the geographic analysis area that could contribute to impacts on environmental justice communities: Ocean Wind 1 in Lease Area OCS-A 0498.

#### *Cumulative Impacts of Alternative A – No Action*

The cumulative impact analysis for the No Action Alternative considered the impacts of the No Action Alternative, inclusive of ongoing activities, in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action). Planned non-offshore wind activities that may affect environmental justice include development projects, onshore construction, and port expansions (see Appendix D for a detailed description of planned activities). These activities may result in temporary and permanent impacts on environmental justice communities. See Table D.A1-9 for a summary of potential impacts associated with planned activities by IPF for environmental justice.

The sections below summarize the potential impacts of planned offshore wind activities on environmental justice during construction and installation, O&M, and decommissioning of the Project. Currently, the following offshore wind projects in the geographic analysis area are planned to overlap in timing with the Proposed Action within Lease Areas OCS-A 0532 (Ocean Wind 2), OCS-A 0549 (Atlantic Shores North), OCS-A 0538 (Attentive Energy), OCS-A 0539 (Community Offshore Wind), OCS-A 0541 (Atlantic Shores Bight), and OCS-A 0542 (Invenergy Wind). These projects, inclusive of the ongoing Ocean Wind 1 Project, are estimated to collectively install 799 WTGs, 23 OSSs and met towers, and 2,834 miles (4,561 kilometers) of submarine export cables and interarray cables in the geographic analysis area between 2026 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2).

BOEM expects ongoing and planned offshore wind development activities to affect environmental justice populations through the following primary IPFs.

**Air emissions:** Emissions at offshore locations under the No Action Alternative from other offshore wind projects would have regional impacts, with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts depending upon the ports that are being used, the ambient air quality, and the increase in emissions at any given port. Onshore, some industrial waterfront locations would continue to lose industrial uses, with no new industrial development to replace it. Cities such Atlantic City are encouraging redevelopment of large areas of vacant lands within the downtown area and along the beach, boardwalk, inlet, and bay areas through redevelopment (City of Atlantic City 2016). These redevelopment areas would have lower emissions than the industrial areas they replace, reducing the impact of air emissions to proximal environmental justice communities.

Emissions attributable to the No Action Alternative affecting any neighborhood have not been quantified; however, it is assumed that emissions from the No Action Alternative at ports would comprise a small proportion of total emissions from those facilities. Therefore, air emissions during construction would have small, short-term, variable impacts on environmental justice communities due to temporary increases in air emissions. The air emissions impacts would be greater if multiple offshore wind projects simultaneously use the same port for construction staging. If construction staging is distributed among several ports, the air emissions would not be concentrated near certain ports, and impacts on proximal environmental justice communities would be less. If construction staging is distributed over time, air emissions would be less concentrated than if multiple projects were operating simultaneously; however, impacts would then be extended over a longer period of time.

As explained in Section 3.4.1, *Air Quality,* operational activities under the No Action Alternative within the air quality geographic analysis area would generate 40–180 tons per year of CO, 159–746 tons per year of $NO_X$, 6-25 tons per year of $PM_{10}$, 5–24 tons per year of $PM_{2.5}$, 1–3 tons per year of $SO_2$, 4–15 tons per year of VOCs, and 11,752–51,412 tons per year of $CO_2$ (Section 3.4.1.3). Operational emissions would overall be intermittent and widely dispersed throughout the combined 241,609-acre (97,776-hectare) lease areas for Ocean Wind 1 and 2 and Atlantic Shores North and the vessel routes from the onshore O&M facility, and would generally contribute to small and localized air quality impacts (Appendix D, Table D.A2-4). Emissions would largely be due to vessel traffic related to O&M and emergency diesel generator operation. These emissions would be intermittent and widely dispersed, with small and localized air quality impacts. Only the portion of those emissions resulting from ship engines and port-based equipment operating within and near the ports (Paulsboro Marine Terminal, New Jersey Wind Port, Repauno Port and Rail Terminal in New Jersey; Portsmouth Marine Terminal in Virginia; and Port of Corpus Christi in Texas) and O&M facility (Atlantic City Harbor, New Jersey) would affect environmental justice communities. Therefore, during operations of offshore wind projects, the air emissions resulting from port activities are not anticipated to be large enough to have impacts on environmental justice communities.

The power generation capacity of offshore wind could potentially lead to lower regional air emissions by displacing fossil fuel plants for power generation, which is analyzed in further detail in Section 3.4.1. A 2019 study found that nationally, exposure to fine particulate matter from fossil fuel electricity generation in the United States varied by income and by race, with average exposures highest for Black individuals, followed by non-Hispanic white individuals. In addition to the reduction in particulate matter and other pollutants, displacing fossil fuel plants for power generation would also result in reduced GHG emissions. Exposures for other groups (i.e., Asian, Native American, and Hispanic) were somewhat lower. Exposures were higher for lower-income populations than for higher-income populations, but disparities were larger by race than by income (Thind et al. 2019). Specific to the Northeast, a 2019 study found a higher percentage increase in mortality associated with $PM_{2.5}$ in census tracts with more Blacks, lower home value, or lower median income (Yitshak-Sade et al. 2019).

Exposure to air pollution is linked to health impacts, including respiratory illness, increased health care costs, and mortality. A 2016 study for the mid-Atlantic region found that offshore wind could produce measurable benefits measured in health costs and reduction in loss of life due to displacement of fossil fuel power generation (Buonocore et al. 2016). Environmental justice populations tend to have disproportionately high exposure to air pollutants, likely leading to disproportionately high adverse health consequences. Accordingly, offshore wind generation analyzed under the No Action Alternative would have potential benefits for environmental justice populations through reduction or avoidance of air emissions and concomitant reduction or avoidance of adverse health impacts at a regional level. Localized adverse impacts could still persist and impact environmental justice communities (see Section 3.4.1 for more detail), especially those identified in Table 3.6.4-2 as having pre-existing health conditions.

**Cable emplacement and maintenance:** As described in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, under the No Action Alternative cable installation and maintenance from other offshore wind projects would have localized, short-term impacts on the revenue and operating costs of commercial and for-hire fishing businesses (see *Land disturbance* for onshore cable emplacement). Commercial fishing operations may temporarily be less productive during cable installation or repair, resulting in reduced income; this may also lead to short-term reductions in business volumes for seafood processing and wholesaling businesses that depend upon the commercial fishing industry. Although the commercial and for-hire fishing businesses could temporarily adjust their operating locations to avoid revenue loss, the impacts would be greater if multiple cable installation or repair projects are underway offshore of the environmental justice geographic analysis area at the same time.

Business impacts could affect environmental justice populations due to the potential loss of income or jobs by low-income workers in the commercial fishing industry. In addition, cable installation and maintenance could temporarily disrupt subsistence fishing, resulting in short-term, localized impacts on low-income residents who rely on subsistence fishing as a food source.

**Land disturbance:** Under the No Action Alternative, other offshore wind projects would require onshore cable installation, substation construction or expansion, and possibly expansion of shore-based port facilities. Depending on siting, land disturbance could result in temporary, localized, variable disturbances of neighborhoods and businesses near cable routes and construction sites due to typical construction impacts such as increased noise, dust, traffic, and road disturbances. Potential short-term, variable impacts on environmental justice communities could result from land disturbance, depending on the particular location of onshore construction for each offshore wind project.

**Noise:** As described in greater detail in Section 3.6.3, *Demographics, Employment, and Economics,* Section 3.6.8, *Recreation and Tourism,* and Section 3.6.9, *Visual Resources,* under the No Action Alternative, noise from site assessment G&G survey activities, pile driving, trenching, and vessels of other offshore wind projects is likely to result in temporary revenue reductions for commercial fishing and marine recreational businesses that operate in the areas offshore from the geographic analysis area for environmental justice populations. Construction noise, especially site assessment G&G surveys and pile driving, would affect fish and marine mammal populations, with impacts on commercial and for-hire fishing and marine sightseeing businesses. The severity of impacts would depend on the proximity and temporal overlap of offshore wind survey and construction activities, and the location of noise-generating activities in relation to preferred locations for commercial/for-hire fishing and marine tours.

The localized impacts of offshore noise on fishing could also have an impact on subsistence fishing by low-income residents. As mentioned in Section 3.6.8, most recreational fishing occurs within 3 miles (4.8 kilometers) of the shore, and some highly migratory species are fished farther offshore. Due to the lack of subsistence fishing reliance indicators, this analysis uses recreation fishing reliance, as defined by the NOAA social indicator, as a proxy for subsistence fishing reliance. Based on the NOAA social indicator mapping (Figure 3.6.4-6), there are no environmental justice communities that have high levels of recreational fishing reliance. In addition, noise would affect some for-hire fishing businesses or marine sightseeing businesses, as these visitor-oriented services are likely to avoid areas where noise is being generated due to the disruption for the customers.

Impacts of offshore noise on marine businesses would be short term and localized, occurring during surveying and construction, with no noticeable impacts during operations and only periodic, short-term impacts during maintenance. Noise impacts during surveying and construction would be more widespread when multiple offshore wind projects are under construction at the same time. The projects within the geographic analysis area for environmental justice could have 822 offshore WTGs, OSSs, and met towers installed by 2030 (Appendix D, Table D.A2-2). The impacts of offshore noise on marine businesses and subsistence fishing would have short-term, localized impacts on low-income workers in marine-dependent businesses as well as residents who practice subsistence fishing and clamming, resulting in impacts on environmental justice populations.

Onshore construction noise would temporarily inconvenience visitors, workers, and residents near sites where onshore cables, substations, or port improvements are installed to support offshore wind. In addition to inconvenience, construction noise has been documented to cause cardiovascular disease, cognitive impairment, sleep disturbance, and tinnitus (WHO 2011). Impacts would depend upon the location of onshore construction in relation to businesses or environmental justice communities. Impacts on environmental justice communities could be short term and intermittent, similar to other onshore utility construction activity.

Noise generated by offshore wind staging operations at ports would potentially have impacts on environmental justice communities if the port is located near such communities. Within the geographic analysis area for environmental justice populations, the ports of Atlantic City, Paulsboro Marine Terminal, New Jersey Wind Port, and Repauno Port and Rail Terminal in New Jersey; Portsmouth Marine Terminal, in the City of Portsmouth in Virginia; and the Port of Corpus Christi in Nueces and San Patricio Counties, in Texas are within or near environmental justice communities. The noise impacts under the No Action Alternative from other offshore wind projects' increased port utilization would be short term and variable, limited to the construction period, and would increase if a port is used for multiple offshore wind projects during the same time period. Noise impacts would be reduced if intervening buildings, roads, or topography lessen the intensity of noise in nearby residential neighborhoods, or if noise reduction mitigations are used for motorized vehicles and equipment.

**Port utilization:** If other offshore wind projects would use the ports of Atlantic City Harbor and Paulsboro Marine Terminal in New Jersey, the Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas that are located near predominantly environmental justice communities (Figures 3.6.4-1 and 3.6.4-2), under the No Action Alternative, impacts would result from increased air emissions and noise generated by port utilization or expansion (see the *Air emissions* and *Noise* IPFs). Port use and expansion resulting from offshore wind would have beneficial impacts on employment at ports. Port utilization for offshore wind would have short-term beneficial impacts for environmental justice populations during construction and decommissioning, resulting from employment opportunities, the support for other local businesses by the port-related businesses, and employee expenditures. Beneficial impacts would also result from port utilization during offshore wind operations, but these impacts would be of lower magnitude.

**Presence of structures:** As described in Sections 3.6.3, 3.6.8, and 3.6.9, under the No Action Alternative, the offshore structures required for offshore wind projects, including WTGs, offshore substations, and offshore cables protected with hard cover, would affect employment and economic activity generated by marine-based businesses.

Commercial fishing businesses would need to adjust routes and fishing grounds to avoid offshore work areas during construction, and to avoid WTGs and offshore substations during operations. Concrete cable covers and scour protection could result in gear loss and would make some fishing techniques unavailable in locations where the cable coverage exists. For-hire recreational fishing businesses would also need to avoid construction areas and offshore structures. A decrease in revenue, employment, and income within commercial fishing and marine recreational industries is likely to impact low-income workers, resulting in impacts on environmental justice populations. The impacts during construction would be short term and would increase in magnitude when multiple offshore construction areas exist at the same time. As many as three ongoing and planned offshore wind projects (Atlantic Shores North, Ocean Wind 1, and Ocean Wind 2) could be under construction simultaneously in the New Jersey lease areas. Impacts during operations would be long term and continuous but may lessen in magnitude as business operators adjust to the presence of offshore structures and as any temporary marine safety zones needed for construction are no longer needed.

In addition to the potential impacts on marine activity and supporting businesses, WTGs are anticipated to provide new opportunity for subsistence and recreational fishing, through fish aggregation and reef effects, and to provide attraction for recreational sightseeing businesses, potentially benefitting subsistence fishing and low-income employees of marine-dependent businesses.

Views of offshore WTGs could also have impacts on individual locations and businesses serving the recreation and tourism industry, based on visitor decisions to select or avoid certain locations. Because the service industries that support tourism are a source of employment and income for low-income workers, impacts on tourism would also result in impacts on environmental justice populations. As explained in Section 3.6.9, portions of all 799 WTGs within the environmental justice geographic analysis area associated with the No Action Alternative (Appendix D, Table D.A2-1) could potentially be visible from shorelines, depending on vegetation, topography, weather, and atmospheric conditions. While WTGs could be visible from some shoreline locations in the geographic analysis area, WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. The impact of visible WTGs on recreation and tourism is likely to be limited to individual decisions by some visitors and is unlikely to affect most shore-based tourism businesses or the geographic analysis area's tourism industry as a whole (Section 3.6.9). Therefore, views of offshore WTGs are not anticipated to result in impacts on environmental justice populations, specifically low-income employees of tourism-related businesses.

### *Conclusions*

**Impacts of Alternative A – No Action.** Under the No Action Alternative, environmental justice populations within the geographic analysis area would continue to be affected by existing regional environmental, demographic, and economic trends. While the proposed Project would not be built under the No Action Alternative, BOEM expects ongoing activities to have continuing impacts on environmental justice populations through the following trends: ongoing population growth and new development; resulting traffic increases and industrial development, possibly increasing emissions near environmental justice communities; ongoing commercial fishing, seafood processing, and tourism industries that provide job opportunities for low-income residents; and construction-related air pollutant emissions and noise when these occur near environmental justice communities. BOEM anticipates that the environmental justice impacts as a result of ongoing activities associated with the No Action Alternative would be minor.

Reasonably foreseeable trends affecting environmental justice populations, other than offshore wind, include changes in the commercial fishing and seafood processing industries due to climate change and environmental stress; growing recreational and tourism industries for coastal economies; new development that would result in increased motor vehicle emissions; historically industrial waterfront locations redeveloping; and continued pressure to balance development pressure and coastal activity with protection of air and water quality. BOEM anticipates that the adverse impacts of these trends and planned actions on environmental justice populations would be **minor**.

**Cumulative Impacts of Alternative A – No Action.** BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in **moderate adverse** impacts. This reflects short-term impacts on minority and low-income communities from cable emplacement, construction-phase noise and vessel traffic, and the long-term presence of offshore structures, which could affect marine-dependent businesses, resulting in job losses for low-income workers. Construction-related port activities could have impacts on environmental justice communities near ports through air emissions, traffic, or noise.

BOEM also anticipates that the impacts associated with planned offshore wind activities in the geographic analysis area would result in **minor beneficial** effects on minority and low-income populations through economic activity and job opportunities in marine trades and the offshore wind industry. Additional minor beneficial effects may result from reductions in air emissions if offshore wind displaces energy generation using fossil fuels.

### 3.6.4.5 Relevant Design Parameters and Potential Variances in Impacts

Effects on environmental justice communities would occur when the Proposed Action's adverse effects on other resources, such as air quality, water quality, employment and economics, cultural resources, recreation and tourism, commercial fishing, or navigation, are felt disproportionately within environmental justice communities, due either to the location of these communities in relation to the Proposed Action or to their higher vulnerability to impacts.

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

- Overall size of project (approximately 1,510 MW for Project 1 and yet to be determined for Project 2) and number of WTGs;
- The Project layout including the number, type, height, and placement of the WTGs and OSS, and the design and visibility of lighting on the structures;
- The extent to which Atlantic Shores hires local residents and obtains supplies and services from local vendors;

- The port(s) selected to support construction, installation, and decommissioning and the port(s) selected to support O&M;
- The design parameters that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity;
- Arrangement of WTGs and accessibility of the WTA to recreational boaters; and
- The time of year during which onshore and near shore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix C. The following summarizes the potential variances in impacts on all members of environmental justice communities and especially those who depend on subsistence fishing or jobs in commercial/for-hire fishing or marine recreation:

- WTG number, size, location, and lighting: More WTGs and larger turbine sizes closer to shore could increase visual impacts that affect local populations, onshore recreation and tourism, and recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- WTG arrangement and orientation: Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.
- Time of construction: Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season.

#### 3.6.4.6 Impacts of Alternative B – Proposed Action on Environmental Justice

Impacts on environmental justice communities from the Proposed Action would result from views of WTGs and impacts on shellfish, fish, and marine mammal populations. The Proposed Action would also result in impacts on low-income workers in the commercial/for-hire fishing, marine recreation, and supporting industries. The most impactful IPFs would likely include cable emplacement, vessel traffic during construction, and the presence of offshore structures, due to the potential impacts of these IPFs on submerged landforms, marine businesses (fishing and recreational), views of WTGs, and subsistence fishing.

**Air emissions:** Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice communities. However, environmental justice communities near ports could experience disproportionate air quality impacts, depending upon the ports that are used. The Proposed Action's contributions to increased air emissions at the ports of Atlantic City, Paulsboro Marine Terminal in New Jersey; Portsmouth Marine Terminal, City of Portsmouth in Virginia; and the Port of Corpus Christi, Nueces and San Patricio Counties, in Texas (Figure 3.6.4-1 and Figure 3.6.4-2), which are predominantly environmental justice communities, are not specifically evaluated; however, as stated in Section 3.4.1, overall air emissions impacts would be minor during Proposed Action construction and installation, O&M, and decommissioning, with the greatest quantity of emissions produced in the WTA and by vessels transiting from ports to the WTA. Construction of the Proposed Action would primarily use ports within the geographic analysis area that could be used for offshore wind staging and shipping (Atlantic City (Atlantic County), Paulsboro Marine Terminal, and Repauno Port and Rail Terminal (Gloucester County) and New Jersey Wind Port (Salem County) in New Jersey; Portsmouth Marine Terminal (City of Portsmouth) in Virginia); and the Port of Corpus Christi (Nueces and San Patricio Counties) in Texas. Of those ports, only the New Jersey Wind Port (Salem County) is sited in an area where environmental justice community prevalence of pre-existing health conditions is at or below the state average rate. Increased short-term and variable emissions from Proposed Action construction and installation, O&M, and conceptual decommissioning could have negligible to moderate disproportionate, adverse impacts on the communities near the ports of Atlantic City and Paulsboro in New Jersey, Portsmouth Marine Terminal in Virginia, and the Port of Corpus Christi in Texas depending on whether VOC and HAP levels around environmental justice communities reach concerning levels; and negligible disproportionate, adverse impacts on the communities near the other ports.

Net reductions in air pollutant emissions resulting from the Proposed Action alone would result in long-term benefits to communities (regardless of environmental justice status) by displacing emissions from fossil-fuel-generated power plants. As explained in Section 3.4.1, by displacing fossil fuel power generation, once operational, the Proposed Action would result in annual avoided emissions of 3,536 tons of $NO_X$, 250 tons of $PM_{2.5}$, 4,170 tons of $SO_2$, and 6,484,000 tons (5,882,155 metric tons) of $CO_2e$ (COP Volume II, Table 3.1-7; Atlantic Shores 2024). Estimates of annual avoided health effects would range from 243.3 to 550.5 million dollars in health benefits and 22 to 50 avoided mortality cases (Section 3.4.1, Table 3.4-5). Minority and low-income populations are disproportionately affected by emissions from fossil fuel power plants nationwide and by higher levels of air pollutants. Therefore, the Proposed Action alone could benefit environmental justice communities by displacing fossil fuel power-generating capacity within or near the geographic analysis area. The Proposed Action, in addition to ongoing and planned offshore wind projects, could benefit environmental justice communities to a greater extent by displacing more fossil fuel power-generating capacity within or near the geographic analysis area.

**Cable emplacement and maintenance:** Offshore cable emplacement for the Proposed Action would temporarily affect commercial and for-hire fishing businesses, marine recreation, and subsistence fishing during cable installation and infrequent maintenance (see the *Land disturbance* IPF for onshore cable emplacement). As noted in Sections 3.6.1 and 3.6.3, installation of the Proposed Action's cables would have short-term, localized, negligible to minor impacts on marine businesses (commercial fishing or recreation businesses). Atlantic Shores is planning to implement a local workforce hiring program, and support local workforce initiatives targeted at environmental justice and disadvantaged communities to reduce any adverse employment impacts from Project activities (EJ-01, EJ-03 Appendix G, *Mitigation and Monitoring,* Table G-1). Installation and construction of offshore components (cable placement, seabed profile alterations, sediment deposition, and cable protection mattress and rock placement) for the Proposed Action could therefore have a short-term, minor impact on low-income workers in marine businesses. As shown in Figure 3.6.4-10, there are a number of fishing access sites near environmental justice communities, and two are within 1 mile (approximately 2,503 feet [763 meters] and 4,888 feet [1,490 meters]) of the Larrabee cable landfall. Near the Atlantic City landfall, there are also several fishing access sites, all three of which are greater than 1 mile away (approximately 8,218 feet [2,505 meters], 9,100 feet [2,774 meters], and 11,434 feet [3,485 meters]). These environmental justice communities may experience short-term variable disturbance and space-use conflicts during cable installation; however, short-term impacts are anticipated to be negligible. Following cable installation, no prolonged disturbance or space use conflicts are anticipated, and long-term impacts are anticipated to be negligible.

**Land disturbance:** As shown on Figure 3.6.4-1, the existing Larrabee onshore substation and the O&M facility in Atlantic City are adjacent to neighborhoods that meet environmental justice criteria. The proposed locations for the Cardiff cable route and O&M facility are primarily in medium- and high-intensity developed areas and contain urban development and forest (COP Volume II, Figure 7.5-1; Atlantic Shores 2024). The Larrabee onshore cable route and substation are also adjacent to environmental justice communities (Figure 3.6.4-1). The proposed location for the Larrabee onshore substation and cable route contains urban development and forest (COP Volume II, Figure 7.5-1; Atlantic Shores 2024). Construction of the onshore export cable route, which is also adjacent to environmental justice communities, would temporarily disturb neighboring land uses through construction noise, vibration, and dust and other air emissions, and cause delays in travel along the affected roads, but would have only short-term, variable, moderate impacts on environmental justice communities. The proposed onshore export and interconnection cables would be located on existing ROWs and previously disturbed areas to the extent practicable (COP Volume I, Sections 4.8.3, 7.5.2, and 7.5.3; Atlantic Shores 2024). Atlantic Shores would install Project infrastructure to avoid disproportionate impacts on environmental justice and disadvantaged communities (EJ-02 Appendix G, Table G-1). During operation and conceptual decommissioning, impacts from land disturbance are determined to be negligible to minor.

**Noise:** Noise from Proposed Action construction (primarily pile driving) could temporarily affect fish and marine mammal populations, hindering fishing and sightseeing near construction activity within the WTA, which could discourage some businesses from operating in these areas during pile driving (see Sections 3.6.1 and 3.6.8). This would result in a localized, short-term, negligible impact on low-income jobs supported by these businesses, as well as on subsistence fishing.

Noise generated by the Proposed Action's staging operations at ports would potentially affect environmental justice communities if the port is near such communities. The Proposed Action would use port facilities at Atlantic City, Paulsboro Marine Terminal in New Jersey; Portsmouth Marine Terminal in the City of Portsmouth in Virginia;, or the Port of Corpus Christi in Nueces and San Patricio Counties in Texas, during construction and installation, O&M, and conceptual decommissioning, which are predominantly environmental justice communities. These ports have other industrial and commercial sites, as well as major roads, which generate ongoing noise. Therefore, noise from the Proposed Action alone would have short-term, variable, minor impacts on environmental justice communities near the ports. The noise impacts from increased port utilization would increase if a port is used for more than one offshore wind project. Onshore Project construction activities are planned to be scheduled to fall within local noise ordinances (EJ-05, Appendix G, Table G-1).

**Port utilization:** The Proposed Action would require port facilities for berthing, staging, and loadout. Air emissions and noise generated by the Proposed Action's activities would potentially affect environmental justice communities during construction, operation, and conceptual decommissioning at ports in or near these communities, including Atlantic City, New Jersey Wind Port, Paulsboro Marine Terminal, and Repauno Port and Rail Terminal in New Jersey; Portsmouth Marine Terminal, City of Portsmouth, in Virginia, and Port of Corpus Christi, Nueces and San Patricio Counties, in Texas (see discussions in Section 3.6.4.3, *Impacts of Alternative B – Proposed Action*, under the *Air emissions* and *Noise* IPFs). The Proposed Action would potentially have a minor beneficial impact on environmental justice from port utilization due to greater economic activity and increased employment at the ports in the geographic analysis area, primarily during construction and decommissioning and to a lesser extent during operations. Atlantic Shores is planning to implement a local workforce hiring program, and support local workforce initiatives targeted at environmental justice and disadvantaged communities to reduce any adverse employment impacts from Project activities (EJ-01, EJ-03, Appendix G, Table G-1).

**Presence of structures:** The Proposed Action's establishment of offshore structures, including up to 200 WTGs, up to 10 OSSs, and hardcover for cables, would result in both adverse and beneficial impacts on marine businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) and subsistence fishing. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for subsistence fishing, tour boats, and for-hire recreational fishing businesses. Impacts would result from navigational complexity within the WTA, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hardcover, leading to possible equipment loss and limiting certain commercial fishing methods. Overall, during construction and installation, O&M, and conceptual decommissioning, the offshore structures for the Proposed Action alone would have minor to moderate impacts on marine businesses (Sections 3.6.1, 3.6.3, and 3.6.8), resulting in long-term, continuous, negligible to minor impacts on environmental justice populations due to the impact on low-income workers in marine industries and low-income residents who rely on subsistence fishing. Atlantic Shores is planning to implement a local workforce hiring program, and support local workforce initiatives targeted at environmental justice and disadvantaged communities to reduce any adverse employment impacts from Project activities (EJ-01, EJ-03, Appendix G, Table G-1). Atlantic Shores expects to hire local workers to the extent practicable for non-specialized skilled labor (COP Volume II, Section 7.2.2.2; Atlantic Shores 2024). Hiring locally could reduce the impacts on environmental justice populations if doing so results in job opportunities for low-income or minority populations, but it is not anticipated to reduce the overall impact level.

### *Impacts of the Connected Action*

As described in Chapter 2, *Alternatives,* bulkhead repair and/or replacement and maintenance dredging activities have been proposed as a connected action under NEPA, per 40 CFR 1501.9(e)(1). The bulkhead site and dredging activities are in-water activities that would be conducted entirely within an approximately 20.6-acre (8.3-hectare) site within Atlantic City's Inlet Marina area, specifically Farley's Marina Fuel and Clam Creek. The connected action includes construction of a new 541-foot (165-meter) bulkhead to replace the existing and deteriorating 250-foot (76-meter) bulkhead. Additionally, the connected action will include maintenance dredging at the site. Atlantic Shores is proposing to implement the construction of the new bulkhead and the City of Atlantic City would complete the maintenance dredging at the site.

BOEM expects the connected action to affect environmental justice through the following primary IPFs.

**Land Disturbance:** The proposed construction activities could result in localized, temporary disturbance to environmental justice communities near the construction site. The connected action is anticipated to have temporary and minor impacts on environmental justice communities due to land disturbance.

**Noise:** Noise from the operation of construction equipment and associated vehicle traffic could result in impacts on environmental justice by increasing the noise levels of surrounding areas. Noise from the connected action would have temporary and minor impacts on environmental justice.

### *Cumulative Impacts of Alternative B – Proposed Action*

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

The most impactful IPFs of the Proposed Action in addition to ongoing activities, and planned activities would include higher levels of air emissions and noise at port facilities, as well as the presence of offshore structures that would affect navigation, commercial fishing, and visual resources. Beneficial economic effects would result from port utilization and reduction in air emissions, resulting from displacement of fossil fuel electricity generation. Impacts are characterized by onshore and offshore activities during each period of the Project (construction and installation, operations and maintenance, and conceptual decommissioning).

**Air emissions:** As noted in Appendix D, other offshore wind projects using ports within the geographic analysis area for environmental justice populations would overlap with the Project's operations phase, and short-term air quality impacts during the construction and operation phases would be likely to vary from negligible to moderate significance levels. The incremental impacts contributed by the Proposed Action to the cumulative air quality impacts on environmental justice populations from ongoing and planned activities including planned offshore wind would likely be noticeable, and negligible to moderate, due to short-term emissions near ports.

**Cable emplacement and maintenance:** Specific offshore cable locations associated with planned offshore wind projects have not been identified within the geographic analysis area with the exception of the Ocean Wind 1 and Atlantic Shores South Project cables. The cable routes of Ocean Wind 1 and the Proposed Action have similar routes to their respective Ocean City and Monmouth County landfalls, which would add to the cumulative impacts from cable emplacement and maintenance on environmental justice communities. The uncertain offshore cable routes associated with the other planned offshore wind activities would likely have some impact on environmental justice communities due to changes in subsistence fishing and employment; however, due to the lack of information on routes, those impacts cannot be determined. The Proposed Action would require export cables that would cross 441 miles (710 kilometers), while interarray cables could cross a maximum total cable length of 547 miles (880 kilometers) (Appendix D, Table D.A2-1). The incremental impacts contributed by the Proposed Action to the cumulative offshore cable emplacement impacts on environmental justice populations from ongoing and planned activities including planned offshore wind would likely be noticeable, short term, and minor during construction and installation, O&M, and conceptual decommissioning, resulting from the impact on subsistence fishing and employment, and income from marine businesses.

**Land disturbance:** The Proposed Action's onshore land disturbance activities are not anticipated to overlap in location with other offshore wind projects. If land disturbance overlaps with planned offshore wind projects, the contribution of the Proposed Action to the cumulative onshore land disturbance impacts on environmental justice populations from ongoing and planned activities would likely be noticeable, short term, variable, and moderate.

**Noise:** Depending upon the specific ports selected to support construction and installation, noise from the Proposed Action, in combination with ongoing and planned activities, would have a variable, short-term, minor impact on environmental justice communities. The incremental impacts contributed by the Proposed Action to the cumulative noise impacts on environmental justice populations would be noticeable and minor, based on the assessment of potential impacts of pile driving on boating, fisheries, and marine mammals.

**Port utilization:** The incremental impacts contributed by the Proposed Action to the cumulative port utilization impacts would be noticeable and negligible to minor, due to emissions and noise generated from port activity.

**Presence of structures:** The Proposed Action's offshore structures are anticipated to negatively impact navigation through the geographic analysis area (see Section 3.6.6 for additional details), reduce the available area for commercial fishing (see Section 3.6.1 for additional details), and cause visual impacts (see Section 3.6.9 for additional details) for environmental justice communities. The incremental impacts contributed by the Proposed Action to the cumulative navigation, commercial fishing, and visual impacts on environmental justice populations from ongoing and planned activities including planned offshore wind would likely be noticeable, long term, and minor.

### *Conclusions*

**Impacts of Alternative B – Proposed Action.** During installation of the onshore cables and substation, the IPFs associated with the Proposed Action alone would result in minor impacts on environmental justice communities due to air emissions and noise at ports and onshore construction sites. During both construction and operations, the impacts on low-income employees of marine industries and supporting businesses (air quality, commercial fishing, support industries, marine recreation, and tourism) from all

IPFs would range from negligible to moderate. The moderate impacts would result from activities causing air quality and land disturbance impacts. Minor beneficial impacts would result from long-term reductions in air emissions that historically disproportionately impact environmental justice communities. In summary, BOEM anticipates that the Proposed Action would have overall **minor to moderate adverse** impacts and **negligible to minor beneficial** impacts on all environmental justice populations.

BOEM expects that the connected action alone would have minor adverse impacts on environmental justice populations due to land disturbance and noise activities.

**Cumulative Impacts of Alternative B – Proposed Action.** Impacts resulting from individual IPFs on environmental justice populations from ongoing and planned actions, including the Proposed Action, would be moderate. Impacts on environmental justice communities near ports and onshore construction areas due to air emissions and noise would be minor. Impacts on low-income employees of marine industries and supporting businesses (commercial fishing, support industries, marine recreation and tourism) would be minor, based upon the anticipated temporary disruption of marine activities due to offshore cable installation and construction noise, and increased vessel traffic during construction, as well as long-term impacts on the marine-dependent businesses resulting from the long-term presence of offshore structures. Potentially beneficial impacts on environmental justice populations would result from port utilization and increased vessel traffic, and the resulting employment and economic activity. Beneficial impacts could also result if wind energy displaces fossil fuel energy generation in locations that improve air quality and health outcomes for environmental justice populations, and would range from **minor** to **moderate beneficial** (Section 3.4.1).

BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with impacts from ongoing and planned actions including planned offshore wind, would be noticeable and **moderate**. The main drivers for the impact ratings are the long-term, minor impacts associated with the presence of offshore structures, which affect marine-dependent businesses (commercial fishing, for-hire recreational fishing, boat tours and other marine recreational businesses) that may hire low-income workers. The Proposed Action would contribute to the overall impact rating primarily through the same IPFs. The overall impact rating is also supported by anticipated negligible to minor impacts from air emissions and noise, minor impacts from offshore construction-related noise and cable emplacement, and construction-related vessel traffic, which would be short term and variable, but not DHAI.

#### 3.6.4.7 Impacts of Alternatives C, D, E, and F on Environmental Justice

**Impacts of Alternatives C, D, E, and F.** The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative C, D, E, or F would be similar to those described under the Proposed Action. The onshore impacts of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts, E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) on environmental justice communities would be the same as those of the Proposed Action for all impacts except for land disturbance, and noise derived from construction. Alternative C could install fewer WTGs (up to 29 fewer WTGs), OSSs (1 fewer substation), and associated interarray cables, which would slightly reduce the construction impact footprint and installation period. The removal of these WTGs would result in a negligible reduction of impacts on visual resources from the presence of structures compared to the Proposed Action. Alternative D would reduce the number of WTGs closest to the shore for the Project, lowering the impact on visual resources from the presence of structures compared to the Proposed Action. Alternative E would alter the layout of the WTGs through the exclusion or micrositing of up to 5 WTGs, which could lower the impact on visual resources from the presence of structures compared to the Proposed Action. Alternative F would either use monopile and piled jacket, suction bucket, or gravity-based foundations.

The offshore impacts of Alternatives C, D, E, and F on environmental justice communities would be similar to those of the Proposed Action for all impacts during construction and installation, O&M, and conceptual decommissioning except for noise, and vehicle traffic derived from construction. Alternative C could install fewer WTGs (up to 29 fewer WTGs), OSSs (1 fewer substation), and associated interarray cables, which would slightly reduce the construction impact footprint and installation period. The removal of these WTGs would result in a negligible reduction of impacts on visual resources compared to the Proposed Action. Alternative D would alter the number of these WTGs to reduce visual impacts. Alternative E would modify the wind turbine array layout through the creation of a 0.81-nautical mile (1,500-meter) to 1.08-nautical mile (2,000-meter) setback between WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) and Ocean Wind 1 Lease Area (OCS-A 0498). This setback would be an improvement to vessel navigation and SAR considerations over no separation between lease areas. This setback would allow for the transit of larger fishing vessels through the WTA and address navigational safety concerns as recommended by USCG. The setback could potentially reduce gear entanglements and loss as well as allisions, and recreational fishing may see a slight decrease due to fewer structures providing reef habitat for targeted species. Fewer vessels and vessel trips would be expected, which would reduce the risk of discharges, fuel spills, and trash in the area. Alternative F’s different foundation types could influence fish aggregation due to the “reef effect,” potentially increasing recreational fishing.

**Cumulative Impacts of Alternatives C, D, E, and F.** The contribution of Alternative C, D, E, or F to the impacts of individual IPFs from ongoing and planned activities would be similar to those of the Proposed Action. The cumulative impacts on environmental justice populations from ongoing and planned activities in combination with Alternative C, D, E, or F would be similar to the level as described under the Proposed Action.

### *Conclusions*

**Impacts of Alternatives C, D, E, and F.** The **minor to moderate adverse** impacts and **negligible to minor beneficial** impact associated with the Proposed Action would not change substantially under Alternatives C, D, E, and F. The impacts associated with Alternatives C, D, E, and F would be slight improvements over the Proposed Action’s impacts, but the impact level would not change.

**Cumulative Impacts of Alternatives C, D, E, and F.** The impacts resulting from individual IPFs associated with ongoing and planned activities including Alternatives C, D, E, and F would be the same as those of the Proposed Action. Impacts on environmental justice communities are expected to be noticeable and to be moderate adverse and minor to moderate beneficial. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternatives C, D, E, and F when each combined with ongoing and planned activities including planned offshore wind would likely be **moderate adverse** and **minor to moderate beneficial**.

### 3.6.4.8 Proposed Mitigation Measures

No measures to mitigate impacts on environmental justice have been proposed for analysis.

### 3.6.4.9 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F from air emissions, land disturbance, lighting, cable emplacement, noise, and traffic would be similar to those of the Proposed Action, ranging from negligible to moderate adverse and minor adverse to minor beneficial (related to the presence of structures). The Proposed Action and alternatives could negatively impact environmental justice communities during construction and installation, but be localized and short term. During operations, the presence of offshore structures would increase navigational complexity in the Lease Area, and scour and cable protection could increase the risk of gear entanglement or loss, and difficulty with anchoring (Section 3.6.1). Beneficial impacts on environmental justice would result from the reef effect (providing additional locations for recreational for-hire fishing trips) and sightseeing attraction of offshore wind energy structures supporting local economies (Smythe et al. 2020) and generating employment for low-income communities, who are employed by the coastal service industry.

By installing fewer structures, Alternative C would slightly reduce the construction impact footprint and installation period. By altering the number of WTGs, Alternative D would reduce negative visual impacts. By modifying the wind turbine layout through the exclusion of WTG positions to create a setback between WTGs in the Atlantic Shores South Lease Area and the Ocean Wind 1 Lease Area, Alternative E would improve vessel navigation and safety for recreational fishing vessels in the WTA. Alternatives C, D, and E could also reduce gear entanglements and loss as well as allisions. There would be fewer vessels and vessel trips, reducing the risk of discharges, fuel spills, and trash in the area and decreasing the risk of collision with marine mammals and sea turtles. However, the presence of fewer structures could reduce reef habitat for targeted species, decreasing recreational fishing in the area.

By using different foundation structures, Alternative F could either encourage or discourage fish aggregation due to the “reef effect,” potentially increasing or decreasing recreational fishing in the area.

### 3.6.4.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the

1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical miles (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative would include up to 195 WTGs,[2] up to 10 OSSs, up to 1 permanent met towner, up to 4 temporary meteorological and oceanographic (metocean) buoys (up to 3 metocean buoys in Project 1, 1 metocean buoy in Project 2), interarray and interlink cables, 2 onshore substations and/or converter stations, 1 O&M facility, and up to 8 transmission cables making landfall at two New Jersey locations: Sea Girt and Atlantic City. All permanent structures must be located in the uniform grid spacing and the total number of permanent structures constructed (WTGs, OSSs, and met tower) would not exceed 197.

The **minor to moderate adverse** impacts and **negligible to minor beneficial** impacts to environmental justice associated with the Proposed Action would not change substantially under the Preferred Alternative. The Preferred Alternative would include a reduction in the number of WTGs compared to the Proposed Action and would modify the wind turbine array layout, reducing impacts on existing ocean uses, such as commercial and recreational fishing and marine navigation. This would lessen the potential impacts on both subsistence, commercial, and recreational fishing and navigation; however, the impact level would not change. Accordingly, impacts of the Preferred Alternative alone would remain the same as for the Proposed Action.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and connected action, would result in similar impacts as the Proposed Action: **moderate adverse** and **minor to moderate beneficial**.

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[2] 195 WTGs assumes that 197 total positions are available and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

## 3.6.5 Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.6.5-1, includes Atlantic City (Atlantic City Harbor), Howell Township, City of Pleasantville, Borough of Sea Girt, Borough of Manasquan, Wall Township, and Egg Harbor Township, New Jersey; and municipal boundaries surrounding ports in Salem and Gloucester Counties, New Jersey; City of Norfolk, Virginia; and San Patricio and Nueces Counties, Texas, that may be used for the Project. In addition, Atlantic Shores proposes to construct an O&M facility in Atlantic City, New Jersey. These areas encompass locations where BOEM anticipates impacts associated with proposed onshore facilities and ports.

### 3.6.5.1 Description of the Affected Environment and Future Baseline Conditions

Existing land use within the geographic analysis area is diverse, including water, wetlands, barren land, forest, urban, and agricultural land uses (Howell Township 2016; Atlantic County GIS 2019a). The Project includes two proposed landing sites. The Atlantic ECC would landfall on a parcel of land that is currently used as a public parking lot bounded by Pacific, South Belmont, and South California Avenues within Atlantic City, New Jersey. Export cables may also make landfall within the roadway on South Iowa Avenue, located one block to the southeast of the parcel sited adjacent to South California Avenue (COP Volume I, Section 4.7; Atlantic Shores 2024). The Monmouth ECC would landfall at the U.S. Army NGTC, located within the Borough of Sea Girt in Monmouth County, New Jersey (COP Volume I, Section 4.7; Atlantic Shores 2024).

The proposed location for the Atlantic Landfall Site and the proposed Atlantic City O&M facility is on land zoned as resort commercial development, designated by Atlantic County (Atlantic County GIS 2019a). The proposed location for the Monmouth Landfall Site is on land zoned for public/government use (GovPilot 2022). The proposed location of the onshore substations and/or converter stations at the existing Cardiff Substation is located on land zoned for commercial use, and the land on which the existing Larrabee Substation POI is located is zoned for special economic development (Atlantic County GIS 2019a, 2019b). Commercial areas are conditionally designated for industrial and office parks and must be buffered from residential areas (Township of Egg Harbor 2002). Special economic development areas are areas where highway and rail infrastructure are readily available and are designated for utility, construction, and commercial uses (Township of Howell 2011). Areas immediately adjacent to the Onshore Project area are zoned as residential, commercial, and recreational (Atlantic County GIS 2019a).

In the vicinity of the Onshore Project area, the existing land use includes public beaches; boardwalks; multi- and single-family homes; and office, retail, and event spaces (Atlantic County GIS 2019a). Proposed onshore cable corridors for the Cardiff Onshore Interconnection Cable Route are sited in Atlantic County. All proposed onshore export and interconnection cable route segments would be within medium- and high-intensity developed areas.

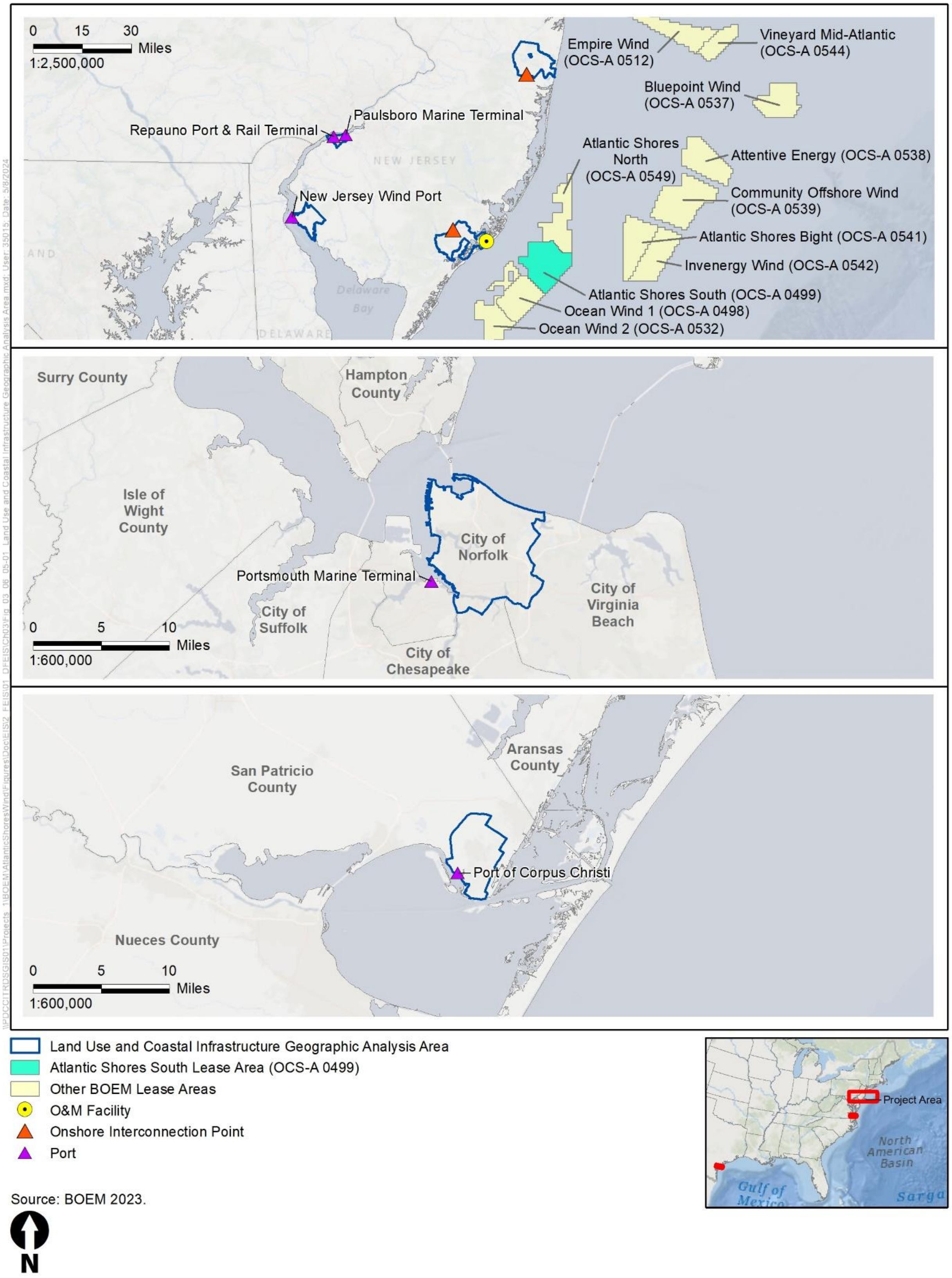


**Figure 3.6.5-1. Land use and coastal infrastructure geographic analysis area**

The existing land use within the Monmouth Onshore Project area is predominantly medium-intensity developed land (Monmouth County 2015). The Monmouth Landfall is located within the Borough of Sea Girt at the NGTC and sited in medium- and high-intensity developed areas, within low-intensity and open space developed areas (COP Volume II, Section 7.5.3; Atlantic Shores 2024). Proposed onshore cable corridors for the Larrabee Onshore Interconnection Cable Route are in Monmouth County. All proposed onshore export and interconnection cable route segments would be within medium- and high-intensity developed areas.

The proposed site for the Cardiff onshore substation and/or converter station is in Egg Harbor Township, New Jersey; it encompasses approximately 20 acres (8 hectares) and is bordered by Fire Road (County Road 651) to the north and Hingston Avenue to the south. The Cardiff onshore substation and/or converter station site is within medium- and high-intensity developed areas and contains urban development and forest (COP Volume II, Figure 7.5-1; Atlantic Shores 2024). The Cardiff POI would be located on a parcel that is currently a vacant lot zoned for commercial uses (Atlantic County GIS 2019b; COP Volume II, Section 7.5.2; Atlantic Shores 2024).

The proposed sites for the onshore substation and/or converter station for Larrabee are in Howell Township, New Jersey. The potential Lanes Pond Road onshore substation and/or converter station site is zoned as Agricultural Rural Estate 2 and 3 within medium-intensity developed areas (Howell Township 2016), which does not permit construction, utilities, and other industrial uses (Township of Howell 2011); the potential Randolph Road onshore substation and/or converter station site is zoned as Special Economic Development and Agricultural Rural Estate 2, which permits construction, utilities, and other industrial uses (Township of Howell 2011); the potential Brook Road onshore substation and/or converter station site is zoned as Special Economic Development, which permits construction, utilities, and other industrial uses (Township of Howell 2011). The Larrabee POI would be sited on a parcel that is an existing and active electrical substation (COP Volume II, Section 7.5.3; Atlantic Shores 2024).

In addition to the landfall locations, onshore substations and/or converter stations, and the O&M facility, the Project would use various ports for construction and installation and O&M. The ports under consideration for construction and installation include New Jersey Wind Port, Paulsboro Marine Terminal, Portsmouth Marine Terminal, Repauno Port and Rail Terminal, and Port of Corpus Christi. Four of the five construction ports are also anticipated for O&M activities (the Port of Corpus Christi is not included). Land use surrounding New Jersey Wind Port falls primarily within medium- and high-intensity developed land and is zoned as industrial district (New Jersey Economic Development Authority 2020). The Paulsboro Marine Terminal is surrounded by land zoned as the marina industrial business park (Borough of Paulsboro 2010). Portsmouth Marine Terminal is characterized by land zoned as industrial and is surrounded by land zoned as light industrial and urban residential (City of Portsmouth 2022). Repauno Port and Rail Terminal (formerly Dupont) Port of Wilmington falls primarily within medium- and high-intensity developed land and is zoned as a manufacturing district, surrounded by land zoned as residential and manufacturing (Gloucester County 2022). The Port of Corpus Christi falls primarily within medium- and high-intensity developed land, with light and heavy industrial uses along the shipping channel and professional office space, other commercial uses, public open spaces, and low-density residential uses along the Corpus Christi Bay (City of Corpus Christi 2016).

### 3.6.5.2 Impact Level Definitions for Land Use and Coastal Infrastructure

This Final EIS uses a four-level classification scheme to characterize potential impacts of the Proposed Action, as shown in Table 3.6.5-1. See Section 3.3, *Definition of Impact Levels,* for a comprehensive discussion of the impact level definitions.

**Table 3.6.5-1. Impact level definitions for land use and coastal infrastructure**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | Adverse impacts on area land use would not be detectable. |
| | Beneficial | Beneficial impacts on area land use would not be detectable. |
| Minor | Adverse | Adverse impacts would be detectable but would be short term and localized. |
| | Beneficial | Beneficial impacts would be detectable but would be short term and localized. |
| Moderate | Adverse | Adverse impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change. |
| | Beneficial | Beneficial impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change. |
| Major | Adverse | Adverse impacts would be detectable, long term, and extensive, and result in permanent land use change. |
| | Beneficial | Beneficial impacts would be detectable, long term, and extensive, and result in permanent land use change. |

### 3.6.5.3 Impacts of Alternative A – No Action on Land Use and Coastal Infrastructure

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

#### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for land use and coastal infrastructure in the geographic analysis area described in Section 3.6.5.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities, particularly related to onshore development activities and port improvement projects (Appendix D, Sections D.2.13 and D.2.6, respectively). The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and zoning regulations. See Appendix D, Table D.A1-11 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for land use and coastal infrastructure. There is one ongoing offshore wind activity within the geographic analysis area for land use and coastal infrastructure: Ocean Wind 1 in Lease Area OCS-A 0498. Ocean Wind 1 is planning on upland improvements, including office and warehouse, which are being reviewed and authorized by USACE and state and local agencies (Ocean Wind 2022).

The geographic analysis area is highly developed, and most construction projects would likely affect land that has already been disturbed from past development, although some development of undeveloped land may also occur. Several development plans are set to commence within the geographic analysis area, including the development of student housing, residential buildings, supermarkets, and other infrastructure in Atlantic City (Jackson 2022). Some of these projects would build on land that is currently undeveloped or on land currently designated for parking. Ports in the geographic analysis area would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs.

### *Cumulative Impacts of Alternative A – No Action*

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

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on land use and coastal infrastructure during construction and installation, O&M, and decommissioning of the projects.

BOEM expects planned offshore wind development activities to affect land use and coastal infrastructure through the following primary IPFs.

**Accidental releases:** Accidental releases of fuel, fluids, or hazardous materials may increase because of planned offshore wind activities. Accidental release risks would be highest during construction and installation, but still pose a risk during O&M and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. Accidental releases could result in restrictions on use of affected properties during the cleanup process; however, the impacts would be localized and short term. The exact extent of impacts would depend on the locations of landfall, substations, and cable routes, as well as the ports that support offshore wind energy projects. The impacts of accidental releases on land use and coastal infrastructure would be minor (except in the case of very large spills that affect a large land or coastal area).

**Land disturbance:** Construction and installation of onshore substations and/or converter stations, O&M facilities, landfalls, buried onshore export cables, and overhead or underground transmission connections to the regional power grid for planned offshore wind projects would cause land disturbance in the geographic analysis area. Land disturbance for installation of landfalls and buried export cables would be short term, with areas restored to preexisting conditions following construction. Construction and installation of new aboveground infrastructure such as onshore substations and/or converter stations and O&M facilities could result in the long-term conversion of land from existing conditions to use for electric power generation and transmission. BOEM expects that disturbed areas not occupied by new facilities would be revegetated or otherwise stabilized for erosion control in compliance with stormwater permits for general construction. Impacts on land use and coastal infrastructure from land disturbance would be minor because impacts would be localized and short term.

**Lighting:** Aviation warning lights on offshore WTGs would be visible from some beaches and coastlines within the geographic analysis area. Visibility would depend on distance from shore, topography, atmospheric conditions, and whether ADLS technology is implemented (COP Volume I, Section 5.3; Atlantic Shores 2024). Nighttime lighting for construction and decommissioning of landfalls, onshore export cables, and interconnection cables could disrupt existing uses on adjacent properties. These impacts would be localized and short term. Nighttime lighting from operation of onshore substations and/or converter stations, O&M facilities, and port facilities could disrupt existing or planned uses on adjacent properties, depending on the specific location of these facilities, the land use and zoning of adjacent properties, and the extent of visual screening incorporated into the design of planned offshore wind facilities. Given the existing level of development in the geographic analysis area and that facilities would be sited consistent with local zoning regulations, BOEM anticipates the impact of facility lighting would be minor.

**Noise:** Offshore wind projects would generate noise, primarily associated with onshore cable trenching and substation construction. Noise from offshore wind construction activities is not expected to reach the geographic analysis area. This IPF may affect land use if noise levels influence business activity or residents' and visitors' decisions on where to visit or live. Ongoing noise from human activity (e.g., transportation, construction projects) occurs frequently in populated areas in the mid-Atlantic. The intensity and extent of noise from construction is due to clearing, grading, excavation, and trenchless cable installation, but impacts are local and short term. Noise from onshore construction activity is anticipated to be similar to noise from other ongoing construction projects in the geographic analysis area and would be temporary in duration, so impacts would be negligible.

**Port utilization:** Ports and navigation channels leading to Repauno Port and Rail Terminal, Paulsboro Marine Terminal, Port of Wilmington, and New Jersey Wind Port would be improved to support planned offshore wind projects and other uses (see Appendix D, Section D.2.6 and Section D.2.13). These improvements would occur within the boundaries of existing port facilities or repurposed industrial facilities, would be similar to existing activities at the ports, and would support state strategic plans and local land use goals for the development of waterfront infrastructure. Therefore, ports would experience long-term major beneficial impacts from greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind.

To meet the demand from planned offshore wind projects, the City of Atlantic City is completing a marina upgrade, namely dredging in the marina and at Absecon Inlet (NJDOT 2021). BOEM expects that ports would experience long-term major beneficial impacts on land use and coastal infrastructure from greater economic activity and increased employment due to increased utilization of ports for planned offshore wind projects. State and local agencies would be responsible for minimizing the potential adverse impacts of these planned port expansions through zoning regulations and permitting of planned improvements.

**Presence of structures:** Planned offshore wind projects would add onshore substations and/or converter stations, O&M facilities, and overhead or underground transmission connections to the regional power grid. Improvements to coastal infrastructure such as bulkheads or marinas could also be made to support planned offshore wind activities. BOEM expects that onshore export cables would generally be buried and would not introduce aboveground structures to the geographic analysis area for land use and coastal infrastructure. Onshore substations and/or converter stations, O&M facilities, and overhead electric power transmission lines would be sited consistent with local zoning regulations and ordinances. Given the existing level of development in the geographic analysis area and that facilities would be sited consistent with local zoning regulations, BOEM anticipates the addition of onshore infrastructure for planned offshore wind would have minor impacts on land use. Improvements made to coastal infrastructure such as bulkheads or marinas to support planned offshore wind activities would have moderate beneficial impacts on land use and coastal infrastructure.

**Traffic:** Offshore wind projects could result in increased road traffic and congestion that may affect land use and coastal infrastructure because traffic volumes may dictate where residents and businesses choose to locate. Onshore construction of cables for offshore wind projects would likely disrupt road traffic for a short period of time. Occasional, temporary traffic delays would result from repairs and maintenance. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for offshore wind energy projects and traffic management plans developed with local governments. Traffic impacts on land use and coastal infrastructure are anticipated to be negligible.

### *Conclusions*

**Impacts of Alternative A – No Action.** Under the No Action Alternative, land use and coastal infrastructure would continue to be affected by existing environmental trends.

BOEM expects ongoing activities to have continuing temporary and permanent impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure are accidental releases, nighttime lighting of onshore construction activity and structures, port utilization and expansion, viewshed impacts of offshore structures, presence of onshore infrastructure, and land disturbance, noise, and traffic from construction. BOEM anticipates that the impacts as a result of ongoing activities associated with the No Action Alternative, especially onshore and coastal commerce, industry, and construction projects, would have **negligible to minor adverse** impacts and **minor beneficial** impacts in the geographic analysis area. Accidental releases and land disturbance could have short-term adverse impacts on local land uses but, overall, ongoing use and development sustains the region's diverse mix of land uses and provides support for continued maintenance and improvement of coastal infrastructure.

**Cumulative Impacts of Alternative A – No Action**. BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area, would result in overall **minor adverse** impacts and **moderate to major beneficial** impacts. Adverse impacts would be due to the short-term and localized land disturbance, traffic and lighting impacts, as well as the long-term presence of structures. Beneficial impacts would be due to port utilization and the presence of structures. Offshore wind would adversely affect land use through land disturbance (during installation of onshore cable and substations), accidental releases during onshore construction, and traffic (depending on landfall locations, onshore routes, and time of year), as well as through the presence of offshore lighting on wind energy structures and views of the structures themselves that could affect the use and value of onshore properties. Beneficial impacts on land use and coastal infrastructure would result because the development of offshore wind would support the productive use of ports and related infrastructure designed or appropriate for offshore wind activity (including construction and installation, O&M, and decommissioning).

#### 3.6.5.4 Relevant Design Parameters and Potential Variances in Impacts

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

- The time of year during which construction occurs. Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). If Project construction were to occur during this season, impacts on roads and land uses during the busy tourist season would be exacerbated.

Changes to the turbine design capacity would not alter the maximum potential impacts on land use and coastal infrastructure for the Proposed Action and other alternatives because the capacity or number of turbines would not affect onshore infrastructure or port utilization.

Atlantic Shores has committed to measures to minimize impacts on land use and coastal infrastructure by developing crossing and proximity agreements with utility owners prior to utility crossings, complying with NJDEP and applicable local government noise regulations, and implementing a construction schedule to minimize onshore construction activities during the peak summer recreation and tourism season (COP Volume II, Section 7.7.10 and Section 7.3.2.4; Atlantic Shores 2024).

#### 3.6.5.5 Impacts of Alternative B – Proposed Action on Land Use and Coastal Infrastructure

The Proposed Action would affect land use and coastal infrastructure in the geographic analysis area through the following IPFs.

**Accidental releases:** Accidental releases of fuel, fluids, or hazardous materials could occur during staging and assembly of Project components at ports, or during construction and installation, O&M, and possible decommissioning of landfalls and onshore export cables (COP Volume I, Section 6.2.6; Atlantic Shores 2024). Atlantic Shores would develop and implement a SWPPP, SPCC Plan, and OSRP to manage accidental spills or releases of oil, fuel, or hazardous materials during construction, O&M, and decommissioning of the Project (GEO-08, GEO-16, and WAT-09; Appendix G, *Mitigation and Monitoring,* Table G-1). The SPCC Plan, which is under development by Atlantic Shores, will include a discussion of mitigation for nearby residents and receptors. Should accidental releases occur, there could be temporary restrictions placed on the use of affected properties during the cleanup process. Accordingly, accidental releases from the Proposed Action alone would have localized, short-term, negligible to minor adverse impacts on land use.

**Land disturbance:** The Proposed Action would construct one onshore substation and/or converter station and the Cardiff POI for the Atlantic ECC and one onshore substation and/or converter station and the Larrabee POI for the Monmouth ECC. The Proposed Action also includes an O&M facility in Atlantic City, New Jersey. Atlantic City Harbor is in a developed area zoned for marine commercial use (Atlantic County GIS 2019a); therefore, construction, O&M, and decommissioning of an onshore substation and/or converter station and O&M facility at Atlantic City Harbor would have minor adverse impacts on land use and coastal infrastructure due to land disturbance.

Construction and installation, O&M, and decommissioning of the Proposed Action landfalls and onshore export cable and interconnection cables would result in temporary land disturbance during construction, maintenance, and decommissioning activities. To minimize disturbance, Atlantic Shores is planning to use HDD for installation of export cable landfalls at the Atlantic Landfall Site and the Monmouth Landfall Site for the Cardiff Onshore Interconnection Cable Route and Larrabee Onshore Interconnection Cable Route, respectively, and would site proposed onshore export and interconnection cables in existing ROWs and previously disturbed areas to the extent practicable (LAN-03 and LAN-04; Appendix G, Table G-1). If the onshore interconnection cable route would cross sensitive resources, trenchless installation such as HDD, jack and bore, or pipe jacking would be used to minimize impacts (GEO-15, WAT-08, Appendix G, Table G-1). Once construction is completed, areas of temporary disturbance would be returned to pre-construction conditions, and at the onshore substations and/or converter stations, land would be appropriately graded, graveled, or grassed to prevent future erosion (LAN-03; Appendix G, Table G-1).

The Cardiff onshore substation and/or converter station would be on an approximately 20-acre (8-hectare) vacant parcel, and impacts on land use from land disturbance at the facility would be negligible (COP Volume I, Section 4.9.1; Atlantic Shores 2024). The Larrabee onshore substation and/or converter station would be on a maximum 100-acre (40.5-hectare) parcel (the Brook Road parcel) (COP Volume I, Section 4.9.1; Atlantic Shores 2024). Modifications for the Cardiff onshore substation and/or converter station could require removal of up to approximately 18 acres (7.3 hectares) of trees, and modifications for the Larrabee onshore substation and/or converter station could require removal of up to 14 acres (5.7 hectares) of trees at the potential Lanes Pond Road Site or Randolph Road Site (COP Volume I, Table 4.9-1; Atlantic Shores 2024). Tree clearing and other site preparation activities at the potential Brook Road Site would be performed by the SAA-awardee (or the designated lead state or federal agency, as appropriate) as part of the development under the SAA and is thereby not included as part of the Proposed Action.

Atlantic Shores would implement measures to avoid and minimize impacts resulting from land disturbance, including fully restoring disturbed areas, limiting construction beyond existing disturbed areas, implementing erosion and sediment control plans, and conducting site-specific mitigation (LAN-05 and LAN-09; Appendix G, Table G-1). Given the nature of the existing conditions of the Onshore Project areas; Atlantic Shores' commitment to measures to avoid and reduce impacts related to land disturbance, and the temporary nature of construction, BOEM expects that the adverse impacts on land use and coastal infrastructure from land disturbance would range from negligible to minor.

**Lighting:** Aviation warning lights on offshore WTGs would be visible from beaches and coastlines within the geographic analysis area. Visibility from a specific viewpoint would depend on distance from shore, topography, and atmospheric conditions. Atlantic Shores would implement an ADLS on WTGs to activate a hazard lighting system in response to detection of nearby aircraft, subject to confirmation of commercial availability, technical feasibility, and agency review and approval (COP Volume I, Section 5.3; Atlantic Shores 2024). With an ADLS, the synchronized flashing of the navigational lights would only occur when aircraft are present, resulting in substantially reduced night sky impacts. BOEM does not expect that intermittent nighttime lighting of WTGs offshore would affect existing land uses onshore given the extent of high- and medium-intensity developed areas present within the geographic analysis area.

Nighttime lighting for construction and decommissioning of Proposed Action landfalls, onshore export cables, and interconnection cables could disrupt existing uses on adjacent properties. These impacts would be localized and short term. BOEM does not expect that nighttime lighting from operation of the proposed onshore substation and/or converter stations; Cardiff and Larrabee POIs; and Atlantic City O&M facility would have adverse effects on existing land uses because these facilities are proposed in commercial or economic development zoning districts that are designated for heavy industry. Atlantic Shores would incorporate lighting reduction measures (i.e., only at nighttime during repairs or detailed inspections) into the design for the onshore substations and/or converter stations to reduce lighting impacts to the extent practicable (COP Volume II, Section 5.2.5; Atlantic Shores 2024) and use vegetative screening, as needed, to screen views of the onshore substation and/or converter station by nearby residents (COP Volume II, Section 5.2.3; Atlantic Shores 2024). With implementation of these measures, BOEM expects that modifications to the Cardiff and Larrabee onshore substations and/or converter stations would have negligible impacts on existing land use due to lighting. Overall, lighting impacts on land use and coastal infrastructure would range from negligible to minor adverse.

**Noise:** The Proposed Action would comply with NJDEP noise regulations and local noise regulations, to the extent practicable, to minimize impacts on nearby communities (COP Volume II, Sections 4.7.1 and 8.1.5; Atlantic Shores 2024). Typical construction equipment ranges from a generator or refrigerator unit at 73 A-weighted decibels (dBA) at 50 feet (15 meters) to an impact pile driver at 101 dBA at 50 feet (15 meters). As the Proposed Action would be built 8.7 miles (14 kilometers) offshore, noise effects from offshore construction noise would be short term and negligible. At a distance of 1,000 feet (305 meters), the sound pressure is on the order of 50 dBA, a level lower than normal conversation (NYSERDA 2013). In this case, operational noise from the offshore WTGs would not be audible onshore. New Jersey Administrative Code 7:29 limits noise from industrial facilities at residential property lines to 50 dBA during nighttime and 65 dBA during daytime. Temporarily increased noise levels during onshore construction may affect local sensitive receptors (such as religious locations, recreational areas, schools, and other places that are particularly sensitive to construction) but would be minimized through BMPs and would not change existing land uses.

**Port utilization:** Atlantic Shores would enter into short-term or long-term lease agreements for use of WTG component staging and construction at New Jersey Wind Port, Paulsboro Marine Terminal, Portsmouth Marine Terminal, Repauno Port and Rail Terminal, and Port of Corpus Christi. To meet the planned demand of the Proposed Action and other planned offshore wind projects, many port entities have plans to upgrade or further develop port facilities in support of the burgeoning offshore wind industry. For instance, the New Jersey Economic Development Authority, on behalf of the State of New Jersey, is constructing an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County, approximately 7.5 miles (12.1 kilometers) southwest of the city of Salem (New Jersey Wind Port 2021). The Delaware River Channel dredging project will improve port access to the New Jersey Offshore Wind Port, Paulsboro Marine Terminal, and Repauno Port and Rail Terminal. Additionally, the State of New Jersey announced a $250 million investment in a manufacturing facility to build steel components for offshore wind turbines at the Paulsboro Marine Terminal on the Delaware River in New Jersey (State of New Jersey 2020). Construction of the facility began in January 2021, with production anticipated to begin in 2023. A channel deepening project at the Port of Virginia is currently underway in Norfolk Harbor and Newport News, Virginia, and is anticipated to be completed in 2024, which will improve port access to the Portsmouth Marine Terminal (USACE 2019). Atlantic Shores has proposed to use a Marine Coordinator to manage any increase in vessel movements during Project construction, O&M, and decommissioning (LAN-01, Appendix G, Table G-1).

BOEM expects that ports would experience long-term major beneficial impacts from greater economic activity and increased employment due to increased utilization of ports for WTG fabrication, staging, and assembly, as well as through increased demand for vessel maintenance services, vessel berthing, loading and unloading, warehousing, capital investment for improvements such as repairs to existing bulkheads/docks, and other business activity related to offshore wind.

Overall, the construction and installation, O&M, and decommissioning of the Proposed Action alone would have moderate beneficial impacts on land use and coastal infrastructure due to port utilization by supporting designated uses and infrastructure improvements in Atlantic City, New Jersey.

**Presence of structures:** Portions of the proposed offshore structures could be visible from certain coastal and elevated areas of the geographic analysis area mainland, depending upon vegetation, topography, and atmospheric conditions. At its closest point, offshore structures would be approximately 8.7 statute miles (14 kilometers) from the coastal viewers, which would be within the predominant focus of visual attention (COP Volume II, Section 5.2.3; Atlantic Shores 2024). The view of these WTGs would not result in changes to land use or zoning.

The Proposed Action would construct an onshore substation and/or converter station along each of the Cardiff and Larrabee interconnection cable routes (COP Volume I, Section 4.9; Atlantic Shores 2024). The

Proposed Action also includes establishing an O&M facility in Atlantic City, New Jersey, that would consist of an office space, warehouse space, harbor area and quayside, a communications antenna, and an outdoor area and parking (COP Volume I, Section 5.5; Atlantic Shores 2024). Construction of the O&M facility would also include repairs to existing docks and installation of new dock facilities (COP Volume II, Section 7.5.2; Atlantic Shores 2024). Construction, building the O&M facility, and ongoing O&M in Atlantic City, New Jersey, would be consistent with existing land use and zoning, which is within a marine commercial zoning district (Atlantic County GIS 2019a). The Atlantic ECC would landfall on a parcel of land that is currently used as a public parking lot bounded by Pacific, South Belmont, and South California Avenues within Atlantic City. Export cables may also make landfall within the roadway on South Iowa Avenue, located one block to the southeast of the parcel sited adjacent to South California Avenue (COP Volume I, Section 4.7; Atlantic Shores 2024). The Monmouth ECC would landfall at the Monmouth Landfall Site, located within the Borough of Sea Girt in Monmouth County, New Jersey, at the NGTC (COP Volume I, Section 4.7; Atlantic Shores 2024).

The proposed Cardiff cable route onshore substation and/or converter station site would be located at a vacant lot on approximately 20 acres (8 hectares) and bordered by Fire Road (County Road 651) and Hingston Avenue in Egg Harbor Township (COP Volume I, Section 4.9.1; Atlantic Shores 2024). The facility is not within a designated floodplain or other flood hazard area nor does the site contain wetland resources. The site is zoned for commercial and industrial uses, and surrounding land uses are characterized by a mixture of urban development and forests.

The proposed Larrabee cable route onshore substation and/or converter station would be located at one of three potential sites in Howell Township, New Jersey. The Lanes Pond Road Site would be approximately 16.3 acres and located at the southeast intersection of Lanes Pond Road and Miller Road. The Randolph Road Site would be approximately 24.7 acres and located east of Lakewood Farmingdale Road and north of Randolph Road. The Brook Road Site would be located west of Brook Road and south of Randolph Road, and is expected to be prepared and developed as part of the State of New Jersey's SAA to support multiple offshore wind generation projects that the state will procure in the future (State of New Jersey 2023). If Atlantic Shores does not receive the award to utilize the Brook Road Site, Atlantic Shores would utilize either the Lanes Pond Road or the Randolph Road Site.

Considering no long-term change in land use is required to use the proposed Cardiff and Larrabee onshore substation and/or converter station sites, BOEM expects that construction, O&M, and decommissioning of the Cardiff and Larrabee cable route onshore substations and/or converter stations, and the Cardiff and Larrabee POIs would have minor adverse impacts on existing land use at the site and negligible impacts on surrounding land uses.

Because onshore export cable and interconnection cable would be buried and utilize existing ROWs and previously disturbed areas to the extent practicable (LAN-03 and LAN-04, Appendix G, Table G-1; COP Volume II, Section 7.5; Atlantic Shores 2024), BOEM expects that construction and installation, O&M, and possible decommissioning of onshore export cable and interconnection cables would have no long-term effects on land use or coastal infrastructure related to the presence of structures.

**Traffic:** Cable installation within the roadway can result in temporary traffic impacts such as lane closures, shifted traffic patterns, or closed roadways with temporary detours. The Cardiff onshore Interconnection Cable Route is expected to be approximately 12.4 to 22.6 miles (20 to 36.4 kilometers) in length, and the Larrabee Onshore Interconnection Cable Route is expected to be approximately 9.8 to 23 miles (15.8 to 37 kilometers) (Atlantic Shores 2024). BMPs and traffic plans would be developed and coordinated with local and state agencies, and the Project would adhere to a construction schedule that avoids major tourism seasons (such as from May to September) (LAN-08 and ONS-03, Appendix G, Table G-1; COP Volume II, Section 7.3.2.4; Atlantic Shores 2024). Traffic impacts would be limited to the immediate construction area. Roadways would be returned to pre-construction conditions, and changes to the existing land use would not result (COP Volume I, Section 4.8.3; Atlantic Shores 2024). Atlantic Shores proposes to designate signage, police details, lane closures, and detours to minimize potential impacts (COP Volume I, Section 4.8.3; Atlantic Shores 2024). Therefore, anticipated traffic impacts on land use and coastal infrastructure would be minor adverse.

#### *Impacts of the Connected Action*

As described in Chapter 2, *Alternatives,* as part of the Proposed Action, an O&M facility would be constructed in Atlantic City, New Jersey, on a site previously used for vessel docking or other port activities. Construction of the O&M facility would involve construction of a new building and potentially an associated parking structure, repairs to the existing docks, and installation of new dock facilities. Independently of the Proposed Action, Atlantic Shores is pursuing a USACE Nationwide Permit 13 to install an approximately 541-foot (165-meter) bulkhead composed of corrugated steel sheet pile. The final design and scope of proposed activities, including dimensions, areas, volumes, construction methodologies, mitigation measures, and other details are subject to change following ongoing design work and permit review and approval. Final details will be included in the approved permit. Bulkhead repair and/or installation, as well as maintenance dredging in coordination with Atlantic City's dredging of the adjacent basins, would be conducted regardless of the construction and installation of the Proposed Action. However, the bulkhead and dredging are necessary for the use of the O&M facility included in the Proposed Action. Therefore, the bulkhead and dredging activities are considered to be a connected action and are evaluated in this section.

The connected action would affect land use and coastal infrastructure in the geographic analysis area through the port utilization IPF.

**Port utilization:** The connected action would facilitate in activating a retired marine terminal into an O&M facility to support the offshore wind industry, thereby resulting in an increase in port utilization. Impacts from port utilization associated with the connected action are expected to be localized and short term.

Implementation of the connected action would provide long-term, moderate beneficial impacts on port utilization from greater economic activity and increased employment in Atlantic City, New Jersey, for an O&M facility, as well as through increased demand for vessel maintenance services, vessel berthing, loading and unloading, warehousing, capital investment for improvements, and other business activity related to offshore wind.

### *Cumulative Impacts of Alternative B – Proposed Action*

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

**Accidental releases:** The Proposed Action would contribute incrementally to the cumulative potential for accidental releases from ongoing and planned activities, including offshore wind projects. The increased risk of (and thus the potential impacts from) accidental releases of fuel, fluids, or hazardous materials in the geographic analysis area would result in localized, short-term, negligible to minor adverse impacts on land use and coastal infrastructure.

**Land disturbance:** The Proposed Action would contribute a noticeable increment to the cumulative land disturbance impacts on land use and coastal infrastructure, which are anticipated to be localized and short term and minor.

**Lighting:** The Proposed Action would contribute a noticeable increment to the cumulative lighting impacts, which would introduce additional sources of nighttime lighting to the geographic analysis area and would result in localized, short-term, negligible to minor impacts on land use and coastal infrastructure.

**Noise:** Construction of planned offshore wind projects within the geographic analysis area would be required to comply with the same or similar noise regulations as the Proposed Action, and noise levels are anticipated to be similar to noise levels from other ongoing activities. The incremental impacts contributed by the Proposed Action to the cumulative noise impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind are anticipated to be localized, short term, and minor.

**Port utilization:** The Proposed Action would contribute a noticeable increment to the cumulative port utilization impacts from ongoing and planned activities, including the connected action, which would have major beneficial impacts on land use and coastal infrastructure due to increased port utilization and resulting economic activity.

**Presence of structures:** The Proposed Action would contribute a noticeable increment to cumulative presence of structures impacts on land use and coastal infrastructure, which are anticipated to be minor adverse. Assuming that new substations for offshore wind projects would be in locations designated for industrial or utility uses, and underground cable conduits would primarily be co-located with roads or other utilities, operation of substations and cable conduits would not affect the established and planned land uses for a local area.

**Traffic:** The incremental impacts contributed by the Proposed Action to cumulative traffic impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind are anticipated to be localized and short term and minor.

*Conclusions*

**Impacts of Alternative B – Proposed Action.** In summary, BOEM anticipates that impacts on land use and coastal infrastructure from the Proposed Action alone would range from **negligible to minor adverse** with **moderate beneficial** impacts. The overall impact is anticipated to be **minor**. The Proposed Action would have moderate beneficial impacts resulting from port utilization by supporting designated uses and infrastructure improvements in Atlantic City, New Jersey; negligible to minor impacts resulting from land disturbance during onshore installation of the cable route and onshore converter stations and/or substations; and resulting from accidental spills. Noise and traffic from onshore construction would have localized, short-term, minor impacts on land use and coastal infrastructure due to traffic and noise impacts being similar to ongoing activities.

BOEM expects that the connected action alone would have moderate beneficial impacts on land use and coastal infrastructure due to port utilization.

**Cumulative Impacts of Alternative B – Proposed Action.** The incremental impacts contributed by the Proposed Action to the cumulative impacts on land use and coastal infrastructure would range from negligible to minor adverse and negligible to moderate beneficial impacts. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities would result in **minor adverse** impacts and **major beneficial** impacts on land use and coastal infrastructure in the geographic analysis area because while detectable, adverse impacts would be short term and localized. The main drivers for this impact rating are the minor adverse impacts on land disturbance, based upon the return of disturbance to pre-construction conditions, as well as short-term and localized impacts from traffic and lighting and the major beneficial impacts of port utilization. The Proposed Action would contribute to the overall impact rating primarily through short-term impacts from onshore landfall, cable, and substation and/or converter station modifications, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

### 3.6.5.6 Impacts of Alternatives C, D, E, and F on Land Use and Coastal Infrastructure

**Impacts of Alternatives C, D, E, and F.** Impacts on land use and coastal infrastructure under Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization), D (No Surface Occupancy at Select Locations to Reduce Visual Impacts), E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1), and F (Foundation Structures) would be the same as those described for the Proposed Action because these alternatives would differ only with respect to the WTG number and layout (Alternatives C, D, and E); OSS number (Alternative C); or the WTG, OSS, and met tower foundation structures (Alternative F); and would not affect construction of onshore Project components or utilization of ports. Therefore, the impacts resulting from individual IPFs associated with onshore construction and installation, O&M, and decommissioning under Alternatives D, E, and F on land use and coastal infrastructure would be the same as those of the Proposed Action and are expected to be minor adverse related to the IPFs for accidental releases, lighting, and land disturbance; minor to moderate adverse related to the presence of structures; and moderate beneficial related to port utilization.

**Cumulative Impacts of Alternatives C, D, E, and F.** The incremental impacts contributed by Alternatives C, D, E, and F to the impacts on land use and coastal infrastructure from ongoing and planned activities, including offshore wind, would be the same as those of the Proposed Action.

*Conclusions*

**Impacts of Alternatives C, D, E, and F.** Impacts of Alternatives C, D, E, and F are expected to be **minor adverse**, primarily related to the IPFs for land disturbance, noise, and traffic; and **moderate beneficial** related to port utilization.

**Cumulative Impacts of Alternatives C, D, E, and F.** Impacts from ongoing and planned activities in combination with each of these action alternatives are expected to be **minor adverse** impacts and **major beneficial** impacts. This adverse impact rating is primarily driven by land disturbance, and noise and traffic impacts associated with installation of onshore infrastructure, which would not change among alternatives. The beneficial impact rating is driven by port utilization, which would not change among alternatives.

#### 3.6.5.7 Proposed Mitigation Measures

No measures to mitigate impacts on land use and coastal infrastructure have been proposed for analysis.

#### 3.6.5.8 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F from accidental releases, lighting, port utilization, presence of structures, and land disturbance would be similar to those of the Proposed Action, ranging from minor adverse related to the IPFs for accidental releases, lighting, noise, and traffic; negligible to minor adverse related to presence of structures and land disturbance; and moderate beneficial for impacts related to port utilization.

By installing up to 17 or 31 fewer offshore structures, Alternative C and Alternative D, respectively, would reduce the impact on lighting and presence of structures. By altering the number of WTGs (Alternatives C, D, and E), or the foundation structure (Alternative F), construction of onshore Project components or utilization of ports would not be affected.

#### 3.6.5.9 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two BOEM-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical mile (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The turbine array layouts would not affect construction of onshore Project components or utilization of ports and would therefore not result in changes to impacts on land use and coastal infrastructure. The impacts resulting from onshore construction and installation, O&M, and decommissioning under the Preferred Alternative are expected to be similar to those of the Proposed Action. The impact of the Preferred Alternative is expected to result in **negligible to minor adverse** and **moderate beneficial** impacts. The overall impact is anticipated to be **minor**.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and connected action, would result in similar impacts as the Proposed Action: **minor adverse** and **major beneficial**.

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### 3.6.8 Recreation and Tourism

This section discusses potential impacts on recreation and tourism resources and activities from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown in Figure 3.6.8-1, includes the 45.1-mile (72.6-kilometer) visual analysis area measured from the borders of the WTA. The geographic analysis area includes Atlantic, Cape May, and Ocean Counties in New Jersey. The geographic analysis area was selected to coincide with the Atlantic Shores South visual analysis area corresponding to the theoretical limits of Project visibility. Section 3.6.3, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the proposed Project area.

#### 3.6.8.1 Description of the Affected Environment and Future Baseline Conditions

##### *Regional Setting*

Proposed Project facilities would be within and off the coast of New Jersey. The coastal areas support ocean-based recreation and tourist activities including boating, swimming, surfing, scuba diving, sailing, and paddle sports. As indicated in Section 3.6.3, recreation and tourism contribute substantially to the economies of New Jersey's coastal counties. More than 1.8 million people visited Island Beach, Barnegat Lighthouse, and Cape May Point state parks in 2016, while over 688,000 used the state's marinas (NJDEP 2018a). In 2019, 116 million people visited New Jersey and spent $46.4 billion, making tourism the sixth largest employer in New Jersey (Tourism Economics 2019). Annual tourism in New Jersey's coastal communities is a $16 billion industry (NJDEP 2021a).

Coastal New Jersey has a wide range of visual characteristics, with communities and landscapes ranging from large cities to small towns, suburbs, rural areas, and wildlife preserves. As a result of the proximity of the Atlantic Ocean, as well as the views associated with the shoreline, the New Jersey shore has been extensively developed for water-based recreation and tourism.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. Additionally, the visual qualities of these historic coastal towns, which include marine activities within small-scale harbors, and the ability to view birds and marine life are important community characteristics.


**Figure 3.6.8-1. Recreation and tourism geographic analysis area**

### *Project Area*

Recreational and tourist-oriented activities are concentrated in the coastal communities in Atlantic, Cape May, and Ocean Counties, which are some of the most densely populated coastal communities in the U.S. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of residents and visitors each year. Although many of the coastal and ocean amenities, such as beaches, that attract visitors to these regions are accessible to the public for free and thus do not directly generate employment, these nonmarket features function as key drivers for recreation and tourism businesses.

Water-oriented recreational activities in the Project area include boating, visiting beaches, hiking, fishing, shellfishing, and bird and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessel use to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding. Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks.

Inland recreational facilities are also popular but bear less of a relationship to possible impacts of the Project. These include inland waters such as ponds and rivers, wildlife sanctuaries, golf courses, athletic facilities, parks, and picnic grounds. Onshore construction may result in short-term and localized traffic, noise, and light around these areas, changing the recreational experience of isolated locations.

### *Coastal and Offshore Recreation*

Recreational boating and fishing activities occur along the coastline, although most fishing activity takes place in lakes, rivers, and bays, rather than in offshore waters. Swimming is also popular along the miles of white sand beaches in New Jersey (COP Volume II, Section 7.3.1; Atlantic Shores 2024). Surfing can occur year-round, with the prime season in the fall. Surfers frequent several towns and cities along the coastline, including Ocean City and Atlantic City (New Jersey Department of State 2021a). Dive sites and fishing grounds, such as artificial reefs and sunken vessels, attract recreational users to the coastline of New Jersey as well.

There is a large and robust recreational fishing industry in New Jersey. The *Fisheries Economics of the United States Report of 2019* estimates that recreational fishing had a $388 million impact on New Jersey's economy in 2019 (NOAA 2022a). Collectively, there were close to 2.0 million recreational angler trips per year (i.e., party boats, rental/private boats, and shore) made in New Jersey from 2015 to 2020 (COP Volume II, Section 7.3.1.1; Atlantic Shores 2024). There are several areas classified as Prime Fishing Areas by NJDEP, which are known fishing target locations and areas frequented by recreational fishermen, that are within the geographic analysis area (Figure 3.6.8-2).

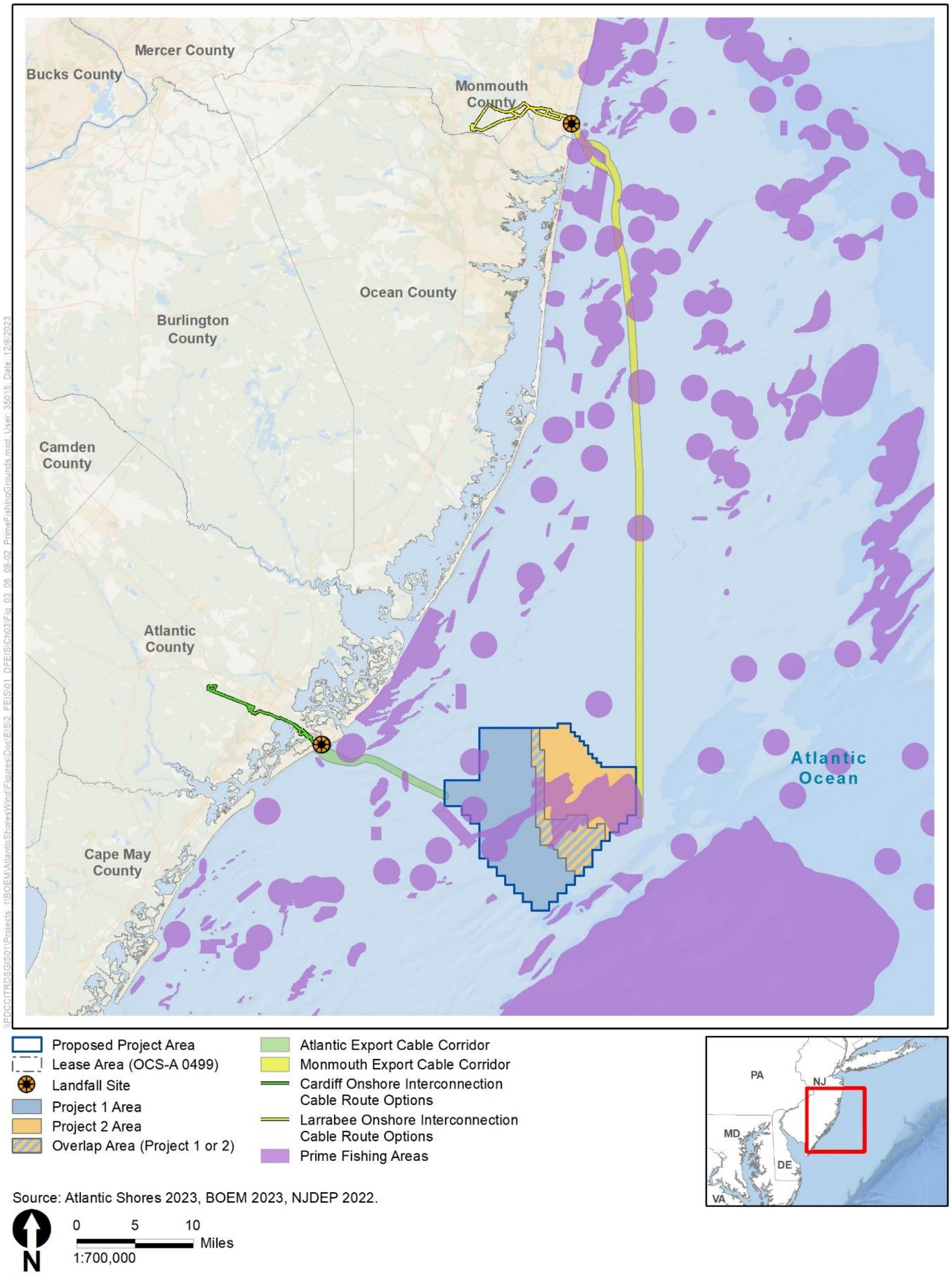


**Figure 3.6.8-2. New Jersey prime fishing areas**

Recreational fishing takes place all year; however, the number of angler trips is greatest in July and August. There are also annual recreational fishing tournaments held in coastal towns in New Jersey. Common species caught most often include striped bass, summer flounder, bluefish, and black sea bass. Most recreational fishing takes place within 3 miles (4.8 kilometers) of shore, although fishing for Atlantic Highly Migratory Species (HMS) such as federally regulated sharks, blue and white marlin (*Makaira nigricans* and *Tetrapterus albidus*), sailfish (*Istiophorus albicans*), roundscale spearfish (*Tetrapturus georgii*), and swordfish (*Xiphias gladius*) takes place farther offshore. According to NOAA Fisheries One Stop Shop database, recreational anglers off the coast of New Jersey caught 36,002,306 pounds (16,330,358 kilograms) of fish in 2017; 27,819,980 pounds (12,618,920 kilograms) in 2018; 21,344,901 pounds (9,681,876 kilograms) in 2019; 29,425,956 pounds (13,347,378 kilograms) in 2020; and 30,520,854 pounds (13,844,015 kilograms) in 2021 (NOAA n.d.).

NMFS's social indicator mapping identifies the importance or level of dependence of recreational fishing to coastal communities. Several communities in the geographic analysis area have a high recreational fishing reliance, which measures the presence of recreational fishing in relation to the population size of a community, and high recreational fishing engagement, which measures the presence of recreational fishing through fishing activity estimates. The communities within the geographic analysis area with the highest reliance on recreational fishing are Cape May, Avalon, Point Pleasant Beach, Atlantic Highlands, and Barnegat Light; Atlantic City has a low reliance on recreational fishing. Communities within the geographic analysis area with the highest recreational fishing engagement are Cape May, Avalon, Sea Isle City, Brigantine, Barnegat Light, Berkeley, Belmar, Atlantic Highlands, Point Pleasant Beach, and Ocean City; the rest of the New Jersey coast within the geographic analysis area has low or medium recreational fishing engagement. The communities with the highest recreational fishing reliance and recreational fishing engagement would be most affected by impacts on recreational fishing from offshore wind development.

Recreational crabbing is important to the region and occurs primarily along the bays and creeks on the Jersey Shore, especially in the upper portion of Barnegat Bay, Little Egg Harbor, and the Maurice River estuary, which contribute 65 to 86 percent of the total recreational harvest (NJDEP 2018b). The peak crabbing season occurs from mid-June until early October and is especially good in August.

#### *Atlantic County*

Atlantic County lies in the southern peninsula of New Jersey and encompasses approximately 556 square miles (1,440 square kilometers) of land (U.S. Census Bureau 2021c). The county is known for its boardwalk along the beach of Atlantic City, with its nine casinos with restaurants, nightclubs, and game rooms (Atlantic City 2022). The county has nine beaches, which collectively total 14 miles (23 kilometers), and 5.75 miles (9.25 kilometers) of boardwalk (Atlantic County n.d.a, n.d.b). There are several boat launches and marinas in the county, which have small recreational boat rentals. Recreational fishing is permitted on the beaches, outside of guarded areas, and from the jetties. There are also multiple fishing piers available to the public.

#### *Cape May County*

Cape May is New Jersey's southernmost county and encompasses 267 square miles (692 square kilometers) of land, receiving millions of visitors annually (Cape May County n.d.a). It is considered one of the premier beach destinations along the mid-Atlantic coast. The Ocean City Boardwalk is more than 2 miles (3 kilometers) long and is lined with shops and amusement park rides. The Wildwood Boardwalk runs from Wildwood into North Wildwood and is home to many amusement attractions (Cape May County n.d.b). Popular activities at the boardwalks include shopping, dining, amusement rides, and walking. The more remote beaches are utilized for sunbathing, swimming, and beachcombing. Surfing, sailing, boating, deep sea fishing, diving, kayaking, and whale watching are also popular offshore activities. Recreational fishing occurs along the back bays and from the surf, piers, and boats along the Jersey Cape (Cape May County n.d.c).

#### *Ocean County*

Ocean County is in the center of the Jersey Shore region, with approximately 629 square miles (1,792 square kilometers) of land (U.S. Census Bureau 2021d). The county provides an array of recreational beaches, boardwalks, marinas, and wildlife areas. Popular activities include swimming, fishing, and wildlife viewing. The boardwalks are lined with shops, restaurants, and amusement park rides. Popular coastal attractions include lighthouses, the Tuckerton Seaport, Jenkinson's Boardwalk, and annual seafood and music festivals (County of Ocean 2022).

### *Onshore Recreation*

#### *Atlantic County*

Most of the Tuckahoe-Corbin City Fish and Wildlife Management Area is within the county and consists of approximately 17,500 acres (7,082 hectares) of tidal marsh, woodlands, fields, and impoundments (NJDEP 2018c). Ten wildlife management areas totaling 55,360 acres (22,403 hectares) also fall within Atlantic County: Absecon (3,946 acres [1,597 hectares]), Cedar Lake (360 acres [146 hectares]), Great Egg Harbor River (7,552 acres [3,056 hectares]), Hammonton Creek (5,720 acres [2,315 hectares]), Makepeace Lake (11,737 acres [4,750 hectares]), Malibu Beach (257 acres [104 hectares]), Maple Lake (4,789 acres [1,938 hectares]), Pork Island (868 acres [351 hectares]), Port Republic (1,471 acres [595 hectares]), and Tuckahoe (18,660 acres [7,551 hectares]) (NJDEP 2021b).

There were 827 accommodation and food service establishments in the county in 2019. Together, these generated over $1.2 billion in annual payroll. There were 113 arts, entertainment, and recreation establishments in Atlantic County, which bring in approximately $41 million in annual payroll. Approximately 13.4 percent of all housing units in Atlantic County are for seasonal, occupational, or occasional use (U.S. Census Bureau 2021a, 2021b).

#### *Cape May County*

There are many parks, state forests, and wildlife management areas in Cape May County. The Cape May National Wildlife Refuge encompasses 11,500 acres (4,654 hectares) of grasslands, saltmarshes, and beachfront (Friends of Cape May National Wildlife Refuge 2022). The Cape May Coastal Wetlands Wildlife Management Area extends along the coast of Cape May County and occupies approximately 17,842 acres (7,220 hectares) (NJDEP 2021b).

There were 917 accommodation and food service establishments in the county in 2019. Together, these generated over $240 million in annual payroll. There were 143 arts, entertainment, and recreation establishments in Cape May County, which brought in approximately $50 million in annual payroll. Approximately 50.9 percent of all housing units in Cape May County are for seasonal, occupational, or occasional use (U.S. Census Bureau 2021a, 2021b).

#### *Ocean County*

Ocean County has 27 parks and conservation areas, with over 4,000 acres (1,619 hectares) of preserved land. Popular activities include hiking, biking, kayaking, golfing, and sightseeing (County of Ocean 2021). Sixteen wildlife management areas fall within Ocean County, including Greenwood Forest (32,353 acres [13,093 hectares]), which is partly in Burlington County (NJDEP 2021b).

The Edwin B. Forsythe National Wildlife Refuge consists of more than 47,000 acres (19,020 hectares) of coastal habitats and provides wildlife viewing and nature trails (New Jersey Department of State 2021a). The Barnegat Lighthouse State Park is located on the northern tip of Long Beach Island and provides panoramic views of Barnegat Inlet as well as trails through maritime forests, birding sites for waterfowl, fishing sites, and nature walks (New Jersey Department of State 2021b).

There were 1,292 accommodation and food service establishments in the county in 2019. Together, these generated over $342 million in annual payroll. There were 272 arts, entertainment, and recreation establishments in Ocean County, which bring in approximately $116 million in annual payroll. Approximately 6.4 percent of all housing units in Ocean County are for seasonal, occupational, or occasional use. (U.S. Census Bureau 2021a; 2021b.)

### *Visual Resources*

As discussed in Section 3.6.9, *Scenic and Visual Resources*, the Project's Lease Area would be in federal waters. At its closest point, the WTA is about 8.7 miles (14 kilometers) from the New Jersey Shoreline (COP Volume I, Section 1.1; Atlantic Shores 2024). The closest key observation point (KOP) is North Brigantine Natural Area in Atlantic County, which is approximately 9 miles (14.5 kilometers) away from the nearest project component, as shown in Table 3.6.8-1 and depicted in Figure 3.6.8-3.

**Table 3.6.8-1. Selected key observation points**

| KOP Identifier | KOP Name | Location | Distance to the Nearest WTG (miles/kilometers) |
|---|---|---|---|
| SPB01 | Seaside Park Borough Boardwalk | Seaside Park Borough, Ocean County | 39/62.8 |
| LAT01 | Edwin B. Forsythe National Wildlife Refuge at the Woodmansee Estate | Lacey Township, Ocean County | 32.2/51.8 |

| KOP Identifier | KOP Name | Location | Distance to the Nearest WTG (miles/kilometers) |
|---|---|---|---|
| LBT03 | Beach at Long Beach Island Arts Foundation | Long Beach Township, Ocean County | 24.9/40.1 |
| BRT01 | Bass River State Forest | Bass River Township, Burlington County | 18.5/29.8 |
| BHB01 | Beach Haven Historic District | Beach Haven Borough, Ocean County | 13.5/21.7 |
| LEHT02 | Great Bay Boulevard Wildlife Management Area/Rutgers Field Station | Little Egg Harbor Township, Ocean County | 11.9/19.2 |
| BC02 | North Brigantine Natural Area | Brigantine City, Atlantic County | 9/14.5 |
| AC04 | Ocean Casino Resort – Sky Garden | Atlantic City, Atlantic County | 10.5/16.9 |
| AC02 | Jim Whelan Boardwalk Hall (Atlantic City Convention Center National Historic Landmark) | Atlantic City, Atlantic County, New Jersey | 11.4/18.3 |
| MC02 | Lucy the Margate Elephant National Historic Landmark | Margate City, Atlantic County | 14.4/23.2 |
| OC04 | Gillian's Wonderland Amusement | Ocean City, Cape May County | 17.2/27.7 |
| SIC02 | Townsend Inlet Bridge | Sea Isle City, Cape May County | 27.4/44.1 |
| LT02 | Cape May Point State Park | Lower Township, Cape May County | 45/72.4 |

Source: COP Volume II, Section 5.2.1, Table 5.2.1; Atlantic Shores 2024.

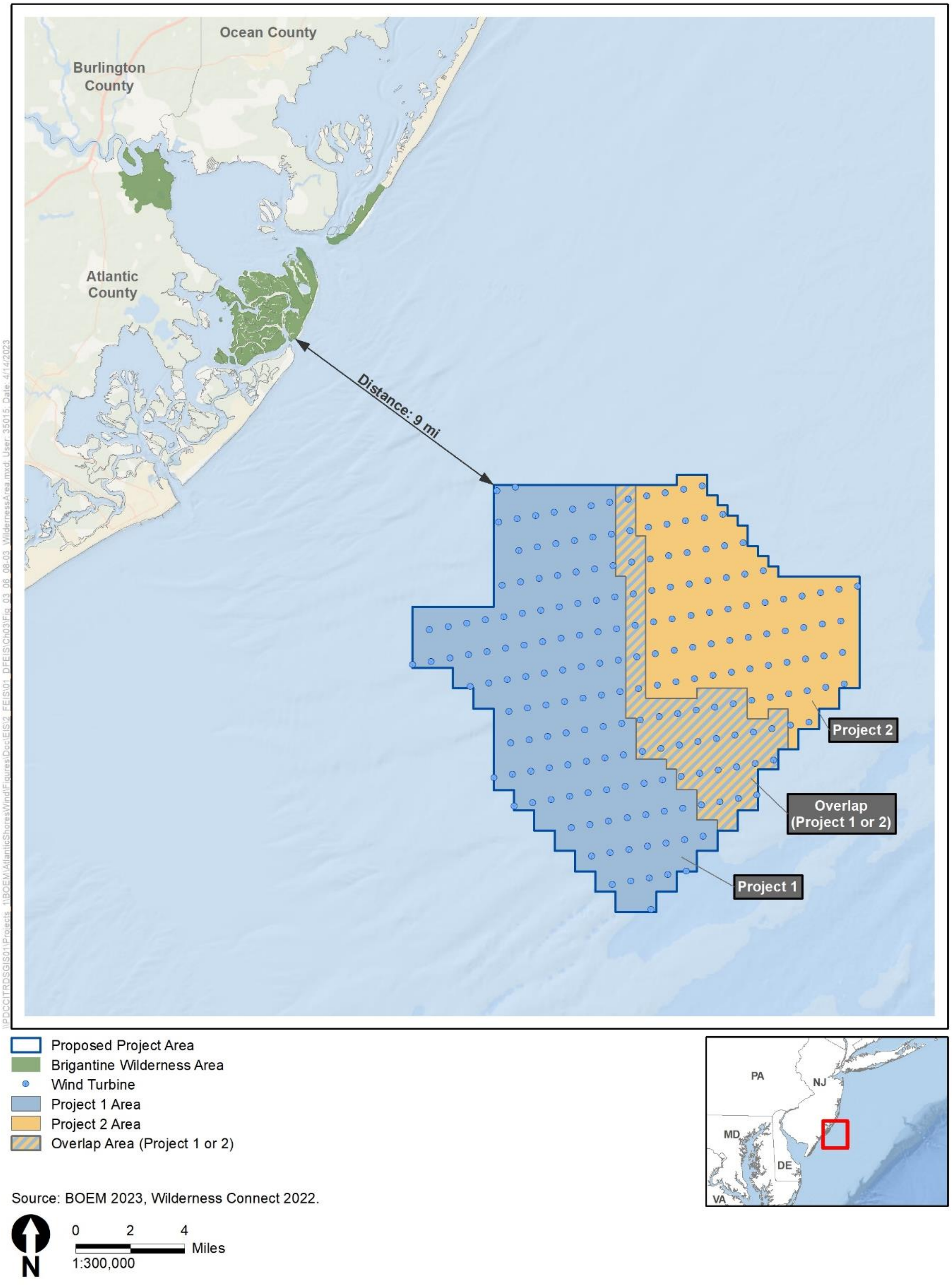


**Figure 3.6.8-3. Wind Turbine Area in relation to Brigantine National Wilderness Area**

Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and the glare of shorefront developments.

Within the 45.1-mile (72.6-kilometer) radius geographic analysis area, the distance from coastal viewpoints to the nearest Project WTG would vary from slightly more than 9 miles (15 kilometers) to nearly 45 miles (61 kilometers) (COP Volume II, Section 5.2.3; Atlantic Shores 2024). A 2013 study concluded that the predominant focus of visual attention occurs at distances up to 10 miles (16 kilometers); facilities were noticeable to casual observers at distances of almost 18 miles (29 kilometers); and were visible with extended or concentrated viewing at distances beyond 25 miles (40 kilometers) (COP Volume II, Section 5.2.3; Atlantic Shores 2024). Because the proposed Project's WTGs are approximately twice as tall as those described in the study, the WTGs would be noticeable at farther distances during clear conditions.

The landward zone of visual influence occurs within the Background zone (5–15 miles [8–24 kilometers]) or Extended Background zone (beyond 15 miles [24 kilometers]) for viewers along the coast of New Jersey (COP Volume II, Section 5.1.1; Atlantic Shores 2024). Visibility diminishes based on meteorological conditions, such as haze, fog, rain, snow, or a combination thereof. A 2020 Rutgers visibility study found that high visibility conditions occur over a period of less than 23 percent of the daylight hours in a given year (COP Volume II, Section 5.2.3; Atlantic Shores 2024).

### 3.6.8.2 Impact Level Definitions for Recreation and Tourism

As described in Section 3.3, *Definition of Impact Levels,* this Final EIS uses a three-level incremental impact and four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. The definitions of potential beneficial and adverse impact levels for recreation and tourism are provided below in Table 3.6.8.2.

**Table 3.6.8-2. Impact level definitions for recreation and tourism**

| Impact Level | Impact Type | Definition |
|---|---|---|
| Negligible | Adverse | Impacts on the recreation section, recreation opportunities, or recreation experiences would be so small as to be unmeasurable. |
| | Beneficial | No effect or measurable impact. |
| Minor | Adverse | Impacts would not disrupt the normal functions of the affected activities and communities. |
| | Beneficial | A small and measurable improvement to infrastructure/facilities and community services, or benefit for tourism. |
| Moderate | Adverse | The affected activity or community would have to adjust somewhat to account for disruptions due to the Project. |
| | Beneficial | A notable and measurable improvement to infrastructure/facilities and community services, or benefit for tourism. |
| Major | Adverse | The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the Project. |

| Impact Level | Impact Type | Definition |
|---|---|---|
| | Beneficial | A large local, or notable regional improvement to infrastructure/facilities and community services, or benefit for tourism. |

### 3.6.8.3 Impacts of Alternative A – No Action on Recreation and Tourism

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

#### *Impacts of Alternative A – No Action*

Under the No Action Alternative, baseline conditions for recreation and tourism described in Section 3.6.8.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Recreation and tourism would continue to be affected by ongoing activities, especially ongoing vessel traffic; noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, and offshore cables; and onshore development activities. These activities would contribute to periodic disruptions to recreational and tourism activities but are a typical part of daily life along the New Jersey coastline and would not substantially affect recreational enjoyment in the geographic analysis area. Visitors would continue to pursue activities that rely on the area's coastal and ocean environment, scenic qualities, natural resources, and establishments that provide services for tourism and recreation. The geographic analysis area has a strong tourism industry and abundant coastal and offshore recreational facilities, many of which are associated with scenic views. See Appendix D, Table D.A1-20 for a summary of potential impacts associated ongoing non-offshore wind activities by IPF for recreation and tourism. There is currently one ongoing offshore wind project within the geographic analysis area that could contribute to impacts on recreation and tourism: Ocean Wind 1 in Lease Area OCS-A 0498.

#### *Cumulative Impacts of Alternative A – No Action*

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

Planned non-offshore wind activities that may affect recreation and tourism include commercial fishing, emplacement of submarine cables and pipelines, dredging and port improvements, marine mineral use, and military use (see Appendix D*,* Section D.2). Like ongoing activities, other planned non-offshore wind activities may result in periodic disruptions to recreation and tourism activities along the coast. However, visitors are expected to be able to continue to pursue activities that rely on other coastal and ocean environments, scenic qualities, natural resources, and establishments that provide services to recreation and tourism.

Offshore wind projects in the geographic analysis area are ongoing within Lease Areas OCS-A 0498 (Ocean Wind 1), and planned within Lease Areas OCS-A 0532 (Ocean Wind 2), OCS-A 0549 (Atlantic Shores North), OCS-A 0538 (Attentive Energy), OCS-A 0539 (Community Offshore Wind), OCS-A 0541 (Atlantic Shores Offshore Wind Bight), OCS-A 0542 (Invenergy Wind), and OCS-A 0482 (GSOE I). These projects are estimated to collectively install up to 893 WTGs, 25 OSSs or met towers, 1,725 miles (2,776 kilometers) of submarine export cable, and 1,448 miles (2,330 kilometers) of interarray cable in the geographic analysis area between 2025 and 2030 (Appendix D, Tables D.A2-1 and D.A2-2).

BOEM expects planned offshore wind activities to affect recreation and tourism through the following primary IPFs.

**Anchoring:** Anchoring could potentially affect recreational boating in the geographic analysis area both through the presence of an increased number of anchored vessels during offshore wind construction, O&M, and decommissioning and through the creation of offshore areas with cable or scour protection where anchors of smaller recreational vessels may fail to hold.

Development of ongoing and planned offshore wind projects between 2025 and 2030 would increase the number of vessels anchored offshore. The greatest volume of anchored vessels would occur in offshore work areas during construction and installation. Vessel anchoring would also occur during O&M but at a reduced frequency. Ongoing and planned offshore wind projects would add an estimated 1,085 acres (439 hectares) of scour protection for foundations and 612 acres (248 hectares) of hard cable protection to the geographic analysis area (Appendix D, Table D.A2-2), which could create resistance to anchoring for recreational boats.

Anchored vessels for construction and installation, O&M, and decommissioning of planned offshore wind projects would have localized, intermittent, long-term impacts on recreational boating. The addition of scour and cable protection would have localized, long-term impacts on anchoring for recreational boats. BOEM expects that recreational boaters could navigate around anchored vessels and adjust the locations for dropping anchor to avoid cable and scour protection with only brief inconvenience, and impacts would be minor.

**Cable emplacement and maintenance:** Under the No Action Alternative, an estimated 1,725 miles (2,776 kilometers) of submarine export cable and 1,448 miles (2,330 kilometers) of interarray cable would be installed in the geographic analysis area between 2025 and 2030 for ongoing and planned offshore wind projects (Appendix D, Table D.A2-1). Recreational uses would be temporarily displaced from work zones during cable installation. Cable installation could also have short-term impacts on fish and invertebrates of interest for recreational fishing, due to trenching and associated underwater noise and turbidity near the work zone. The degree of temporal and geographic overlap of each cable is unknown, although cables for some projects could be installed simultaneously. Displacement of recreational activities due to cable emplacement would be short term and limited to the construction safety zones established for safe performance of the work. Displacement of recreational uses for cable maintenance during the O&M phase of each project would be short term and intermittent over the life of the project.

**Land disturbance:** Planned offshore wind development would require installation of landfalls, onshore export cable and interconnection cable, and onshore substations or converter stations and POIs, which could result in localized, short-term disturbance to recreational activity or tourism-based businesses near construction sites. BOEM expects these impacts would be localized and short term during construction, O&M, and decommissioning. The exact extent of impacts would depend on the locations of onshore infrastructure for planned offshore wind projects; however, the No Action Alternative would generally have localized, short-term, and minor impacts.

**Lighting:** Ongoing and planned offshore wind projects would add new sources of light to onshore and offshore areas, including nighttime vessel lighting and fixed lighting at onshore substations and/or converter stations and POIs and up to 893 WTGs and 25 OSSs or met towers (Appendix D, Tables D.A2-1 and D.A2-2). BOEM expects that lighting at onshore substations or converter stations and POIs would have negligible impacts on recreation and tourism. Impacts of vessel lighting would be short term for the duration that the vessel is engaged in construction, O&M, or decommissioning activities and is either anchored or transiting at night. WTGs would be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively. Impacts of lighting on WTG and OSS structures would be long term.

Aviation warning lighting required for WTGs would be visible from beaches and coastlines within the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for up to 893 WTGs (Appendix D, Table D.A2-1). The installation of these WTGs—affixed with red flashing lights mounted on opposite rear sides of the nacelle and spaced around the mast midway between the nacelle and above mean sea level within the offshore wind lease areas—would have long-term minor to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view, and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles (24.1 kilometers) from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS); however, the WTGs for the study were 574 feet tall, which is about half the height of the proposed Project's WTGs. Therefore, the visual prominence of the proposed WTGs would be greater than what is represented in the study. A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5–8 miles [8–13 kilometers]) would adversely affect the rental price of properties with ocean views (Lutzeyer et al. 2017). It did not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles (24.1 or more kilometers) from shore. More than 95 percent of the WTG positions likely to be present based on anticipated offshore wind lease area build-out in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

The New Jersey shore that is within the viewshed of planned offshore wind projects has been extensively developed. Because of the high development density, existing nighttime lighting is prevalent. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments. Visible aviation warning lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view.

In addition to recreational fishing, some recreational boating in the region involves whale watching and other wildlife viewing activity. A 2013 BOEM study evaluated the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish. The study found that existing guidelines "appear to provide for the marking and lighting of WTGs that will pose minimal if any impacts on birds, bats, marine mammals, sea turtles or fish" (Orr et al. 2013). By extension, existing lighting guidelines or ADLS (if implemented) would impose a minimal impact on recreational fishing or wildlife viewing.

As a result, although lighting on WTGs would have a continuous, long-term, adverse impact on recreation and tourism, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to the New Jersey shore and elevated areas, with less impact on the recreation and tourism industry as a whole.

An ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. Activation of ADLS, if implemented, would occur for less than 11 hours per year, as compared to standard continuous FAA hazard lighting (COP Volume II, Section 4.3.2.2; Atlantic Shores 2024). An ADLS-controlled obstruction lighting system could result in an over 99 percent reduction in system activated duration as compared to a traditional always-on obstruction lighting system (COP Appendix II-M4; Atlantic Shores 2024).

**Noise:** Noise from operation of construction equipment, pile driving, and vehicle and vessel traffic could result in adverse impacts on recreation and tourism. Onshore construction noise near beaches, parkland, recreation areas, or other areas of public interest would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Similarly, offshore construction noise would intrude upon the natural sounds of the marine environment. Construction noise could cause some boaters to avoid construction areas, although the most intense noise sources (such as pile driving) would originate within the temporary safety zones that USCG will establish for areas of active construction, which will be off-limits to boaters. BOEM conducted a qualitative analysis of impacts on recreational fisheries for the construction phases of offshore wind development in the Atlantic OCS region. Results showed the construction phase is expected to have a slightly negative to neutral impact on recreational fisheries due to both direct exclusion of fishing activities and displacement of mobile target species by construction noise (Kirkpatrick et al. 2017).

BOEM expects that the impact of noise on recreation and tourism during construction would be short term and localized. Multiple construction projects occurring simultaneously would increase the number of locations within the geographic analysis area that experience noise disruptions. The impact of noise during O&M would be localized, continuous (for operation of WTGs and OSS), and long term, with brief periods of more-intense noise during occasional repair activities.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing within the geographic analysis area. Pile driving using an impact hammer would cause the most impactful noises. Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by construction of WTGs, OSSs, and submarine cables. Recreational fishing for HMS such as tuna, shark, and marlin is more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, more likely to experience short-term impacts resulting from the noise generated by construction for planned offshore wind projects. Construction noise could contribute to short-term impacts on marine mammals, with resulting impacts on chartered tours for whale watching or other wildlife viewing. However, planned projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers) that would avoid and minimize underwater noise impacts on marine mammals.

Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals, and consequently little effect on recreational fishing or sightseeing. BOEM expects that planned offshore wind construction would result in localized, short-term, impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple, simultaneous construction projects would increase the spatial and temporal extent of short-term disturbance to marine species within the geographic analysis area. As shown in Table D.A2-1 in Appendix D, BOEM expects that up to eight offshore wind projects (not including the Proposed Action) could be under construction simultaneously in the recreation and tourism geographic analysis area in 2026. No long-term, adverse impacts are anticipated, provided that mitigation measures are implemented to prevent population-level harm to fish and marine mammal populations.

**Port utilization:** Ports within the geographic analysis area for recreation and tourism that could be used for construction and O&M of offshore wind development include the ports of Atlantic City, New Jersey; the Paulsboro Marine Terminal, Repauno Port and Rail Terminal, and the New Jersey Wind Port (Lower Alloways Creek), New Jersey. The Atlantic City port may also provide facilities for recreational vessels or may be on waterways shared with recreational marinas, and may experience increased activity, expansion, or dredging. These ports, and other regional ports suitable for staging and construction of other offshore wind development projects, are primarily industrial in character, with recreational activity as a secondary use.

Port improvements could result in short-term delays and crowding during construction but could provide long-term benefits to recreational boating if the improvements result in increased berths and amenities for recreational vessels, or improved navigational channels.

**Presence of structures:** The construction and installation of up to 893 WTGs and 25 OSSs or met towers within the recreation and tourism geographic analysis area would contribute to impacts on recreational fishing and boating (Appendix D, Tables D.A2-1 and D.A2-2). The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, planned offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects. The WTGs and OSSs installed within offshore wind lease areas are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue. On the other hand, fish aggregation could have negative impacts on recreation and tourism by causing increased natural predation and subsequent fishing effort, resulting in a decrease in fish stocks.

The presence of planned offshore wind structures would increase the risk of allision or collision with other vessels and the complexity of navigation within the geographic analysis area. Generally, the vessels more likely to allide with WTGs or OSSs would be smaller vessels moving within and near wind farm installations, such as recreational vessels. Planned offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the adverse impact of the planned offshore wind structures on recreational boating would be limited by the distance offshore. Recreational boating routes in the geographic analysis area mainly occur within 3 miles (4.8 kilometers) of the New Jersey shore (COP Volume II, Section 7.3.1.1; Atlantic Shores 2024).

The geographic analysis area would have an estimated 1,085 acres (439 hectares) of scour protection for WTG foundations and 612 acres (248 hectares) of hard cable protection (Appendix D, Table D.A2-2), which would result in an increased risk of entanglement. Accurate marine charts could make operators of recreational vessels aware of the locations of the cable protection and scour protection. If the hazards are not noted on charts, operators may lose anchors, leading to increased risks associated with drifting vessels that are not securely anchored. Lessees would engage with both USCG and NOAA in developing a comprehensive aid to navigation plan. Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Smaller commercial or recreational vessels anchoring in the offshore wind lease areas may have issues with anchors failing to hold near foundations and any scour protection. Considering the small size of the geographic analysis area compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario, it is unlikely that offshore wind activities would affect vessel-anchoring activities. Because anchoring is uncommon in water depths where the No Action Alternative WTGs would be installed, anchoring risk is more likely to be an impact over export cables in shallower water closer to coastlines. The risk to recreational boating would be localized, continuous, and long term.

Planned offshore wind structures could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The WTG and OSS structures could produce artificial reef effects (COP Volume II, Section 4.5.2.5; Atlantic Shores 2024). The "reef effect" refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat. The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters traveling farther from shore in order to fish. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. However, an increase in fish species could also lead to additional natural predation and consequently a growth in fishing effort, which could decrease fish stocks. Although the likelihood of recreational vessels visiting the offshore structures would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the offshore wind lease areas. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels.

As it relates to the visual impacts of structures, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.6.9 describes the visual impacts from offshore wind infrastructure. If the purpose of the viewer's sightseeing excursion is to observe the mass and scale of the WTGs' offshore presence, then the increasing visual dominance would benefit the viewer's experience as the viewer navigates toward the WTGs. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then the increasing visual dominance may detract from the viewer's experience.

Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism found that established offshore wind facilities in Europe did not result in decreased tourist numbers, tourist experience, or tourist revenue; that study also found that the BIWF's WTGs in Rhode Island provide excellent sites for fishing and shell fishing (Smythe et al. 2018). A survey-based study found that for prospective offshore wind facilities (based on visual simulations), proximity of WTGs to shore is correlated to the share of respondents who would expect a worsened experience visiting the coast (Parsons and Firestone 2018).

- At 15 miles (24.1 kilometers), the percentage of respondents who reported that their beach experience would be worsened by the visibility of WTGs was about the same as the percentage of those who reported that their experience would be improved (e.g., by knowledge of the benefits of offshore wind).
- About 68 percent of respondents indicated that the visibility of WTGs would neither improve nor worsen their experience.
- Reported trip loss (respondents who stated that they would visit a different beach without offshore wind) averaged 8 percent when wind projects were 12.5 miles (20 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32 kilometers) offshore.

- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

A 2019 survey of 553 coastal recreation users in New Hampshire included participants in water-based recreation activities such as fishing from shore and boats, motorized and non-motorized boating, beach activities, and surfing at the New Hampshire seacoast. Most (77 percent) supported offshore wind development along the New Hampshire coast, while 12 percent opposed it, and 11 percent were neutral. Regarding the impact on their outdoor recreation experience, 43 percent anticipated that offshore wind development would have a beneficial impact, 31 percent anticipated a neutral impact, and 26 percent anticipated an adverse impact (Ferguson et al. 2020). Similar sentiment is expected among coastal recreation users in New Jersey.

The shore areas within the viewshed of the WTGs are highly developed. Public beaches and tourist attractions in this area are highly valued for scenic, historic, and recreational qualities, and draw large numbers of daytime visitors during the summertime tourism seasons. When visible (i.e., on clear days, in locations with unobstructed ocean views), WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view.

Based on the currently available studies, portions of the up to 893 WTGs (Appendix D, Table D.A2-1) associated with the No Action Alternative could be visible from shorelines (depending on vegetation, topography, weather, atmospheric conditions, and the viewers' visual acuity). WTGs visible from some shoreline locations in the geographic analysis area would have adverse impacts on visual resources when discernable due to the introduction of industrial elements in previously undeveloped views. Based on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation would be long term, continuous, and adverse. Seaside locations could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to affect shore-based or marine recreation and tourism in the geographic analysis area as a whole. See also Section 3.6.3.

**Traffic:** Planned offshore wind project construction and decommissioning, and, to a lesser extent, planned offshore wind project operation would generate increased vessel traffic that could inconvenience recreational vessel traffic within the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the planned offshore wind construction areas. Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action, which is projected to generate an average of two to six vessel roundtrips per day collectively between construction staging port facilities under consideration and offshore construction areas (COP Volume II, Section 4.3.2.4; Atlantic Shores 2024). Two to six vessel trips per day are also expected during Project operations (COP Volume II, Section 4.7.2.1; Atlantic Shores 2024). Between 2023 and 2030, as many as eight offshore wind projects (not including the Proposed Action) could be under construction simultaneously within the geographic analysis area (Appendix D, Table D.A2-1). During such periods, assuming similar vessel counts, construction of offshore wind projects would generate an average of 550 to 2,050 annual round trips depending on whether SOVs or CTVs are used (COP Volume II, Section

7.6.2.1; Atlantic Shores 2024). If Atlantic Shores employs an SOV-based O&M strategy, those SOVs would likely be operated out of existing ports such as Lower Alloways Creek Township (New Jersey Wind Port), the Port of New Jersey/New York, or another industrial port identified in COP Volume II, Table 7.5-1 (Atlantic Shores 2024) that has suitable water depths to support an SOV.

This level of increase in vessel traffic from CTVs operating from Atlantic City would represent only a modest increase compared to the background volumes of vessel traffic in and around offshore Atlantic City, New Jersey, and BOEM expects that vessel traffic would have minor impacts on recreation and tourism in the geographic analysis area.

### *Conclusions*

**Impacts of Alternative A – No Action**. BOEM anticipates that recreation and tourism impacts as a result of ongoing activities associated with the No Action Alternative (including commercial fishing, emplacement of submarine cables and pipelines, dredging and port improvement projects, marine minerals use and ocean dredging, military use, marine transportation, and onshore development activities) would be **minor** because these are typical activities occurring along the New Jersey coastline and would not substantially affect visitor use or experience.

**Cumulative Impacts of Alternative A – No Action**. Planned offshore wind activities would have localized, short-term, minor impacts on recreation and tourism related to land disturbance, cable emplacement and maintenance, noise, and traffic. Planned offshore wind activities would have localized, long-term, minor impacts on recreation and tourism due to anchoring and lighting, and localized, long-term, **minor** adverse and minor beneficial impacts on recreation and tourism due to the presence of structures, with beneficial impacts attributed to the anticipated reef effect resulting from installation of new offshore structures. BOEM expects the combination of ongoing and planned activities including planned offshore wind to result in minor impacts on recreation and tourism.

BOEM anticipates that the cumulative impacts associated with the No Action Alternative, when combined with all other planned activities (including offshore wind) in the geographic analysis area would result in overall **minor adverse** and **minor beneficial** impacts because the short-term land disturbance, cable emplacement, noise, and traffic, as well as the long-term presence of structures, anchoring, and lighting impacts would not disrupt the normal functions of the affected activities and communities. Planned offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and cable emplacement during construction and the presence of offshore structures during operations. Noise and cable emplacement could temporarily displace recreational uses at construction sites and affect recreational fishing and sightseeing as a result of the impacts on fish, invertebrates, and marine mammals. The long-term presence of offshore wind structures would result in increased navigational complexity, potential entanglement and loss of gear, and visual impacts from offshore structures. BOEM also anticipates that the planned offshore wind activities in the analysis area would result in minor beneficial impacts due to the presence of offshore structures and cable hard cover, which could provide opportunities for fishing and sightseeing due to the reef effect.

### 3.6.8.4 Relevant Design Parameters and Potential Variances in Impacts

This Final EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following proposed PDE parameters would influence the magnitude of the impacts on recreation and tourism:

- The Project layout including the number, type, height, and placement of the WTGs and OSSs, and the design and visibility of lighting on the structures;
- Arrangement of WTGs and accessibility of the WTAs to recreational boaters; and
- The duration and time of year during which onshore and nearshore construction occurs.

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

- WTG number, size, location, and lighting: More WTGs and larger turbine sizes closer to shore could increase visual impacts that affect onshore recreation and tourism as well as recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- WTG arrangement and orientation: Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.
- Duration and timing of construction: Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season. A shorter or longer duration for construction activities would decrease or increase the time that recreational uses could be displaced from construction sites.

### 3.6.8.5 Impacts of Alternative B – Proposed Action on Recreation and Tourism

The Proposed Action would install up to 200 WTGs, up to 10 small OSSs, 5 medium OSSs, or 4 large OSSs, 1 met tower, 547 miles (880 kilometers) of interarray cable, and 441 miles (710 kilometers) of export cable in the geographic analysis area between 2025 and 2028 (Appendix D, Table D.A2-1). The proposed landfall locations are the Monmouth landfall in Sea Girt, New Jersey and the Atlantic landfall in Atlantic City, New Jersey. BOEM expects the Proposed Action to affect recreation and tourism through the following primary IPFs.

**Anchoring:** Anchoring could potentially affect recreational boating in the geographic analysis area both through the presence of an increased number of anchored vessels during offshore wind construction, O&M, and decommissioning (creating space use conflicts) and through the creation of offshore areas with cable or scour protection where anchors of smaller recreational vessels may fail to hold.

Construction of the Proposed Action between 2025 and 2028 would increase the number of vessels anchored offshore. Most construction vessels used for the Atlantic Shores South Project would maintain position using dynamic positioning, which limits the use of anchors and jack-up features. Atlantic Shores would implement safety zones around active construction sites, which would reduce the potential for interaction between recreational and tour boats with anchored construction vessels; however, safety zones would also temporarily displace those uses from the work area. Vessel anchoring would also occur during O&M but at a reduced frequency. The Proposed Action would add an estimated 289 acres (117 hectares) of scour protection for foundations and 294 acres (119 hectares) of hard cable protection to the geographic analysis area (Appendix D, Table D.A2-2), which could make anchoring more difficult for recreational boats.

Anchored vessels for construction, O&M, and decommissioning of the Proposed Action would have localized, intermittent, short-term impacts on recreational boating. The addition of scour and cable protection would have localized, long-term impacts on anchoring for recreational boats. BOEM expects that recreational boaters could navigate around anchored vessels and adjust the locations for dropping anchor to avoid cable and scour protection with only brief inconvenience, and impacts would be minor.

**Cable emplacement and maintenance:** Cable emplacement would generate vessel traffic and trenching along cable routes, creating space use conflicts and resulting in short-term disturbance to species important to recreation and tourism. Recreational and tour boats traveling near the offshore cable routes would need to navigate around vessels and access-restricted areas associated with the offshore cable installation. Atlantic Shores would regularly work with USCG to communicate these zones and other work areas to the boating public via Local Notices to Mariners (COP Volume II, Section 7.7.8; Atlantic Shores 2024). Space use conflicts with recreation and tourism related to offshore cable emplacement would result in localized, short-term, minor impacts.

Cable installation could also affect fish and marine mammals of interest for recreational fishing and sightseeing through dredging and resulting underwater noise and turbidity. Impacts of cable installation on fish and marine mammals would be localized and short term, and affected species are expected to recover upon completion of the activity, resulting in minor impacts on recreation and tourism (see Section 3.5.6, *Marine Mammals*, Section 3.5.7, *Sea Turtles*, and Section 3.6.6, *Navigation and Vessel Traffic*).

**Land disturbance:** Construction of the Proposed Action would require installation of landfalls, onshore export cable and interconnection cable, and onshore substations and/or converter stations and POIs, which could result in localized, short-term disturbance to recreational activity or tourism-based businesses near construction sites. Onshore construction activities could disrupt access to public use areas and degrade the recreational experience through establishment of restricted work zones and increases in traffic, noise, and construction emissions. Atlantic Shores would use ultra-low sulfur diesel (ULSD) fuel, which would reduce air emissions during construction (COP Volume II, Section 3.1.2.7; Atlantic Shores 2024). Shoreside recreational fishing sites may potentially be affected during cable placement activity and maintenance. Recreational fishing and related sites in proximity to the Atlantic and Monmouth onshore export cable routes include Ventnor City Fishing Pier, Brigantine South End

Beach & Jetty, and Atlantic City Jetties North & South in Atlantic County (NOAA 2022b). BOEM expects impacts of land disturbance during construction, O&M, and decommissioning would be localized and short term.

The proposed onshore substations and/or converter stations and POIs would be in predominantly high- and medium-intensity developed areas, and construction is not expected to affect recreation or tourism in the long term. Overall, BOEM expects that impacts of the Proposed Action on recreation and tourism due to land disturbance would be negligible to minor, due to the temporary nature of construction impacts and limited geographic extent of impacts related to conversion of affected properties from existing uses to a use for an electric utility.

**Lighting:** The Proposed Action would add new sources of light to onshore and offshore areas including nighttime vessel lighting and fixed lighting on up to 200 WTGs, up to 10 OSSs, 1 met tower, 2 onshore substations and/or converter stations, and 2 onshore POIs. Onshore substations and/or converter stations and POIs would be in developed areas, and BOEM expects that lighting at onshore substations and/or converter stations and POIs would have negligible impacts on recreation and tourism. Impacts of vessel lighting would be short term for the duration that the vessel is engaged in construction, O&M, or decommissioning activities and is either anchored or transiting at night. Offshore structures would be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively (REC-10; Appendix G, *Mitigation and Monitoring,* Table G-1). Lighting impacts would be long term.

Aviation warning lighting required for WTGs would be visible from beaches and coastlines within the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for the up to 200 WTGs of the Proposed Action. The installation of these WTGs affixed with red flashing lights mounted on opposite rear sides of the nacelle and spaced around the mast midway between the nacelle and above mean sea level within the offshore wind lease areas would have long-term, minor to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The New Jersey shore that is within the viewshed of the Proposed Action has been extensively developed. Because of the high development density, existing nighttime lighting is prevalent. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments. Visible aviation warning lighting would add a built visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view. Atlantic Shores plans to use an ADLS, subject to FAA and BOEM approval, which could substantially reduce the amount of time that the aviation obstruction lights are actually illuminated. An ADLS automatically activates all aviation obstruction lights when aircraft approach the WTA; at all other times, the lights are off. Atlantic Shores would implement an ADLS or similar system on WTGs as a base case, pending commercial availability, technical feasibility, and agency review and approval. The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation.

As a result, although lighting on WTGs would have a long-term impact, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to the New Jersey shore and elevated areas, with less impact on the recreation and tourism industry as a whole. Due to the distance of the Proposed Action's WTGs and OSSs from shore and potential to implement ADLS or a similar system on WTGs, BOEM expects that aviation hazard lighting for the Proposed Action would result in long-term, intermittent, minor impacts on recreation and tourism in the geographic analysis area. Lighting associated with vessel traffic and onshore substations and/or converter stations and POIs would have negligible impacts on recreation and tourism.

**Noise:** Noise from the operation of construction equipment, pile driving, and vehicle or vessel traffic could result in adverse impacts on recreation and tourism. Onshore construction noise near beaches, parkland, recreation areas, or other areas of public interest would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Atlantic Shores would implement measures such as use of mufflers, adjustable backup alarms, and noise barriers to reduce onshore construction noise (COP Volume II, Section 8.1.5; Atlantic Shores 2024). The construction schedule would be developed in accordance with municipal noise ordinances (REC-03, Appendix G, Table G-1).

Similarly, offshore construction noise would intrude upon the natural sounds of the marine environment. Construction noise could cause some boaters to avoid construction areas, although the most intense noise sources (such as pile driving) would originate within the safety zones established for areas of active construction, which would exclude recreational and tour boats. BOEM expects that the impact of noise on recreation and tourism during construction would be short term and localized. The impact of noise during O&M would be localized, continuous (for operation of WTGs and OSSs), and long term, with brief periods of more-intense noise during occasional repair activities.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing within the geographic analysis area. Pile driving using an impact hammer would cause the most impactful noises. Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by the construction of WTGs and OSSs. Recreational fishing such as for HMS including tuna, shark, and marlin is more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, more likely to experience short-term impacts resulting from the noise generated by construction within the Lease Area.

Construction noise could contribute to short-term impacts on marine mammals, with resulting impacts on chartered tours for whale watching or other wildlife viewing. Atlantic Shores would implement measures such as seasonal restrictions on construction activity to avoid months (January to April) when North Atlantic right whale densities are higher, initiation of pile driving (if used) only when it is expected that pile driving can be completed during daylight hours, and equipment operating procedures (e.g., soft starts, ramp-downs, and shut-downs) to reduce impacts of underwater noise on marine mammals (COP Volume II, Section 8.2.3; Atlantic Shores 2024). Lower levels of noise associated with cable installation activities could also affect fish species and marine mammals in the nearshore environment. Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals, and consequently little effect on recreational fishing or sightseeing.

Overall, noise generated from construction and installation, O&M, and decommissioning of the Proposed Action alone would have localized, short-term, minor impacts on recreation and tourism

**Port utilization:** Within the geographic analysis area, the Proposed Action would use an O&M facility at Atlantic City Harbor (Atlantic County) for O&M support. The Proposed Action would use several port facilities in New Jersey, Virginia, and Texas. Ports in New Jersey anticipated to be used for construction include the New Jersey Wind Port (Salem County), the Paulsboro Marine Terminal (Gloucester County), and Repauno Port and Rail Terminal (Gloucester County) (COP Volume I, Section 4.10.3, Table 4.10-2; Atlantic Shores 2024). These construction ports are outside of the geographic analysis area for recreation and tourism.

Material storage, day-to-day management of inspection and maintenance activities, vehicle parking, marine coordination, vessel docking, and dispatching of technicians would take place at the O&M facility in Atlantic City, New Jersey (COP Volume I, Section 5.5; Atlantic Shores 2024). Increased vessel traffic and construction activity at Atlantic City may result in short-term delays and crowding during construction. The Proposed Action would have a short-term, negligible impact on recreation and tourism due to port utilization within the geographic analysis area.

**Presence of structures:** The construction and installation of up to 200 WTGs, up to 10 small OSSs, 5 medium OSSs, or 4 large OSSs, and 1 met tower within the Lease Area would contribute to impacts on recreational fishing and boating. The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects. The WTGs and OSSs installed within the WTA are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue. On the other hand, fish aggregation could lead to additional natural predation and increased fishing effort, resulting in a decrease in fish stocks.

The presence of offshore wind structures would increase the complexity of navigation within the Lease Area and risk of allision (with fixed structures) or collision (with other vessels). The presence of structures within the Lease Area could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the impact on recreational boating would be limited by the distance offshore. Recreational boating routes in the geographic analysis area mainly occur within 3 miles (4.8 kilometers) of the New Jersey shore (COP Volume II, Section 7.3.1.1; Atlantic Shores 2024).

The Proposed Action would install an estimated 289 acres (117 hectares) of scour protection for foundations and 294 acres (119 hectares) of offshore export cable hard protection in the geographic analysis area (see Table D.A2-2 in Appendix D), increasing the risk of entanglement with fishing gear. Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Also, because anchoring is more common in shallower water depths, anchoring risk is more likely to have an impact over export cables in shallower water closer to coastlines. The risk to recreational boating from the addition of scour and cable protection would be localized, continuous, and long term.

Construction of new offshore structures in the Lease Area could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. Although some recreational anglers would avoid the WTA, the scour protection around the WTG foundations would likely attract forage fish as well as game fish, which could provide new opportunities for certain recreational anglers. Evidence from BIWF indicates an increase in recreational fishing near the WTGs (Smythe et al. 2018). The WTG and OSS structures are also likely to produce artificial reef effects. The "reef effect" refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat (COP Volume II, Section 4.5.2.5; Atlantic Shores 2024). The reef effect could attract species of interest for recreational fishing, resulting in an increase in recreational boaters traveling farther from shore in order to fish. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. However, an increase in fish species could also lead to additional natural predation and consequently a growth in fishing effort, which could decrease fish stocks. Although the likelihood of recreational vessels visiting the offshore structures would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the Lease Area. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels.

As it relates to the visual impacts of structures, the vertical presence of the Proposed Action's up to 200 WTGs, up to 10 OSSs, and 1 met tower on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.6.9 describes the visual impacts from offshore wind infrastructure. During construction, viewers on the New Jersey shore would see the upper portions of tall equipment such as mobile cranes. These cranes would move from WTG to WTG as construction progresses, and thus would not be long-term fixtures. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a short-term, minor impact on recreation and tourism.

The visual contrast created by the WTGs during operations could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer's values, the activity engaged in, and the purpose for visiting the area. Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism have identified variable reactions to offshore wind, with respondents having positive, neutral, or negative views of the effect that offshore wind infrastructure would have on their experience of coastal recreation (Parsons and Firestone 2018; BOEM 2021), while a study in Europe found that established offshore wind facilities did not result in decreased tourist numbers, tourist experience, or tourist revenue (Smythe et al. 2018).

Based on the impacts of the WTGs and OSSs on navigation and fishing, the potential reef effects of these structures, and the risks to anchoring and gear loss associated with scour or cable protection, the Proposed Action would have long-term, continuous, minor beneficial and minor adverse impacts on recreation and tourism.

**Traffic:** The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk along routes between ports and the offshore construction areas, and within the Lease Area during Project construction, O&M, and decommissioning. The Proposed Action is projected to generate an average of two to six vessel roundtrips per day collectively between construction staging port facilities under consideration and offshore construction areas (COP Volume II, Section 4.3.2.4; Atlantic Shores 2024). Two to six vessel trips per day are also expected during Project operations (COP Volume II, Section 4.7.2.1; Atlantic Shores 2024). The Proposed Action could generate as many as 1,705 total trips during construction and installation and 1,880 trips annually during O&M. The proposed layout was developed in close coordination with fishermen and to align with the predominant flow of vessel traffic (REC-07, Appendix G, Table G-1). A Marine Coordinator would be employed to monitor daily vessel movements, implement communication protocols with external vessels both in port and offshore to avoid conflicts, and monitor safety zones. Daily coordination meetings between contractors are expected to be held to avoid conflicting operations at port facilities and transit routes to the Offshore Project area. The Marine Coordinator would be responsible for coordinating with USCG for any required Notice to Mariners (REC-20, Appendix G, Table G-1).

If all Project construction activities were to occur simultaneously, a total of 51 vessels could be present; however, this is unlikely (COP Volume II, Section 7.6.2.1; Atlantic Shores 2024). Between 2023 and 2027 as many as eight offshore wind projects (including the Proposed Action) could be under construction simultaneously within the geographic analysis area. During such periods, assuming similar vessel counts, construction of offshore wind projects would generate an average of 550 to 2,050 annual round trips depending on whether SOVs or CTVs are used (COP Volume II, Section 7.6.2.1; Atlantic Shores 2024). CTVs are expected to operate out of the Atlantic City port. SOVs are expected to operate out of ports other than Atlantic City.

This level of increase in vessel traffic from CTVs operating from Atlantic City would represent only a modest increase compared to the background volumes of vessel traffic in and around offshore Atlantic City, New Jersey, and BOEM expects that vessel traffic would have long-term, minor impacts on recreation and tourism in the geographic analysis area.

Non-routine activities such as response to spills from maintenance or repair vessels would generally require intense, temporary activity to address emergency conditions or respond to an oil spill. Non-routine activities could temporarily prevent or deter recreation or tourist activities near the site of a given non-routine event. Atlantic Shores would develop an emergency plan in coordination with the USCG and Oil Spill Response Plan to minimize risk of sediment contamination (COP Volume II, Sections 2.1.2.2 and 7.4.4.1; Atlantic Shores 2024). A construction schedule that minimizes overlap with the tourist season and other seasonal events would be developed to ensure onshore construction activities do not occur during peak tourist season, thereby reducing impacts such as vessel traffic, noise, and other construction activity that might otherwise adversely affect communities during this time (REC-01, REC-02, Appendix G, Table G-1). With implementation of navigation-related mitigation measures, the impacts of non-routine activities on recreation and tourism would be minor.

### *Impacts of the Connected Action*

As described in Chapter 2, *Alternatives,* improvements to the existing marine infrastructure within an approximate 20.6-acre (8.3-hectare) site at the Atlantic City, New Jersey, Inlet Marina area are planned in connection with construction of the O&M facility of the Proposed Action. The connected action includes construction of a new 541-foot (165-meter) bulkhead. Additionally, the connected action would include maintenance dredging at the site. Atlantic Shores is proposing to implement the construction of the new bulkhead, regardless of whether the Proposed Action is implemented, and the City of Atlantic City would complete the maintenance dredging at the site.

BOEM expects the connected action to affect recreation and tourism through the following primary IPFs.

**Noise:** Noise from the operation of construction equipment and associated vehicle traffic could result in impacts on recreation and tourism by temporarily disturbing the natural sounds of the marine environment or the expected quiet of recreation areas. However, onshore construction would be limited to areas zoned for heavy industries that generate ongoing noise and traffic. Noise from constructing the connected action would have temporary but negligible impacts on recreation and tourism.

**Land disturbance:** The proposed construction activities could result in localized, temporary disturbance to recreation activities or tourism-based businesses near the construction site. However, the connected action is anticipated to have negligible impacts on recreation and tourism due to land disturbance.

### *Cumulative Impacts of Alternative B – Proposed Action*

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

**Anchoring:** The Proposed Action would contribute a noticeable increment to the cumulative anchoring impacts on recreational boating, which would result in localized minor impacts on recreation and tourism related to anchoring.

**Cable emplacement and maintenance:** The Proposed Action would contribute a noticeable increment to the cumulative impacts of cable emplacement and maintenance on recreational marine activities from ongoing and planned activities. The cumulative impacts would likely be minor due to the localized and temporary nature of the impacts and ability of displaced users to use alternate nearby locations during construction and installation, O&M, and decommissioning of offshore export cables. With the exception of the Ocean Wind 1 Project, specific cable locations associated with other offshore wind projects have not been identified within the geographic analysis area.

**Land disturbance:** The Proposed Action would contribute a noticeable increment to the cumulative land disturbance impacts on recreation and tourism and would result in localized, minor impacts on recreation and tourism.

**Lighting:** BOEM expects that lighting for the Proposed Action would contribute a noticeable increment to the cumulative lighting impacts from ongoing and planned activities, which would have negligible to minor impacts on recreation and tourism.

**Noise:** The Proposed Action would contribute a noticeable increment to the cumulative noise impacts on marine recreation activities from ongoing and planned activities, which would likely be minor due to the localized and temporary nature of the impacts and ability of displaced users to use alternate nearby locations during construction and decommissioning. Impacts of noise on recreation and tourism during operations would be negligible and long term.

**Port utilization:** The Proposed Action would contribute a noticeable increment to the cumulative port utilization impacts on recreation and tourism from ongoing and planned activities including offshore wind, which would be localized, long term, continuous, and negligible.

**Presence of structures:** Structures from other planned offshore wind development would generate comparable types of impacts as the Proposed Action alone. The geographic extent of impacts would increase as additional offshore wind projects are constructed, but the level of impacts considering the Proposed Action and other ongoing and planned activities would likely be the same. The Proposed action would contribute a noticeable increment to the cumulative impacts on recreation and tourism, which would range from minor beneficial (related to reef effects and recreational fishing and sightseeing opportunity) to minor adverse (related to increased navigational complexity, space use conflicts, anchoring, and gear entanglement or loss).

**Traffic:** The Proposed Action would contribute an undetectable increment to the cumulative vessel traffic impacts on recreation and tourism from ongoing and planned activities, which would be short term and minor during construction and installation and long term and minor during operations.

### *Conclusions*

**Impacts of Alternative B – Proposed Action**. In summary, the impacts resulting from individual IPFs associated with the Proposed Action alone would be minor adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor beneficial** (related to the presence of structures), resulting in an overall **minor** impact. IPFs could disrupt recreation and tourism during construction but be localized and short term, and recreation and tourism could be temporarily displaced to alternate areas. During operations, the presence of offshore structures would increase navigational complexity in the Lease Area, and scour and cable protection could increase the risk of gear entanglement or loss, and difficulty with anchoring. Beneficial impacts on recreation and tourism would result from the reef effect (providing additional locations for recreational for-hire fishing trips) and the sightseeing attraction of offshore wind energy structures.

BOEM expects that the connected action alone would have negligible impacts on recreation and tourism.

**Cumulative Impacts of Alternative B – Proposed Action**. The incremental impacts contributed by the Proposed Action to the cumulative impacts on recreation and tourism would range from undetectable to noticeable. The contribution of the Proposed Action to the cumulative impacts of individual IPFs resulting from ongoing and planned activities (including planned offshore wind) would increase the geographic extent of impacts as additional offshore wind projects are constructed, but the level of impacts considering the Proposed Action and other ongoing and planned activities would likely be the same: negligible to minor adverse (related to IPFs for anchoring due to obstacles posed by an increased number of anchored vessels during offshore wind construction, land disturbance due to the short-term impact of cable installation on recreational activity or tourism-based businesses near construction sites, lighting due to long term negligible visual impacts, cable emplacement due to disruption of species important to recreation and tourism businesses, noise due to disruption of otherwise quiet or natural-sounding conditions, and traffic due to the increased congestion recreational and tourism vessels would face); and minor adverse to minor beneficial (related to the presence of structures, as the Proposed Action's WTGs would encourage the reef effect and therefore support new marine species habitats important to recreation and tourism, but would also increase navigational complexity for recreational and tourism vessels). Considering all IPFs together, the overall impacts of the Proposed Action alone or in combination with ongoing and planned activities would likely be **minor adverse** and **minor beneficial** because the incremental impacts contributed by the Proposed Action, including noise, traffic, and long-term visual impacts, would not disrupt the normal functions of the affected activities and communities.

#### 3.6.8.6 Impacts of Alternatives C and E on Recreation and Tourism

**Impacts of Alternatives C and E**. Impacts of Alternatives C (Habitat Impact Minimization/Fisheries Habitat Impact Minimization) and E (Wind Turbine Layout Modification to Establish a Setback Between Atlantic Shores South and Ocean Wind 1) would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. The construction of Alternative C could install fewer WTGs (up to 29 fewer WTGs) and associated offshore substations (1 fewer offshore substation) and interarray cables, which would slightly reduce the construction impact footprint and installation period. The removal of these WTGs and OSS would result in a negligible reduction of impacts on visual resources compared to the Proposed Action, unnoticeable to the casual viewer. Alternative E would modify the wind turbine array layout through the exclusion or micrositing of up to 5 WTG positions to create a 0.81-nautical-mile (1,500-meter) to 1.08-nautical-mile (2,000-meter) setback between WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) and Ocean Wind 1 Lease Area (OCS-A 0498) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation. This setback would be an improvement to vessel navigation and SAR considerations over no separation between lease areas. Alternatives C and E could potentially reduce gear entanglements and loss as well as allisions, and recreational fishing may see a slight decrease due to fewer structures providing reef habitat for targeted species. Fewer vessels and vessel trips would be expected, which would reduce the risk of discharges, fuel spills, and trash in the area and decrease the risk of collision with marine mammals and sea turtles (Sections 3.5.6 and 3.5.7).

**Cumulative Impacts of Alternative C and E**. The incremental impacts contributed by Alternatives C and E to the cumulative impacts on recreation and tourism would be similar to those described under the Proposed Action.

*Conclusions*

**Impacts of Alternative C and E**. The **minor adverse** impacts and **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternatives C and E. The impacts associated with Alternatives C and E would be slight improvements over the Proposed Action's impacts, because Alternative C would potentially reduce the amount of time (and therefore noise and disruption) associated with WTG installation, and Alternative E would lessen the potential impacts on recreational fishing and navigation; however, the impact level would not change.

**Cumulative Impacts of Alternative C and E**. The incremental impacts contributed by Alternatives C and E to the cumulative impacts on recreation and tourism would be the same as under the Proposed Action and would range from negligible to minor adverse impacts and minor beneficial impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternatives C and E when each combined with ongoing and planned activities including planned offshore wind would likely be **minor adverse** and **minor beneficial**.

### 3.6.8.7 Impacts of Alternative D on Recreation and Tourism

**Impacts of Alternative D**. Impacts of Alternative D (No Surface Occupancy at Select Locations to Reduce Visual Impacts) would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures on visual resources. Alternative D would alter the layout and number of WTGs to reduce visual impacts. Alternative D1 would remove turbines up to 12 miles (19.3 kilometers) from shore, resulting in the removal of up to 21 WTGs. Alternative D1 would also restrict the turbines in Project 1 to a maximum hub height of 522 feet (159 meters) ASML and maximum blade tip height of 932 feet (284 meters) ASML. Alternative D2 would remove turbines up to 12.75 miles (20.5 kilometers) from shore, resulting in the removal of up to 31 WTGs. The removal of these WTGs would ensure that the closest key observation viewpoint to the nearest project components would be at least 12 miles (19.3 kilometers) away rather than approximately 9 miles (14.5 kilometers) away. The remaining turbines in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) ASML and maximum blade tip height of 932 feet (284 meters) ASML. Alternative D3 would remove turbines up to 10.8 miles (17.4 kilometers) from shore, resulting in the removal of up to 6 WTGs. The remaining WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and maximum blade tip height of 932 feet (284 meters) AMSL.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. Therefore, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area depending on the purpose of the viewer's sightseeing excursion. If the purpose is to observe the mass and scale of the WTGs' offshore presence, then decreasing visual dominance by removing WTGs would not benefit the viewer's experience from shore. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then decreasing visual dominance by removing WTG positions would benefit the viewer's experience. When visible (i.e., on clear days, in locations with unobstructed ocean views), WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean.

A 2013 study concluded that the predominant focus of visual attention occurs at distances up to 10 miles (16 kilometers); facilities were noticeable to casual observers at distances of almost 18 miles (29 kilometers) and were visible with extended or concentrated viewing at distances beyond 25 miles (40 kilometers) (COP Volume II, Section 5.2.3; Atlantic Shores 2024). Because the proposed Project's WTGs are approximately twice as tall as those described in the study, the WTGs would be noticeable at farther distances during clear conditions. Therefore, even with the removal of the closest WTG positions and the hub height and blade tip restrictions, other WTGs would still be visible.

Alternative D could also potentially reduce gear entanglements and loss as well as allisions and is likely to lead to a slight decrease in recreational fishing. Turbines are very likely to provide a reef habitat for targeted species, and while the exact ecosystem response to the turbines is unknown, fewer structures would likely lead to a decrease in this effect. Fewer vessels and vessel trips would be expected, which would reduce the risk of discharges, fuel spills, and trash in the area and decrease the risk of collision with marine mammals and sea turtles (Sections 3.5.6 and 3.5.7).

**Cumulative Impacts of Alternative D**. The incremental impacts contributed by Alternative D to the cumulative impacts on recreation and tourism would be similar to those described under the Proposed Action.

### *Conclusions*

**Impacts of Alternative D.** The **minor** adverse and **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternative D. The impacts associated with Alternative D would be slight improvements over the Proposed Action's impacts by reducing the visual impacts of WTGs, but the impact level would not change.

**Cumulative Impacts of Alternative D**. The incremental impacts contributed by Alternative D to the cumulative impacts on recreation and tourism would be the same as under the Proposed Action and would range from negligible to minor adverse impacts and negligible to minor beneficial impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative D when combined with ongoing and planned activities including planned offshore wind would likely be **minor** adverse and **minor beneficial**.

### 3.6.8.8 Impacts of Alternative F on Recreation and Tourism

**Impacts of Alternative F.** Impacts of Alternative F (Foundation Structures) would be similar to those of the Proposed Action for recreation and tourism except for the impact of foundation structures. The construction of Alternative F would either use monopile and piled jacket, suction bucket, or gravity-based foundations. Alternative F1 would use piled foundations, Alternative F2 would use suction bucket foundations, and Alternative F3 would use gravity-based foundations. Piled (monopile and piled jackets) foundations require impact pile driving, which would generate noise that can adversely affect species important to recreational fishing and sightseeing, such as whales (COP Volume II, Section 8.2.2; Atlantic Shores 2024). Suction bucket foundations, on the other hand, require non-impulsive pile installation methods, which would result in lower peak pressure levels than impact pile driving. Noise from suction bucket installation is unlikely to harm fish or pelagic invertebrates due to the lower peak pressure levels and relatively short duration (COP Volume II, Section 4.6.2.3.2; Atlantic Shores 2024).

Gravity-based foundations may require seabed preparation, which would consist of removal of the top layer of sediment to establish a level surface (COP Volume II, Section 2.1.2.2; Atlantic Shores 2024). Removing the uppermost sediment layer and any other sediments that are too weak to support the foundation would temporarily disturb benthic habitats; however, benthic organisms would be expected to recover quickly, and the total area of disturbance would be small relative to the surrounding habitat (COP Volume II, Section 4.5.2.1; Atlantic Shores 2024). Piled foundations may also require seabed preparation prior to installation, causing increased sedimentation and turbidity (COP Volume I, Section 4.2.1; Atlantic Shores 2024). Suction bucket foundations are not expected to require seabed preparation, although it may be required to establish a level surface in the seabed (COP Volume I, Section 4.2.2; Atlantic Shores 2024).

The different foundation types could each serve as artificial reef structures, influencing fish aggregation due to the “reef effect” (COP Volume II, Section 4.5.2.5; Atlantic Shores 2024). The “reef effect” refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat. The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters traveling farther from shore in order to fish. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. However, an increase in fish species could also lead to additional natural predation and consequently a growth in fishing effort, which could decrease fish stocks.

**Cumulative Impacts of Alternative F**. The incremental impacts contributed by Alternative F to the cumulative impacts on recreation and tourism would be similar to those described under the Proposed Action.

*Conclusions*

**Impacts of Alternative F.** The **minor adverse** impacts and **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternative F. The impacts associated with Alternative F would be slight improvements over the Proposed Action's impacts due to the potential for fish aggregation, but the impact level would not change.

**Cumulative Impacts of Alternative F**. The incremental impacts contributed by Alternative F to the cumulative impacts on recreation and tourism would be the same as under the Proposed Action and would range from negligible to minor adverse impacts and negligible to minor beneficial impacts. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative F when combined with ongoing and planned activities including planned offshore wind would likely be **minor adverse** and **minor beneficial**.

### 3.6.8.9 Proposed Mitigation Measures

No measures to mitigate impacts on recreation and tourism have been proposed for analysis.

### 3.6.8.10 Comparison of Alternatives

The impacts of Alternatives C, D, E, and F from anchoring, land disturbance, lighting, cable emplacement, noise, and traffic would be similar to those of the Proposed Action: minor adverse and minor beneficial (related to the presence of structures, and whether fish aggregation would increase fishing trips and revenue or decrease fish stocks). The Proposed Action and alternatives could disrupt recreation and tourism during construction, but impacts would be localized and short term, with recreation and tourism possibly displaced temporarily to alternate areas. During operations, the presence of offshore structures would increase navigational complexity in the Lease Area, and scour and cable protection could increase the risk of gear entanglement or loss, and the difficulty with anchoring. Beneficial impacts on recreation and tourism are likely to result due to the reef effect (providing additional locations for recreational for-hire fishing trips) and sightseeing attraction of offshore wind energy structures.

By installing fewer structures, Alternative C would slightly reduce the construction impact footprint and installation period. By altering the layout and number of WTGs, Alternative D would reduce negative visual impacts for tourists who want to experience a vast pristine ocean with less of a developed/industrial visual element. By modifying the wind turbine layout through the exclusion of WTG positions to create a setback from the boundary between the Ocean Wind 1 and Atlantic Shores South Lease Area, Alternative E would improve vessel navigation and safety for recreational fishing vessels in the WTA. Alternatives C, D, and E could also reduce gear entanglements and loss as well as allisions. There would be fewer vessels and vessel trips, reducing the risk of discharges, fuel spills, and trash in the area and decreasing the risk of collision with marine mammals and sea turtles. However, the presence of fewer structures could reduce reef habitat for targeted species, decreasing recreational fishing in the area.

By using different foundation structures, Alternative F could either increase construction noise that adversely affects species important to recreational fishing and sightseeing or reduce noise during foundation installation. Certain foundations require seabed preparation, which increases turbidity and sedimentation and affects benthic habitats, while other foundations do not require removing the top layer of sediment. The foundations in Alternative F could also either encourage or discourage fish aggregation due to the "reef effect," potentially increasing or decreasing recreational fishing in the area. Fish aggregation could result in recreational boaters traveling farther from shore in order to fish but could also result in increased natural predation and fishing, leading to a decrease in fish stocks.

#### 3.6.8.11 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of the Proposed Action and Alternatives C4, D3, and E, as well as two agency-proposed mitigation measures, as described in Section 2.1.7. Under the Preferred Alternative, 29 WTGs, 1 OSS, and their associated interarray cables would be microsited outside of the 1,000-foot (305-meter) buffer of the sand ridge and swale features within AOC 1 (Lobster Hole) and AOC 2 (NMFS-identified sand ridge complex); WTGs in Project 1 would be restricted to a maximum hub height of 522 feet (159 meters) AMSL and a maximum blade tip height of 932 feet (284 meters); 2 WTGs would be removed and 1 WTG would be microsited to establish a 0.81-nautical mile (1,500-meter) setback between WTGs in the Atlantic Shores South Lease Area and WTGs in the Ocean Wind 1 Lease Area; and no permanent structures would be placed in a way that narrows any linear rows and columns to fewer than 0.6 nautical mile (1.1 kilometers) by 1.0 nautical mile (1.9 kilometers) or in a layout that eliminates two distinct lines of orientation in a grid pattern. Additionally, one WTG sited approximately 150 to 200 feet (45.8 to 61 meters) from the observed Fish Haven (Atlantic City Artificial Reef Site) would be removed. The Preferred Alternative would include up to 195 WTGs,[1] up to 10 OSSs, up to 1 permanent met towner, interarray and interlink cables, 2 onshore substations and/or converter stations, 1 O&M facility, and up to 8 transmission cables making landfall at two New Jersey locations: Sea Girt and Atlantic City. All permanent structures must be located in the uniform grid spacing and the total number of permanent structures constructed (WTGs, OSSs, and met tower) would not exceed 197.

The **minor adverse** impacts and **minor beneficial** impacts on recreation and tourism associated with the Proposed Action would not change substantially under the Preferred Alternative. The Preferred Alternative would include a reduction in the number of WTGs compared to the Proposed Action and would modify the wind turbine array layout, reducing impacts on existing ocean uses, such as commercial and recreational fishing and marine navigation. This would lessen the potential impacts on recreational fishing and navigation; however, the impact level would not change. Accordingly, impacts of the Preferred Alternative alone would remain of the same level as for the Proposed Action.

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[1] 195 WTGs assumes that 197 total positions are available and that a minimum of 1 OSS is constructed in each Project, with 195 remaining positions available for WTGs. Fewer WTGs may be constructed to allow for placement of additional OSSs and a met tower on grid.

BOEM anticipates that the cumulative impacts of ongoing and planned activities, including the Preferred Alternative and the connected action, would result in similar impacts as the Proposed Action: **minor** adverse and **minor beneficial**.

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